

SEXUAL INTERACTION IN DIGITAL CONTEXTS: OPPORTUNITIES AND RISKS FOR SEXUAL HEALTH

EDITED BY: Nicole Krämer, Matthias Brand, Nicola Döring,
Tillmann H. C. Kruger, Johanna M. F. Van Oosten and
Gerhard Vowe

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SEXUAL INTERACTION IN DIGITAL CONTEXTS: OPPORTUNITIES AND RISKS FOR SEXUAL HEALTH

Topic Editors:

Nicole Krämer, University of Duisburg-Essen, Germany

Matthias Brand, University of Duisburg-Essen, Germany

Nicola Döring, Technische Universität Ilmenau, Germany

Tillmann H. C. Kruger, Hannover Medical School, Germany

Johanna M. F. Van Oosten, University of Amsterdam, Netherlands

Gerhard Vowe, Heinrich Heine University of Düsseldorf, Germany

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Editorial: Sexual Interaction in Digital Contexts: Opportunities and Risks for Sexual Health

Nicola Döring^{1*†}, Nicole Krämer^{2*†}, Matthias Brand³, Tillmann H. C. Krüger⁴, Johanna M. F. van Oosten⁵ and Gerhard Vowe⁶

¹ Media Psychology and Media Design, Institute of Media and Communication Science, Department of Economic Sciences and Media, Technische Universität Ilmenau, Ilmenau, Germany, ² Social Psychology: Media and Communication, Department of Computer Science and Applied Cognitive Science, Faculty of Engineering, University of Duisburg-Essen, Duisburg, Germany, ³ General Psychology: Cognition and Center for Behavioral Addiction Research (CeBAR), Department of Computer Science and Applied Cognitive Science, Faculty of Engineering, University of Duisburg-Essen, Duisburg, Germany, ⁴ Clinical Psychology and Sexual Medicine, Department of Psychiatry, Social Psychiatry and Psychotherapy, Hannover Medical School and Center for Systems Neuroscience, Hannover, Germany, ⁵ Youth and Media Entertainment, Faculty of Social and Behavioral Sciences, University of Amsterdam, Amsterdam, Netherlands, ⁶ Communication and Media Studies, Center for Advanced Internet Studies (CAIS), Bochum, Germany

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Sexual Interaction in Digital Contexts: Opportunities and Risks for Sexual Health

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Edited and reviewed by:

Anton Nijholt,
University of Twente, Netherlands

*Correspondence:

Nicola Döring
nicola.doering@tu-ilmenau.de
Nicole Krämer
nicole.kraemer@uni-due.de

[†]These authors share first authorship

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Sexual intercourse initiated *through* a sex dating online platform, sexually suggestive interpersonal communication *via* a messaging app, or flirtation *with* a voice assistant are examples of sexual interaction in digital contexts. In all of these cases the interaction is linked to both sexual arousal and digital technology. The digitalization of human sexuality has been an issue of polarized public and academic debates for decades. Concerns about negative health outcomes (e.g., online pornography addiction and online sexual abuse) go hand in hand with hopes for positive health effects (e.g., improved sexual intimacy and wellbeing).

There have been prior special issues on forms of digitalized sexuality that we partly build on and partly strive to advance: Delmonico and Griffin (2012) in their special issue focus almost exclusively on the “dark side” of cybersex, namely clinical and criminal aspects. Sevcikova and Daneback (2014) cover both positive and negative effects and also address consent and commerce—but only with a view to Internet technology. Twist and McArthur (2017) encourage therapists to explore both the challenging and beneficial roles that technologies play in their patients’ sexual lives. Ngo et al. (2017) edited a special issue on the legal regulation of sexting, while Potenza (2018) edited a special issue on the personal and public health aspects of online pornography and its problematic use. A recent special issue edited by Dibble and McDaniel (2021) addresses the romantic dimension of online dating and a special issue on “current and emerging aspects of cybersexuality” edited by Shaughnessy (2022) is under preparation.

In this Frontiers Research Topic, we aimed to explore recent developments in the field of sexual interaction in digital contexts by describing their contexts and characteristics as well as acknowledging their opportunities and risks for sexual and overall wellbeing. In order to advance the field, our special issue follows the systematization proposed by Döring et al. and distinguishes sexual interaction *through*, *via*, and *with* digital technology. Theoretical and empirical articles are included, namely qualitative and quantitative studies with cross-sectional, longitudinal and experimental designs. Data from Australia, Canada, Germany, the Netherlands, and the United States are presented.

In the first article, Döring et al. provide a conceptual analysis and explain the new concept SIDC (Sexual Interaction in Digital Contexts) with its three types: sexual interaction *through*, *via*, and *with* digital technology. For a comprehensive understanding and analysis of each of the three types of SIDC, four key causes and consequences as well as the two main mediators (consent and commerce) are suggested and elaborated.

SEXUAL INTERACTION THROUGH DIGITAL TECHNOLOGY

In the second article, Ponseti et al. address one main subtype of sexual interaction *through* digital technology, namely searching for new sexual and romantic partners and initiating sexual encounters through online dating platforms and apps. Based on 13 earlier studies, the selective review argues that women and men in the modern digital dating arena act according to ancient sex-typical strategies and evolutionary programs. They also explain why women appear to be more successful than men in reaching their sexual goals in online dating.

The sexual face-to-face communication and interaction of some couples is shaped *through* their joint use of pornography. Earlier research has shown that joint use can inspire open communication and sexual exploration within couples. The third article by Kohut et al.—based on four separate survey studies—confirms that couples who watch pornography together also report higher sexual and relationship quality. However, when one partner uses pornography alone and the other partner does not use pornography at all, couples report lower sexual and relationship satisfaction.

SEXUAL INTERACTION VIA DIGITAL TECHNOLOGY

Flirtatious and openly sexual interpersonal communication takes place more and more often *via* digital media. People engage in sexy self-presentation on their social media profiles and exchange nude selfies or suggestive text messages via smartphone or computer. Although this behavior can strengthen social relationships, it also comes with risks. The fourth article by Reer et al. reports about a longitudinal study among more than 1,000 German internet users aged 14–64 years. They found that online sexual engagement is fairly widespread and predicts future online sexual victimization.

In the fifth article, Courtice et al. differentiate the gender and relationship contexts in which non-consensual sexting or—more broadly—non-consensual TMSI (technology-mediated sexual interactions) occur. Based on an online survey of about 450 university students in Canada, it is shown that young women tend to receive more undesired sexual content from known non-partners and strangers than men. Young men, on the other hand, send non-consensual sexts to strangers more often than women.

The sixth study by Budde et al. is focused on an even younger demographic group, namely adolescents aged 16–17 years and their sexting experiences. In group discussions

with about 20 girls and 20 boys, three types of adolescent sexters were identified: the “experimenters” who approve of sexting as a way of experimenting with sexuality, the “reflexive-criticals” who question social norms around sexting, and the “disapprovers” who reject and abstain from digital sexual practices. This qualitative study gives young people a voice and demonstrates the different perspectives on sexting among adolescents.

Based on a representative national survey of about 21,000 Dutch 12–24-year-olds, the seventh article by Boer et al. reveals that 4% of the participants have shared someone else's sext in the last 6 months. Being male, aged 12–14 years, engaging in frequent social media usage, watching online porn, having sexual experience, and being subjected to sext-sharing themselves is associated most strongly with sext-sharing. The article calls for the integration of sexting and non-consensual sext-sharing as critical topics in both sex education and media literacy programs.

SEXUAL INTERACTION WITH DIGITAL TECHNOLOGY

Sexual interactions *with* digital media such as online erotica or pornography can be very engaging. Although some individuals and couples enjoy their interactions with sexually explicit digital media content and report mostly neutral or positive effects, others develop problematic (e.g., addiction-like) use patterns. In the eighth article, Markert et al. report on a neuroscientific experiment comparing healthy men's brain reactions to pornographic images while being in a negative vs. a neutral mood. It turned out that negative mood alone was not enough to trigger increased reaction to pornographic cues. Only men who had a higher solitary sexual motivation reacted more strongly to pornography when they were in a bad mood.

Although traditional digital pornography elicits interaction in the form of media selection and para-social interaction with porn performers, some digital platforms provide sexually explicit content and invite users to actively interact with it in the form of liking, rating or commenting. So-called “slutpages,” for example, provide the opportunity to upload sexual photos of third parties and have them rated by the community. The ninth article by Clancy et al.—based on an online survey of a convenience sample of more than 1,100 young adults from the United States and Australia—links interactions on “slutpages” with online image-based evaluative voyeurism (OIBEV). Men and women are curious about the sexual content, but women are 3–4 times more likely than men to check if their own photos are being published.

In the age of upcoming artificial sexual partners with interactive capacities such as software bots or hardware robots, it is important to better understand underlying mechanisms. The tenth study by Szczuka investigates effects of sexual suggestive and flirtatious verbal interactions with a human being vs. a voice assistant based on the Sexual Interaction Illusion Model (SIIM). An online experiment with more than

250 participants revealed that the voice assistant evoked more interest in further messages and in the technology itself, while the human was still perceived to be more sexually attractive and flirtatious.

We hope that the Frontiers Research Topic on Sexual Interaction in Digital Contexts will inspire future studies and global collaborations in this growing, interdisciplinary field.

AUTHOR CONTRIBUTIONS

ND, NK, MB, TK, JO, and GV contributed to planning the Research Topic. ND, NK, MB, TK, and JO served as associate editors. ND took the lead in writing and editing the editorial. All authors contributed to the editorial and approved the submitted version.

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Prevalence and Correlates of Sext-Sharing Among a Representative Sample of Youth in the Netherlands

Sarah Boer^{1*}, Özcan Erdem¹, Hanneke de Graaf² and Hannelore Götz¹

¹ Public Health Service Rotterdam-Rijnmond, Rotterdam, Netherlands, ² Rutgers, Utrecht, Netherlands

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Edited by:

Nicola Döring,
Technische Universität
Ilmenau, Germany

Reviewed by:

Sebastian Wachs,
University of Potsdam, Germany
Rohangis Mohseni,
Technische Universität
Ilmenau, Germany

*Correspondence:

Sarah Boer
se.boer@rotterdam.nl

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Many adolescents use their electronic devices to send each other sexually explicit texts, photos, and videos of themselves—commonly known as sexting. This can be fun and is not usually problematic. However, if the intended recipient decides to share these sexts with a broader audience, the consequences for the depicted can be detrimental. The purpose of this study was to investigate the prevalence of (non-consensual) sext-sharing among Dutch adolescents and explore the characteristics of those who do, to gain a better understanding of factors involved in dissemination. We used data from “Sex under the age of 25,” a representative national survey on sexual health among a sample of 20,834 Dutch 12–24-year-olds. The prevalence of sext-sharing was estimated using Complex Samples. Logistic regressions were used to assess associations between demographics, school-based sexting education, sexual- and online behavior, and mental health and sext-sharing. About 4% of the adolescents reported having shared someone else’s sext in the last six months. Being male, aged 12–14 years, frequent social media usage, watching online porn, sexual experience, and being subjected to sext-sharing themselves associated most strongly with sext-sharing. Our findings show that the likelihood of sext-sharing is lower in older adolescents and that it associates with the extent of adolescents’ sexual curiosity and online activity. The overlap between sharing sexts of others and having one’s own sext shared suggests that dissemination of personal sexual content might be normalized or used as an act of retribution. Further research could be helpful to explain the mechanisms underlying this overlap. The results of this study illustrate the importance of exposing adolescents to evidence based preventive educational interventions on sexting from 12 years onwards and not just within the context of traditional school-based sex education, but also as a part of the (online) media-literacy curriculum.

Keywords: sexting, non-consensual sharing, social media, adolescents, online sexual risk behavior

INTRODUCTION

On average U.S teens spend over 7 h on their screens per day (excluding homework), of which 70 min are spent on social media platforms. With a social life that increasingly takes place via the internet, it should come as no surprise that young people also use their electronic devices to explore their sexuality and send each other sexually explicit texts, photos, and videos of themselves—commonly referred to as sexting (Lenhart, 2009; Mitchell et al., 2012; Gámez-Guadix et al., 2017; Molla-Esparza et al., 2020). A meta-analysis of studies from 2009 to 2016 estimated that the lifetime prevalence of sexting among adolescents is about 15% for sending a sext (image, video, and/or message), and 27% for receiving one (Madigan et al., 2018). Findings from the most recent Dutch periodical sexual health survey “Sex under the age of 25” confirm that sexting has increased since 2012. Within the 6 months prior to the survey in 2017, 12% of the 12–24-year-olds had sent a sext (a nude image or sex-video) of themselves to someone else. This rate doubled since 2012 (De Graaf et al., 2017). Young people engage in sexting with platonic friends, casual flings and desired or established romantic partners to receive positive affirmation of their physical appearance, have fun, express affection, or elicit sexual desire (Anastassiou, 2017). Especially sexual minorities seem to rely on the internet for exploration of their sexuality and to meet romantic partners, as these prove more difficult for them to do in the physical domain (Hillier et al., 2012; Harper et al., 2016; Döring and Rohangis, 2019). Sexting is often labeled as a positive experience (Naezer, 2017).

Previously, the public discourse about sexting predominantly emphasized the associated risks and recommendations for abstinence. In recent years there has been increasing consensus on a normalcy perspective. In this perspective voluntary and consensually sharing sexually explicit imagery is seen as contributory to teenagers’ sexual development and as a normal form of sexual self-expression and exploration (Döring, 2014; Lippman and Campbell, 2014; Naezer, 2017). The high lifetime prevalence of sexting among older age groups, suggesting it to be an accepted form of romantic interaction in adult life, further supports the perception that sexting plays a common role in the coming-of-age of sexually developing adolescents (Döring, 2014; Klettke et al., 2014; Döring and Rohangis, 2019). However, there is an agreement in the field that boundaries are crossed when consent is lacking and it is therefore essential to distinguish between consensual and non-consensual sexting (Albury and Crawford, 2012; Döring, 2014; Hasinoff, 2015).

Despite a bill to change this¹ the Dutch laws that apply to sexting among minors do not yet discriminate between consensual sexting and non-consensual sexting. Officially, all forms of sexting are still punishable for this age group, because legally it is not yet distinguished from child pornography (article 240b sr, Penal Code). For adults, on January 1st 2020 a law was passed that makes sexting a punishable offense when it is done

without consent or if the perpetrator could have known that sharing could be harmful for the person portrayed^{2, 3}.

Sharing a sext with others beyond the dyadic relationship exposes the depicted to intolerable risks. Once a sext gets into circulation, dissemination can go fast (Garcia et al., 2016; Van Ouytsel et al., 2017) and this has been known to result in reputational damage, self-blame, feelings of threat and paranoia, embarrassment and even suicide (Bates, 2016; Anastassiou, 2017). The Dutch “Sex under the age of 25” survey has demonstrated that having one’s own sext shared with someone else than the intended recipient was generally disliked by the young people who experienced it (De Graaf et al., 2017). Despite the risks, sharing sexts with a wider audience is not uncommon. A meta-analysis on sexting behaviors among adolescents found a mean lifetime prevalence of 12% of forwarding a sext without consent (Madigan et al., 2018). This is not necessarily done with malicious intent. It is likely that adolescents do not always grasp the serious nature of sharing received sexts with others (Barrense-Dias et al., 2019; Clancy et al., 2019; Walker et al., 2019).

Since an effective way to avoid unwanted exposure is to prevent sexts from being shared, it is important to understand the characteristics of those sharing sexts and conditions facilitating this behavior (Walker and Sleath, 2017; Madigan et al., 2018; Naezer and Oosterhout Van, 2020).

Our review of the literature showed that until recently, primary sexting (sending and receiving) among adolescents has received the bulk of attention (Barrense-Dias et al., 2017) and that existing studies on sext-sharing often focus on the (usually female) victims exposed in non-consensually shared sexts (Livingstone and Smith, 2014; Branch et al., 2017; Clark et al., 2018). However, attention for perpetrators is growing. Existing research for instance suggests that non-consensual sharing is more common among men, non-heterosexuals (Barrense-Dias et al., 2019; Powell et al., 2019; Ruvalcaba and Eaton, 2020), older adolescents (Molla-Esparza et al., 2020) and by those with lower levels of education (Barrense-Dias et al., 2020). To our knowledge there is no information available about non-consensual sexting among ethnic minority groups in countries with a comparably diverse population as the Netherlands. We do know however, that Antillean adolescents, especially boys, are generally more involved in sending and receiving sexts than their peers (De Graaf et al., 2017).

Non-consensual sext-sharing can be considered as an act of bullying (Finkelhor et al., 2020). Ojeda et al. (2019) found a relationship between bullying and forwarding of sexts and point to the common characteristics between the two, such as a power imbalance and abuse thereof. Former studies on bullying found that the perpetrators more often have poorer mental health and that victims and perpetrators are not seldomly the same person (Kowalski and Limber, 2013). There are indications that these associations also apply to non-consensual sext-sharing. Barrense-Dias et al. (2019) indeed found a link between forwarding sexts and poorer mental health and the overlap between victimization

¹<https://www.rijksoverheid.nl/actueel/nieuws/2020/05/12/grapperhaus-moderniseert-wetgeving-seksueel-grensoverschrijdend-gedrag>.

²<https://www.rijksoverheid.nl/onderwerpen/seksueel-misdrijven/wraakporno>.

³<https://www.government.nl/latest/news/2019/09/24/grapperhaus-several-offences-to-receive-higher-maximum-sentence>.

and perpetration in the unwanted distribution of sexually explicit material is revealed in multiple recent studies (Powell et al., 2019; Walker et al., 2019; Clancy et al., 2021).

Several studies describe an association between (non-consensual) sexting and other forms of sexual activity, although the link with porn consumption is inconsistent (Clancy et al., 2019; Raine et al., 2020). However, Van Oosten and Vandenbosch (2020) demonstrated that porn consumption and a higher instrumental attitude (i.e., seeing sex as purely physical, fun and exciting) toward sex, can increase willingness to forward sexts of strangers. There is some evidence to suggest that online porn consumption is related to viewing women as sex objects (Brown and L'Engle, 2009; Flood, 2009; Peter and Valkenburg, 2009), which could potentially lower inhibitions to share nude images with others. Vanden Abeele et al. (2014) draw attention to the similarities in group dynamics of online porn consumption and sexting, in which both behaviors coexist with a greater need for popularity and both are used as a currency to gain social status within the peer group.

Sexting is a social affair that often takes place through social network applications like Snapchat, WhatsApp, and Facebook. The available literature supports the notion that a higher involvement in sexting goes hand in hand with a higher smartphone usage and increased social engagement in general (Baumgartner et al., 2014; Yépez-Tito et al., 2020). More specifically, associations were established between sexting and a higher internet use, excessive texting and a more frequent use of WhatsApp and Snapchat (Rice et al., 2014; West et al., 2014; Yépez-Tito et al., 2020) and between forwarding sexts and more social network applications used (Molla-Esparza et al., 2020).

Lastly, our literature review demonstrated that both in the Netherlands and internationally, there is a wide range of school-based interventions aimed at preventing online sexual violence, including unwanted sext sharing. Many of these programs center around sexting abstinence and the use of fear appeals about the risks, to discourage sexting altogether (Oosterwijk and Fischer, 2017; Finkelhor et al., 2020). Experts question the effectiveness of programs that promote abstinence, and according to them, methods that are evidence-based are currently lacking (Döring, 2014; Finkelhor et al., 2020). It is further argued that strongly promoting abstinence from sexting as the sole solution to prevent dissemination might contribute to victim-blaming. It could involuntarily convey the notion that it is foolish to exchange sexts and therefore someone's own fault when their sext is shared with a broader audience (Setty, 2019). The only study that we could find that examined the relationship between sext-sharing and sexting prevention education, found that those who had received lessons about sext-sharing, were slightly more likely to have shared sexts. This might suggest that sexting is sometimes discussed in response to an incident (Johnson et al., 2018).

The purpose of this study was to investigate the prevalence of (non-consensual) sext-sharing among Dutch adolescents and explore the characteristics of those who do, to gain a better understanding of factors involved in dissemination. We included known correlates of (non-consensual) sexting from earlier studies and looked at the relationship between sext-sharing and socio-demographic characteristics (gender, age,

ethnic background, urbanity, and sexual orientation); school based education about sexting; online behavior (social media usage, dating apps); sexual activity (watching online porn, experience with partner sex); victimization of non-consensual sexting (unwanted exposure to sexts, having your own sext shared) and mental health. For this we used data from the Dutch national sexual health survey "Sex under the age of 25–2017".

Our findings will be useful to identify directions for follow-up research and ultimately contribute to the development of evidence-based interventions to prevent sext-sharing.

Given earlier findings as discussed above, we expected that adolescents who are male, older, have a gay-bisexual orientation, show more online activity, are more sexually active, have been victims of non-consensual sexting themselves and have poorer mental health are more likely to share-sexts. Despite the existing doubts about the effectiveness of present educational programs on sexting, the basic assumption remains that these programs should reduce the risks of sexting. Therefore, we also expected that having received education about sexting would show a lower likelihood of sharing sexts.

MATERIALS AND METHODS

Ethics Statement

The study proposal was submitted to The Medical Research Ethics Committee of the University Medical Center Utrecht and exempt from ethical review (reference number Wag/mb16/013562).

Study Population

Data for this study were collected as part of "Sex under the age of 25," a large representative national sexual health study in 2017 among youth aged 12–24 years in the Netherlands (De Graaf et al., 2017).

Sampling Procedure

Participants were recruited by means of high schools and the Dutch population register. Respondents aged 12–16 years were recruited from the first four grades of selected high schools. To create a representative sample that reflected the geographical and educational distribution of young people in the Netherlands, we stratified all Dutch secondary schools by geographic region and educational level. From those strata we invited a random selection of schools to participate. For every school that refused to participate a substitute school was recruited from the same stratum.

The sample of 17–24-year-olds was drawn from the population register by Statistics Netherlands. We approached this age group with a postal letter, and two reminders, inviting them to fill out an online questionnaire. To account for the anticipated lower response rate among adolescents with a non-Western background, this group was oversampled (Ahlmarm et al., 2015). Incentives varied between Public Health Service regions, but the majority of the selected young people received a voucher worth €5, which they could cash irrespective of participation.

Final Study Sample

From the 361 schools we approached, 106 participated in the study (response rate: 29%). In total, 4,927 adolescents aged 12–16 years filled out our questionnaire. Of the 92,399 17–24-year-olds that were invited to fill out the online survey, 17,227 (18.6%) responded.

About 6% of the respondents ($n = 1,320$) were excluded from the original sample because they indicated that they did not answer all questions honestly or because there were more than two inconsistencies in their responses. Respondents were also excluded if a parent had filled in the questionnaire or if they did not speak Dutch. The remaining analytical sample consisted of 20,834 respondents; comprising 4,846 respondents of 12–16 years old and 15,988 respondents of 17–24 years old. To adjust for selective non-response and overrepresentation of certain regions, the data were weighted for geographical location, gender, age and educational level. Further details about recruitment and the sample can be found elsewhere (De Graaf et al., 2017, 2018).

Of the 20,834 potential respondents, no data were missing on the outcome measure. The percentage of missing data of the independent variables were all below 5% (Table 1) and ranged from 0% for most socio-demographic variables to 3.3% for watching online porn. In the multivariate analyses, participants with missing data on one or more variables were excluded.

Measures

The questionnaire commenced with several sociodemographic characteristics such as gender, age, educational level, and ethnic background followed by a broad range of topics like relational involvement, sexual experiences, online behavior and mental health, with tailored questions according to previous answers. We will now further describe the variables we used in this study, starting with the outcome measure.

Sext-sharing. The outcome variable was measured by asking whether the respondent had ever sent a nude image or sex-video of someone else within the last six months (1 = *never*, 2 = *once*, 3 = *more than once*). The answers were then dichotomized (0 = *never* and 1 = *once/more than once*).

Sexual orientation. To assess sexual orientation respondents were asked: “Do you feel attracted to boys, girls or both?” (1 = *only boys*, 2 = *mainly boys, but also girls*, 3 = *equally to boys and girls*, 4 = *mainly girls, but also boys*, 5 = *only girls*, 6 = *none*, 7 = *undecided*). The outcomes were then dichotomized accordingly for boys and girls into (1 = *only or mainly attracted to the opposite sex* 2 = *equally, mainly or only attracted to the same sex*).

School-based sexting education. Respondents were asked to rate the amount of information they had received in school about several subjects. One of these subjects was: “Sending nude images or sex-videos” (1 = *none*, 2 = *little*, 3 = *sufficient*). The outcomes were then dichotomized (1 = *sufficient* and 2 = *none/little*).

Time spent on social media. The quantity of time spent on social media was determined by asking respondents: “On average, how much time do you spend on social media each day?” (1 = *less than 1 hour*, 2 = *1–3 h*, 3 = *3–5 h*, 4 = *5–10 h*, 5 = *10 h or more*). The outcomes were then trichotomized (1 = *less than 1 h*, 2 = *1–3 h*, 3 = *3 or more hours*).

Using dating apps. Dating app usage was measured by letting respondents indicate which of the listed dating apps (*Tinder, Happn, Grindr, Badoo, Hot or not, Inner Circle*; *another dating app, namely...*) they had ever used. If they had never used a dating app, respondents could check the option: “I have never used a dating app.” The outcomes were then dichotomized (1 = *never used a dating app* and 2 = *used one or more dating apps*).

Watching online porn. Online porn consumption was measured by letting respondents indicate how often within the last 6 months they had viewed online porn-videos (1 = *never*, 2 = *less than once a month*, 3 = *1–3 times a month*, 4 = *once a week*, 5 = *multiple times a week*). The outcomes were trichotomized (1 = *never watched online porn-videos*, 2 = *watched online porn videos up to once a week*, 3 = *watched online porn videos multiple times per week*).

Experience with partner sex. According to respondents' answers to dichotomized questions about several sexual experiences (1 = *no*, 2 = *yes*), respondents were divided into three levels of experience [1 = *none* (kissing, masturbation), 2 = *some* (petting, manual sex), 3 = *advanced* (oral sex, intercourse, anal sex)].

Unwanted exposure to sexts. A composite variable was created to determine whether a respondent had been exposed to sexually explicit images, videos or video-chats and disliked it. For this variable we used a combination of variables measuring whether within the last 6 months the respondent had 1. received personal nude images or sex-videos or 2 saw someone's genitals during a video-chat or 3 saw someone masturbate during a video-chat (1 = *never*, 2 = *once*, 3 = *more than once*) and, if applicable, variables measuring how the respondent had experienced this (1 = *I liked it*, 2 = *I did not like/dislike it* and 3 = *I disliked it*). Based on the answers to these questions, respondents were divided into two categories (1 = *not exposed to unwanted sexts* and 2 = *exposed to unwanted sexts*).

Having one's own sext shared. To identify respondents who experienced having their own sext shared, a composite variable was created. This variable combined two variables measuring whether within the last 6 months the respondent had experienced that someone had 1. showed his/her sext to someone else or 2. forwarded his/her sext to someone else (1 = *never*, 2 = *once*, 3 = *more than once*). The variable was then dichotomized (1 = *never* and 2 = *once/more than once*).

Mental health. We included the Kessler Psychological Distress Scale as an overall measure for mental health; its properties are described elsewhere (Kessler et al., 2002; Fassaert et al., 2009). Because one item was accidentally omitted, we used the overall mean score of the 9 remaining items (0–5) which were then divided into tertiles (1 = *high*, 2 = *middle* and 3 = *low*).

Statistical Analyses

We used the Complex Samples module to generate the weighted prevalence of recent sext-sharing by subgroups (Table 1). Further, we performed multivariable logistic regression analyses for which we used unweighted data but included variables that were used for the weighting factor as independent variables in our models (Table 2). This is the preferred approach when sample weights are not a function of the dependent variable in the model

TABLE 1 | Sample characteristics of 20,834 adolescents in the Netherlands in 2017 and the weighted prevalence of sext-sharing.

Variable	Total sample		Shared sext < 6 months	
	n ^a	Weighted ^b (%)	Weighted ^b (%)	95% CI
Total	20,834	100	4.2	3.7–4.7
Sex (0% missing)				
Female	12,653	49.4	2.1	1.7–2.6
Male	8,181	50.6	6.3	5.4–7.2
Age group (0% missing)				
12–14 years	2,980	22.9	3.5	2.6–4.5
15–17 years	4,154	23.1	5.7	4.7–6.9
18–20 years	6,268	22.1	4.1	3.3–5.1
21–24 years	7,432	31.8	3.7	2.9–4.8
Education (8% missing)				
Less	7,926	55.7	5.0	4.2–5.8
More	12,740	44.3	3.2	2.7–3.7
Ethnic background (0% missing)				
Dutch/Western background	18,517	85.0	4.0	3.5–4.5
Turkish	326	2.4	1.8	0.7–4.6
Moroccan	265	2.1	7.1	3.3–14.6
Surinamese	472	3.0	3.0	1.7–5.1
Antillean	227	1.2	11.8	6.3–20.9
Other non-Western	1027	6.4	6.1	3.7–9.8
Urbanity (6% missing)				
Urban	10,785	48.3	3.7	3.1–4.5
Urban-rural	3,383	18.7	4.3	3.4–5.5
Rural	6,533	33.0	4.4	3.6–5.4
Sexual orientation (2.3% missing)				
Heterosexual	19,496	96.1	4.1	3.6–4.6
Gay/Bisexual	854	3.9	8.2	4.7–13.8
School-based sexting education (0% missing)				
Sufficient	5,313	28.9	5.3	4.4–6.4
Non or little	15,521	71.1	3.8	3.2–4.4
Time spent on social media (0.5% missing)				
< 1 h p/d	2,602	13.6	2.4	1.3–4.4
1–3 h p/d	9,882	45.4	3.5	2.9–4.2
3 or more hours p/d	8,253	41.0	5.6	4.9–6.5
Ever used a dating app (0% missing)				
No	12,900	66.9	3.4	2.9–3.9
Yes	7,933	33.1	5.9	5.0–7.0
Watching online porn-videos < 6 months (3.3% missing)				
Never	8,506	43.2	1.9	1.4–2.4
Up to once p/w	8,550	40.0	4.9	4.2–5.8
Multiple times p/w	3,090	16.9	9.2	7.5–11.3
Experience with partner sex (0% missing)				
None	6,138	38.2	2.0	1.5–2.6
Little	2,019	11.0	6.8	5.2–8.9
Advanced	12,677	50.8	5.3	4.6–6.2
Unwanted exposure to sexts < 6 months (0% missing)				
No	19,659	94.3	4.0	3.5–4.5
Yes	1,174	5.7	8.0	5.7–11.1
Own sext shared by others < 6 months (0% missing)				
No	20,056	95.4	3.5	3.1–4.0
Yes	777	4.6	19.0	14.9–23.9

(Continued)

TABLE 1 | Continued

Variable	Total sample		Shared sext < 6 months	
	n ^a	Weighted ^b (%)	Weighted ^b (%)	95% CI
Mental health (in tertiles) (1.8% missing)				
High	5,716	31.6	4.0	3.3–5.0
Middle	7,917	36.6	3.2	2.6–3.9
Low	6,819	31.7	5.4	4.5–6.6

^aNumber of participants do not always add up to total N due to missing values.

^bCalculated using SPSS complex samples, weighted for geographical location, gender, age and educational level.

(Winship and Radbill, 1994). To mitigate the impact of influential observations on our regression model we used bootstrapping, a technique that uses random resampling to produce regression estimates that are more resistant to outliers in the data (Efron and Tibshirani, 1994). A correlation matrix of the independent variables can be found in **Supplementary Material A**. All our analyses were performed in IBM SPSS statistics 27.

RESULTS

Table 1 presents the characteristics of the weighted sample and the weighted prevalence of recent sext-sharing by subgroup. Of the 12–24-year-olds, 4.2% had shared nude images or sex videos of someone else within the last six months. Sext-sharing was most prevalent among males (6.3%), youth with an Antillean background (11.8%), gay- and bisexuals (8.2%), those watching online porn multiple times a week (9.2%) and those who had been exposed to unwanted sexts (8.0%). However, the proportion was highest in the group whose own personal sext was shared by others recently (19.0%).

Table 2 shows the logistic regression results. Model 1 describes the strength of the associations between demographic variables and sext-sharing. It demonstrates that young males were almost three times more likely to share someone else's sext than their female counterparts (aOR = 2.69; 95% CI: 2.27–3.20). The likelihood of sext-sharing was higher among 15–17-year-olds, compared to the 12–14-year-olds (aOR = 1.89; 95% CI: 1.45–2.51), somewhat lower among more educated young people (aOR = 0.69; 95% CI: 0.58–0.80), compared to less educated participants and (somewhat) higher among young people with an other non-Western background (aOR = 1.41; 95% CI: 0.99–1.92), a Surinamese background (aOR = 1.63; 95% CI: 0.96–2.46), and an Antillean background (aOR = 2.30; 95% CI: 1.13–3.70), compared to those with a Dutch/Western background.

In model 2 we added the independent variables: sexual orientation, school-based sexting education, online behavior (social media usage, dating apps) sexual activity (watching online porn, experience with partner sex), victimization of non-consensual sexting (unwanted exposure to sexts, having your own sext shared) and mental health. Adding these variables to the model resulted in a decreased association with being male (aOR = 2.19; 95% CI: 1.76–2.72) and a shift to the youngest age group (12–14-year-olds) that was most likely to share a sext. Adolescents with a Moroccan and Antillean background showed

to be twice as likely to share a sext as those with a Dutch/Western background. Model 2 further demonstrates that youth living in urban-rural and rural areas were more likely to share someone else's sext compared to their urban counterparts. We also found a strong association with porn consumption. Compared to those not watching online porn videos, the ones who did multiple times a week had a 2.68 higher likelihood of sext-sharing (95% CI: 2.00–3.67). With respect to other online behavior, model 2 shows that those who spent 3 or more hours a day on social media, had an adjusted odds ratio of 2.87 (95% CI: 2.04–4.42) compared to those who spent less than one hour a day on social media. Most strongly associated with sext-sharing was the recent experience of having one's own sext shared by others (aOR = 4.31; 95% CI: 3.32–5.55), followed by advanced experience with partner sex compared to having no experience with partner sex (aOR = 3.64; 95% CI: 2.67–5.13). Sexual orientation and school-based sexting education were not significantly associated with sext-sharing.

DISCUSSION

The purpose of this study was to investigate the prevalence and correlates of sext-sharing among a nationally representative sample of youth living in the Netherlands. The results show that sext-sharing is not uncommon among Dutch youth, since 4.2% of the 12–24-year-olds shared a nude image or sex-video of someone else in the previous six months. The lifetime prevalence of sext-sharing is probably multiple times higher, as was found in a recent meta-analysis (Madigan et al., 2018). We found that males, 12–14-year-olds (when adjusted for other variables), less educated youth and adolescents with a Moroccan or Surinamese background are more likely to share someone else's sext. Furthermore, the use of social media, dating apps, watching online porn, having more experience with partner sex, unwanted exposure to sexts, having one's own sext shared and a lower mental health are all associated with a higher risk of sext-sharing. This is in line with our expectations. Contrary to what we anticipated, we did not find an association between sexual orientation or having received school-based sexting education and the likelihood of sext-sharing.

Males are twice as likely to share sexts than females. Earlier studies found that females were commonly judged more harshly whether they sexted (e.g., “slut”) or not (e.g., “prude”) compared to males, which could explain their reluctance to share sexts of others (Lippman and Campbell, 2014). Males are also found to

TABLE 2 | Multivariate associations with sext-sharing within the last 6 months (95% percentile bootstrap confidence intervals based on 1,000 samples).

Variable	Model 1 (N = 20,533)			Model 2 (N = 19,003)		
	aOR	95% CI	p	aOR	95% CI	p
Sex						
Female	1			1		
Male	2.69	2.27–3.20	0.001	2.19	1.76–2.72	0.001
Age group						
12–14 years	1			1		
15–17 years	1.89	1.45–2.51	0.001	0.78	0.55–1.13	0.165
18–20 years	1.33	1.01–1.81	0.050	0.40	0.28–0.60	0.001
21–24 years	1.11	0.84–1.48	0.491	0.37	0.25–0.56	0.001
Education						
Less	1			1		
More	0.69	0.58–0.80	0.001	0.82	0.70–0.98	0.023
Ethnic background						
Dutch/Western background	1			1		
Turkish	0.46	0.10–0.92	0.057	0.45	0.10–1.01	0.088
Moroccan	1.39	0.66–2.30	0.275	2.01	0.91–3.52	0.027
Surinamese	1.63	0.96–2.46	0.036	1.43	0.83–2.24	0.139
Antillean	2.30	1.13–3.70	0.002	2.11	0.97–3.70	0.016
Other non-Western	1.41	0.99–1.92	0.039	1.38	0.90–1.93	0.083
Urbanity						
Urban	1			1		
Urban-rural	1.24	0.98–1.53	0.059	1.43	1.13–1.79	0.007
Rural	1.13	0.92–1.35	0.226	1.31	1.07–1.58	0.010
Sexual orientation						
Heterosexual				1		
Gay/bisexual				1.21	0.81–1.66	0.269
School-based sexting education						
Sufficient				1		
Non or little				0.88	0.74–1.08	0.195
Time spent on social media						
< 1 h p/d				1		
1–3 h p/d				1.65	1.14–2.51	0.010
3 or more hours p/d				2.87	2.04–4.42	0.001
Ever used a dating app						
No				1		
Yes				1.44	1.20–1.74	0.001
Watching online porn-videos < 6 months						
Never				1		
Up to once p/w				1.66	1.32–2.16	0.001
Multiple times p/w				2.68	2.00–3.67	0.001
Experience with partner sex						
None				1		
Little				2.70	1.86–3.90	0.001
Advanced				3.64	2.67–5.13	0.001
Unwanted exposure to sexts < 6 months						
No				1		
Yes				1.59	1.17–2.11	0.002
Own sext shared by others < 6 months						
No				1		
Yes				4.31	3.32–5.55	0.001
Mental health (tertiles)						
High				1		
Middle				1.08	0.86–1.35	0.483
Low				1.31	1.07–1.67	0.015

Bold values indicate significant at $p < 0.05$ level.

perceive sext-sharing more often as a common activity, whereas females feel that sexting is private behavior (Walker and Sleath, 2017). Furthermore, males sometimes engage in sext-sharing to brag about their capacities to obtain these images (Walker and Sleath, 2017), to strengthen the social bonds with their peer-group or increase social status (Bindesbøl Holm Johansen et al., 2018; Barrense-Dias et al., 2019; Clancy et al., 2019). This finding could also be explained by higher levels of sensation-seeking and lower levels of impulse control which are both more prevalent in males than in females (Shulman et al., 2015).

Whereas the prevalence of general forms of sexting is higher in older age groups (De Graaf et al., 2017), when sexting increasingly occurs within the context of a romantic relationship (Lippman and Campbell, 2014), our findings show that the risk of *sharing* is highest among the 15–17-year-olds. However, after controlling for other factors (e.g., online behavior and sexual activity), the highest risk shifts from age 15 to 17 to age 12–14. Apparently, the primary higher prevalence of sext-sharing among 15–17-year-olds (partly) parallels their increased (sexualized) media usage or offline sexual activity. Given equal levels of other behaviors such as online and sexual activity among 12–14-year-olds, their risk of sext-sharing would be much higher. Young adolescents are especially vulnerable because their risk for harmful side-effects of sexting is higher, yet their risk perception is lower (Garcia et al., 2016; Barrense-Dias et al., 2017). This could also be explained from a neuropsychological perspective, which states that young adolescents make more impulsive decisions because of a maturational imbalance between the part of the brain that is sensitive for (short-term) rewards and the part involved in goal-directed behavior (Steinberg et al., 2008).

Young people's lives are embedded in their socio-cultural environment, which shapes their perspectives on sexuality. Cense (2019) argues that existing messages about sexuality in our western culture are often ethnocentric in nature and do not consider other realities with different values and morals with regards to sexuality. Second generation Moroccan youth often grow up in an environment where premarital sex is strongly disapproved of, especially for girls (Hendrickx et al., 2002). As a result, they are unlikely to adopt an (imposed) western point of view that acknowledges sexting as an accepted form of sexual self-expression between unmarried people. Disapproval of sexting in general, may lower reservations to share sexts that are already in circulation. The observation that Antillean adolescents are more likely to share sexts, may be explained by Antillean boys having a relatively large number of sex partners (De Graaf et al., 2017). It is important to reach young people with messages that match their socio-cultural realities. This calls for additional qualitative exploration, into the motives for sex-sharing, in which special attention is required for the perceptions, norms and experiences of young people from different cultural backgrounds.

We found that school-based sexting education was not significantly associated with sext-sharing. We cannot draw any conclusions about the effectiveness of existing school-based education based on this outcome, since we did not measure what the content of these lessons was. We also do not know if a formal educational program was used, or if only casual discussions were held. If a formal educational program was used, it is possible that

these lessons focused on abstinence from sexting as a means to avoid risks, which is unlikely to prevent (non-consensual) sext sharing (Döring, 2014; Oosterwijk and Fischer, 2017; Finkelhor et al., 2020; Patchin and Hinduja, 2020). It is also conceivable that programs were used that were effective, but that the effects were neutralized by schools that only addressed the subject following an incident with sext-sharing (Johnson et al., 2018). Finally, we did not assess whether the topic was discussed one time or repeatedly. It is unlikely to find an effect of a single time intervention, since behavioral change requires a systematically developed intervention which is repeated at diverse moments in the school-career (Finkelhor et al., 2020).

Our findings do confirm an association between sext-sharing and other forms of sexual activity. The link with frequent porn consumption could originate from the fact that both sexting and watching porn are signs of an increasing interest in sexuality. Pornography is primarily used to stimulate sexual arousal (Sun et al., 2016). It is conceivable that sexts are sometimes exchanged among friends to elicit sexual arousal. A normalization of non-consensual sharing or dissemination of sexts could also be suggestive of some sort of sexual objectification or an instrumental attitude (Van Oosten and Vandenbosch, 2020). Further research could illuminate if there are shared attitudes that can explain the connection between porn consumption and sext-sharing and if so, how these are related to both behaviors. For example, a high instrumental attitude could simultaneously precede porn consumption and sext-sharing, but it could also be a mediating factor.

The connection we found with experience with partner sex parallels the findings in earlier studies that sexting and offline sexual behaviors coincide (Baumgartner et al., 2012; Raine et al., 2020). Possibly, both sext-sharing and offline sexual behavior are forms of sexual experimentation and a reflection of a developmentally normative interest in sexuality. One study found that the likelihood of getting sexually active was higher for young people who had previously sent a nude picture of themselves. This suggests that sexting could be a form of preparatory behavior or a sign that someone is ready to have offline sex. Another explanation can be found in the routine activity theory, which assumes that a person is more likely to offend if he or she has more opportunities to do so (Pratt and Turanovic, 2016). More sexually experienced young people could have more opportunities for sext-sharing than inexperienced young people. This theory could also underpin the correlation between time spent on social media and sext-sharing.

Of all factors included in the present study, the recent experience of having one's own sext shared associates most strongly with sharing someone else's sexts. One theory that could explain this association is the general strain theory (Agnew, 1992). This theory states that the negative treatment by others generates negative emotions, which in turn instigate negative actions. If sexts are exchanged within a romantic relationship, and one of the partners betrays the other one's trust, it is conceivable that the latter retaliates. Retribution could also play a role in the association we found between sext-sharing and unwanted exposure to sexts. Naezer and Oosterhout Van (2020) describe that some of their respondents forwarded unsolicited

sexts because they felt harassed by the sender and wanted to teach him a lesson.

Strengths and Limitations

One of the strengths of our study was the use of a representative national sample which enabled us to gain insight in the prevalence of sext-sharing among Dutch youth. However, despite using sampling weights to increase the representativeness of the sample, it is conceivable the sample still differs from the study population on characteristics that could not be weighed for. Also, only a minority of the schools that were approached to take part in this study, participated. This has possibly resulted in a selective sample of schools, as schools with a more permissive school climate toward sexuality or an increased emphasis on sexual health in their curriculum may have been more likely to participate.

Secondly, the nature of our outcome measure (i.e., “Have you ever sent nude pictures or videos of someone else”) has a few limitations. It is possible that the prevalence we found is an underestimation, if some of the respondents felt inclined to give a socially desirable answer despite the anonymity they were guaranteed. Additionally, the formulation of the question is not entirely unambiguous, since the question does not include consent. In theory this question could also be answered affirmative if someone took a consensual photo or video of someone else and then shared the result only with the person depicted in the sext. Furthermore, we cannot rule out that “someone else” is in some cases someone depicted on a publicly available image, for example leaked celebrity sex-tapes. Since the outcome variable was part of a series of questions relating to sharing personal sexually explicit content, we however believe this specific interpretation of the question is unlikely. A strength but also a weakness is the narrow definition of the outcome measure. We excluded sexual text messages from the outcome measure because explicit images or videos are believed to have a potentially greater impact than sharing sexual text messages (Houck et al., 2014). This is in agreement with other studies about non-consensual sext-sharing (Walker and Sleath, 2017; Clark et al., 2018; Johnson et al., 2018). A consequence of this is that it limits comparability of our results with studies that do include sexual text messages in their outcome measure.

In our study we followed the dichotomous gender classification (male/female) that was customary at the time. Unfortunately, as a result it remains unclear to what extent non-binary, transgender and intersex youth are involved in sext-sharing and this should be addressed in future research.

Another limitation is that our dataset is cross-sectional, making any conclusions about causality impossible. To illustrate this, in the association found between the variable *mental health* and sext-sharing, sext-sharing can be the cause, outcome or both, or both variables can be related to a confounding variable. Since this research was explorative in nature, no comprehensive framework could be applied to this study which can be considered to be a limitation as well.

Finally, the original Kessler psychological distress scale (which was used to assess mental health) consists of 10 items. One item (i.e., “During the past 30 days, how often did you feel nervous?”)

was accidentally omitted from the questionnaire. Fortunately, Cronbach's Alpha of the remaining 9 items was still high (0.92).

In conclusion, our findings warrant additional research to improve the understanding of the mechanisms underlying the victim-offender overlap between those sharing sexts and those having their sext shared. Additional research could possibly also shed more light on the reasons for not finding a positive relationship between school-based sexting education and the sharing of sexts. The results further illustrate the importance of targeting adolescents from a young age (from 12 years onwards) with educational interventions specifically addressing the risks of sharing someone else's sext. This is important because sext-sharing by young people often seems to result from an underestimation of the possible consequences rather than from bad intentions (Clancy et al., 2019). Targeting adolescents at a young age will also increase the probability of being able to address the subject preventively rather than as a response to unfavorable incidents. In the Netherlands ensuring social safety is an obligatory part of the responsibilities of schools⁴. This includes the protection of adolescents against (non-consensual) sext-sharing and other types of (cyber)bullying, requiring effective school-based educational interventions. In these interventions, a shift in focus is recommended from the initial senders to the recipients and factors that facilitate further dissemination. It is also advised to concentrate on teaching young people skills to minimize the harms that may result from sexting, rather than to advocate abstinence. Furthermore, the importance is emphasized of addressing the normative aspects of sexting and to convey the notion that a sext is private and that it is never OK to share received sexts with someone else (Finkelhor et al., 2020; Naezer and Oosterhout Van, 2020; Patchin and Hinduja, 2020). Our findings suggest that sext-sharing closely links to sexual activity as well as with other online social and romantic ventures. It also shares characteristics with other forms of bullying. It is therefore recommendable to not include the subject of (non-consensual) sext-sharing in school-based sexual health education exclusively, but to also integrate the topic in media-literacy lessons teaching adolescents how to use (online) media safely, responsibly and respectfully as well as in traditional school based anti-bullying programs. This way, the subject can receive the repeated attention that is required for effectiveness. For the development of evidence and theory-based interventions we suggest the application of the Intervention Mapping Approach (Bartholomew Eldredge et al., 2016; Mevissen et al., 2018). This approach uses a thorough, systematic and detailed protocol to guide intervention development, implementation and evaluation and has been widely used to plan health promotion programs in the Netherlands.

DATA AVAILABILITY STATEMENT

All partners involved in this study (Rutgers, SoaAids Nederland and the Public Health Services) share ownership of the data used for his study. Permission from them would be needed

⁴<https://www.rijksoverheid.nl/onderwerpen/veilig-leren-en-werken-in-het-onderwijs/veiligheid-op-school>.

before sharing this dataset with third parties. Any data-requests would also need to comply with existing data-sharing regulations as stipulated by the municipality of Rotterdam. Requests to access the dataset should be directed to Sarah Boer, se.boer@rotterdam.nl.

ETHICS STATEMENT

The study proposal was submitted to The Medical Research Ethics Committee of the University Medical Center Utrecht and exempt from ethical review (reference number Wag/mb16/013562). Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

SB and ÖE initiated the study, all authors discussed the design. SB, ÖE, and HdG collaborated in the data-preparation and analysis. Results were interpreted by all authors. SB wrote the introduction, methods, and result section and HdG wrote the discussion of the manuscript. HG provided expert input and

supervised the collaboration process. All authors contributed to drafting and revision of the paper and all authors approved the final manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2021.655796/full#supplementary-material>

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Just Checking It Out? Motivations for and Behavioral Associations With Visiting “Slutpages” in the United States and Australia

Elizabeth M. Clancy^{1*}, Megan K. Maas², Evita March³, Dominika Howard¹ and Bianca Klettke¹

¹ School of Psychology, Deakin University, Burwood East, VIC, Australia, ² Human Development and Family Studies, Michigan State University, East Lansing, MI, United States, ³ School of Science, Psychology, and Sport, Federation University Australia, Berwick, VIC, Australia

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Germany

*Correspondence:

Elizabeth M. Clancy
elizabeth.clancy@deakin.edu.au

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“Slutpages” are a pernicious form of online image-based evaluative voyeurism (OIBEV), whereby (sexualized) images of women are posted on webpages for (predominantly) male groups to rate and comment. Despite media and public concern, OIBEV sites have garnered limited empirical study. This paper presents the first analysis of OIBEV site visitation motivations across United States and Australian samples. Participants comprised a convenience sample of 1148 young adults aged 18 to 29 years ($M = 22.54$, $SD = 2.50$); 53.0% women, 47.0% men; 54% residing in the U.S. and 46% in Australia. Respondents completed an online questionnaire. Overall, 23% of United States and 16% of Australian respondents had visited OIBEV sites. OIBEV site visitation was uniquely associated with gender and country (with men and United States being more likely to visit OIBEV sites), requesting and disseminating sexts and having one’s own image shared. Cyberbullying perpetration was associated with reduced odds of OIBEV site visitation. Motivations differed by gender, with men (80%) being most likely to visit sites to “check them out” while women were equally likely to check it out (41%) or to see if they were depicted (36%). For men, unique predictors of OIBEV site visitation were having requested, disseminated and received disseminated sexts, lower levels of anxiety and reduced likelihood of cyberbullying perpetration. For women, OIBEV site visitation was uniquely associated with being a United States resident, sext dissemination victimization, receipt of disseminated sexts, higher levels of anxiety but reduced stress. Our findings confirm that OIBEV sites represent a highly gendered form of online image-based sexual abuse, and may have important mental health implications, given the associations with increased anxiety. Our results support the need for “slutpage” education for adolescents and young adults to address social and peer norms that encourage and support non-consensual use of intimate images.

Keywords: sexting, pornography, gender, slutpages, image-based sexual abuse, sexual harassment

INTRODUCTION

Emerging adults in Western society spend increasing time online communicating via messenger apps, social media, and blogs. For example, usage among United States and United Kingdom emerging adults has been estimated at over 3 h per day, in addition to work and/or study requirements (Code Computer Love, 2019; Mackay, 2019). Although some aspects of this communication are positive and adaptive, online communication and social media can also negatively impact functioning and overall well-being. For example, the ease and scope with which users can create and share sensitive or harmful information and media has been linked to poorer mental health outcomes for affected individuals (Best et al., 2014; Keles et al., 2020). These harmful forms of communication include the non-consensual sharing of sexual content, particularly explicit images of individuals, conceptualized as image-based sexual abuse (Powell et al., 2018; Henry and Flynn, 2019). Although not all non-consensual sharing of explicit information is motivated by malicious intentions (Clancy et al., 2019), such behaviors can be aimed to publicly shame, threaten, or abuse those depicted (McGlynn et al., 2017). In this paper, we focus on the under-researched phenomenon of “slutpages,” a specific form of image-based sexual abuse that is more secretive, yet social.

The term “slutpages” refers to digitally created groups, websites, or email listservs where individuals share sexually explicit images of others, most often girls and women, usually without their knowledge or consent (Sales, 2016, 2017). Others, usually peers and not necessarily public audiences, are invited to view and comment on the appearance, sexuality, and/or sexual performance of those depicted (Uhl et al., 2018). It is important to acknowledge that the term “slutpages” is itself problematic, as it attributes blame and negative connotations toward those depicted. To avoid these concerns, we have chosen to use a less value-laden term, referring to online image-based evaluative voyeurism (OIBEV), but acknowledge the term “slutpages” is perhaps a more commonly known term in general discourse.

Specific instances of OIBEV have been identified in schools, college-based groups, and the military (Sales, 2016, 2017). In 2014, a United States University fraternity was suspended for creating a private Facebook group, where explicit photos of intoxicated, and in some cases allegedly unconscious, female students were shared (Garrity and Blinder, 2015). In Australia, OIBEV behaviors have been reported predominantly in elite private school settings; whereby male students post photos of female peers with the opportunity for others to comment and assess or evaluate these women in relation to their appearance, attractiveness, or other criteria (Cook, 2016; Houston and Cook, 2016; Olding, 2016; Carmody, 2017). Thus, the creation of, and visitations to, OIBEV sites is not unique to the United States.

The images that are uploaded to these OIBEV sites are often obtained via sexting (Sales, 2016, 2017), a form of sexual digital communication encompassing sending, receiving, or forwarding of sexually explicit messages, images, or photos to others through electronic means (Klettke et al., 2014). However, many of the women whose images have been shared on OIBEV sites report being unaware of the existence of these sexually explicit pictures

and/or the OIBEV sites (e.g., Garrity and Blinder, 2015). This implies that some, if not most, of the images of such sites may have been taken without the knowledge or consent of the victimized person(s), whether due to intoxication (Garrity and Blinder, 2015), or other voyeuristic behaviors, such as upskirting or downblousing. Effects on those who become aware of being victimized on such sites are significant, with reports of increased anxiety and suicidal thoughts (Sales, 2016), and fear for one's physical safety (Sales, 2017). Given the potential for such negative impacts for victims, it is concerning that research regarding this behavior remains in its infancy.

To date, there has been minimal empirical research addressing OIBEV. In a United States -based college sample, Maas et al. (2021) found that 33.7% of emerging adults reported having visited “slutpages,” whilst 2.8% had posted images to such sites. Men (6.5%) were significantly more likely to post images than women (0.8%). Younger respondents were more likely than older participants to both visit and post on such sites, particularly if they were engaged in Greek Life (fraternities and sororities) or participated in team sports. Alcohol and pornography use were also associated with increases in both viewing and posting to OIBEV sites. In another study exploring OIBEV, albeit obliquely, Walker et al. (2019) found that 2% of adults reported having non-consensually posted images publicly on social networking sites. However, this study was limited by (1) the lack of investigation of motivations for such behaviors, and (2) the focus on general social networking sites, instead of specifically exploring closed or secret webpages such as OIBEV sites. A third qualitative study from Italy explored the non-consensual diffusion of intimate images via Telegram, an app which facilitates large groups or channels whilst maintaining anonymity (Semenzin and Bainotti, 2020). This study noted that such large, and usually male, online communities support and facilitate online image-based harassment, and can reinforce norms of hegemonic masculinity. Despite these emerging studies, motivations for posting to, visiting, and viewing OIBEV sites are yet to be clarified.

Conceptually, OIBEV can be likened to other forms of image-based sexual abuse (McGlynn et al., 2017; Powell et al., 2018). As with other forms of sexual violence, image-based sexual abuse is considered a gendered issue, with younger women and sexual minorities over-represented as victims (Henry and Powell, 2018). Although research investigating this space is limited, such differences are unsurprising. Younger women (Kussin-Shoptaw et al., 2017) and sexual minorities (Mellgren et al., 2018) experience high rates of sexual violence offline. Such behaviors may be attributed to *cis*-gendered and heteronormative norms, attitudes about gender and sexuality, power-related motivations for perpetration, and victim blaming attitudes (Henry and Powell, 2018).

Online image-based evaluative voyeurism sites, which are generally created and shared amongst male peer groups, may also be attributed to similar *cis*-gendered, heteronormative norms and attitudes about sexuality, gender and roles, as they can form bonding mechanisms between (typically male) friendship or peer groups, within schools, clubs, or teams (Sales, 2016, 2017). Explanations for such bonding may lie in Male Peer Support Theory (DeKeseredy and Schwartz, 1993, 2016) which posits

that in both offline and online contexts, violent men are likely to align with those peers who explicitly and implicitly support their misogynistic or violent tendencies. Indeed, DeKeseredy and Schwartz (2016) note that online behaviors facilitate wider displays of aggressive or violent masculinity as a form of peer recognition or bonding. Posting and viewing such images could also represent a way for men to assert heterosexual masculinity (Anderson, 2005; Waldron, 2015).

However, the only empirical study regarding OIBEV to our knowledge (Maas et al., 2021), found that 30% of women also viewed "slutpages," albeit less frequently than men (40%). Given that most OIBEVs almost exclusively depict women, and are predominantly designed for the male gaze, this gives rise to questions about why women would view such sites. Potential explanations, derived from pornography research (Maas and Dewey, 2018; Davis et al., 2020) include curiosity or sexual arousal (including same-gender orientations), as well as wanting to know whether they themselves or their friends are depicted on these sites. However, specific motivations for OIBEV have not yet been empirically explored. Thus, these motivations are worthy of investigation, as understanding why people engage with or purposefully witness different forms of image-based sexual abuse can help inform prevention, policy development, and intervention programs (Duncan and March, 2019).

Uses and Gratification Theory (UGT) offers a framework to understand why individuals may seek out and use specific media to meet certain needs (Rubin, 2002) and has been applied to a range of online behaviors including cyberbullying (Hu, 2016; Tanrikulu and Erdur-Baker, 2019). Equally, it can be applied to OIBEV, which may serve a need to gratify via content (i.e., the images themselves) or serve process gratification needs (i.e., purposefully navigating to answer a question) by exploring whether one's images have been posted. To test this theory, we proposed to explore expressed motivations for OIBEV. Additionally, we were interested in analyzing associations with other forms of image-based sexual abuse, such as non-consensual sext dissemination, and technology-facilitated violence, such as cyberbullying, given conceptual similarities. By extension, OIBEV victimization (and visiting sites to see if one is depicted) might overlap with sext dissemination victimization and cyberbullying victimization. Further, visiting OIBEV sites to view/check out images might be associated with engagement in other harmful forms of technology-facilitated violence, such as sext dissemination and cyber-bullying perpetration.

Sext dissemination refers to the distribution of sexts (sexually explicit messages, images, or photos sent to others via electronic means) to people beyond the original intended audience, and often (although not exclusively) against the wishes or without the knowledge of the person depicted (Strasburger et al., 2019; Clancy et al., 2020). This can include posting images on OIBEV sites, as well as more private forms of dissemination via mobile phones. Victims of non-consensual dissemination may experience distress, anxiety and reduced self-esteem (Walker and Sleath, 2017), loss of employment (Citron and Franks, 2014; Cannon, 2015) and even post-traumatic stress symptoms and suicidal ideation (Bates, 2016). However, most of those engaging in sext dissemination report relatively innocuous motivations,

such as thinking the individual was "hot," as a joke or to be funny, or to enhance social status (Clancy et al., 2019, 2020), consistent with UGT that this behavior serves a functional purpose. Given the potential impact on victim mental health, and the potential for polyperpetration and/or polyvictimization, relationships between dissemination and OIBEV will also be explored.

Cyberbullying constitutes a form of online aggression, involving intentional and repeated harm inflicted on another via electronic means (Patchin and Hinduja, 2006). Perpetrators of cyberbullying derive gratification from their actions, perceiving themselves in a position of power relative to their victim(s; Patchin and Hinduja, 2006), and perpetration has been explained with reference to UGT, with cyberbullying offering opportunities for entertainment, revenge or domination of others (Hu, 2016; Tanrikulu and Erdur-Baker, 2019). Cyberbullying behaviors typically include threats, spread of harmful or untrue information about the targeted person(s), exclusion, and "outing," acts of public sharing of private, intimate, and potentially embarrassing information or images of the victim(s; Willard, 2007). Both victims and perpetrators suffer adverse mental health outcomes including peer and emotional problems, psychiatric symptoms/disorders, lower self-esteem, substance use and conduct problems (Kowalski et al., 2014; Fisher et al., 2016; John et al., 2018).

Parallels between OIBEV, non-consensual dissemination and cyberbullying are striking. Those who post material to OIBEV sites are typically engaging in a form of non-consensual dissemination, with no consent obtained for the sharing of such images, and become cyberbullying perpetrators as the intention behind this online behavior is to cause harm to the individual/s depicted. All three behaviors may serve functional outcomes, with positive experiences being reinforcing as they fulfill gratification needs as suggested by UGT. Analogously, being featured on OIBEV sites echoes cyberbullying and non-consensual dissemination victimization, with consequent experiences of significant distress and fear. Visiting sites, whether OIBEV sites or social media, to determine whether one is a victim and the extent of impact, would serve process gratification needs, consistent with UGT. As such, investigation of potential overlaps between "slutpage" use, sext dissemination perpetration and victimization, and cyberbullying perpetration and victimization, is of interest to see where prevention efforts could be mutually supportive. In addition, we aimed to investigate potential associations with depression, anxiety and stress for OIBEV site visitation, given previous proposed associations (Sales, 2016, 2017), and whether this differs with OIBEV site visitation motivations.

Lastly, given the paucity of information regarding OIBEV site visitation generally, it is of value to document this behavior in two nations, investigate potential cross-national differences, and determine any trends in rates of behaviors between different nations which can help explain these behaviors. This will be of interest to those seeking to develop programs that can prevent such behaviors, particularly those developing school-based sexual and relationship health education programs. In addition, this information will inform service responses for victim-survivors of this form of image-based sexual abuse.

Recent research exploring non-consensual sexting behaviors across various nations has found striking differences. In a study involving participants from ten nations across four continents (Morelli et al., 2020), there was considerable variation in rates of non-consensual dissemination based on nationality and personality traits. However, the overall model explained only 5% of variance, hence such differences may possibly be explained by factors other than personality traits and nationality.

One potential explanation could be the difference in school-based sexual health and relationships education programs, which vary between nations in their reference to online behaviors. Comparing Australian and United States programs provides an illustration. Australian schools are mandated to provide comprehensive sexuality education as part of school curricula, addressing physical sexual health, social issues of relationships and consent (Smith et al., 2011). More recent materials are increasingly focusing on online as well as offline behaviors (Fisher et al., 2019). By contrast, United States requirements show significant variation between states, with some states emphasizing abstinence approaches as the preferred approach for preventing pregnancy and sexually transmitted infections, limiting information about safe sex practices (Peters, 2007; Ford et al., 2013), whilst broader discussions of sexual practices remain controversial (Mullinax et al., 2017). Differences in the use of OIBEV sites between United States and Australian participants may relate to differences in a range of factors, including differences in compulsory relationship and sexuality education.

Despite its presence in the popular press, the phenomenon of “slutpages” has received little empirical attention. As noted, only one study to date has assessed the prevalence of “slutpage” use and associated behaviors, within a United States college sample. To further build on this line of work, we aim to (1) identify the motivations for visiting OIBEV sites in the United States and Australia, and whether visitation frequency and ascribed motivations vary cross-nationally or by gender; (2) examine OIBEV site visitation with associated online behaviors, specifically sext dissemination and cyberbullying perpetration, and (3), identify associations with mental health. Drawing on available prior research, we proposed the following hypotheses:

1. Men would be more likely to visit OIBEV sites overall.
2. Men would be more likely to visit OIBEV sites to view images than women.
3. Women would be more likely to be motivated to visit OIBEV sites to see if they were depicted themselves than men.
4. OIBEV site visitation would be positively associated with sext dissemination and cyberbullying perpetration.
5. OIBEV site visitation to see if one was depicted would be positively associated with mental health concerns, specifically depression, anxiety, and stress, whereas there would be no association with negative mental health outcomes for frequenting OIBEV sites for general viewing.

Given minimal available prior research, no *a priori* hypotheses were generated regarding cross-national differences.

MATERIALS AND METHODS

Participants

Participants in this study included 1148 young adults aged 18 to 29 years ($M = 22.54$, $SD = 2.50$); 53.0% women, and 47.0% men. Participants were residents of the United States (53.8%) and Australia (46.2%). The majority (80.7%) reported their sexual orientation as heterosexual, 14.5% as bisexual, 3.7% lesbian or gay, and 1.0% were unwilling to disclose their sexuality. Most (81.8%) reported being currently sexually active, with 17.19 years ($SD = 2.44$) being the average age of first sexual activity.

Materials

OIBEV Site Visitation

Drawing on Maas et al. (2021), we determined whether participants had ever visited an OIBEV site with the following item: “Have you ever visited a secret page on social media (such as Instagram, Facebook, or Snapchat, etc.) or a website of nude images or video that were posted without the knowledge of those in the images/videos (sometimes referred to as Slutpages/Listservs)?”. Participants could respond with yes/no responses. Those responding in the affirmative were asked “What was your purpose?” and could respond with one of the following: *To check out the people on the page*; *To see if I was listed or depicted on the page* or *Other (please specify)*, with qualitative responses manually coded to identify themes.

Sext Dissemination Behaviors

This study adapted a previous sext dissemination questionnaire to focus on specific aspects of sexting. For the purposes of this study, all sexting-related questions referred to sexts as “sexually explicit images, sent, received or shared via mobile phone messaging or apps.” Sexting behaviors were assessed via questions about engagement in requesting, receiving, sending, and disseminating sexually explicit images via mobile phone messaging or apps, as well as frequency of dissemination (for all survey items, see Clancy et al., 2021). Participants were asked about both disseminating and receiving disseminated sexts; “Has someone ever forwarded you an image-based sext via text or mobile app that was not originally intended for you?” (*Yes/No*) and “Have you ever received an image-based sext intended for yourself which you subsequently showed/sent to another person?” (*Yes/No*). Participants were also asked whether they knew of their own images having been shared with others; “Have you ever sent an image-based sext of yourself that was subsequently forwarded (to your knowledge?)”. If they were aware of this occurring, they were also asked whether they had consented; “Had you given permission for this image to be forwarded?” with responses options of *Yes/No*.

Cyberbullying Perpetration and Victimization

Cyberbullying victimization and perpetration were assessed using measures drawn from Ybarra et al. (2007). Each scale consist of three items, addressing how frequently in the past year the individual engaged in cyberbullying behaviors, or was the target of such behaviors. A sample item is: “In the last year, how many times did you receive rude or nasty comments from someone

while online?” Response options provided were *everyday/almost every day, once or twice a week, once or twice a month, a few times a year, less than a few times a year, and never*. Participants who reported any of the three experiences in the previous year were coded as having experienced cyberbullying/perpetrated cyberbullying. Responses were reverse coded for analysis, so that higher scores on the scale indicate a greater degree of cyberbullying behaviors. These scales had good reliability, with ordinal alpha scores of 0.83 and 0.88 for victimization and perpetration, respectively.

Depression, Anxiety, and Stress

Depression, anxiety and stress symptoms were measured using the short form of the Depression, Anxiety and Stress Scale (DASS-21; Lovibond and Lovibond, 1995). This 21-item self-report instrument includes three 7-item subscales, and participants indicate how much this statement has applied to them over the past week, using a 4-point Likert scale ranging from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*). Responses for each subscale are summed, and higher scores indicating greater levels of psychological distress. The DASS-21 has demonstrated good psychometric properties (Henry and Crawford, 2005) and internal reliability in this sample was good, with Cronbach's alphas for depression, anxiety and stress subscales of 0.93, 0.87, and 0.89, respectively.

Procedure

After obtaining ethics approval from the Deakin University Human Research Ethics Committee, participants were recruited through social media (Facebook, Instagram, and Reddit), as well as survey aggregator sites Amazon MTurk ($N = 702$) and Prolific ($N = 136$), which were used to achieve balanced samples by gender and country. Planned contrasts between social media and survey aggregator participants identified that those recruited via social media were more likely to be women ($t = 20.26, p < 0.001$), and resident in Australia ($t = -34.51, p < 0.001$), whilst there was no significant difference in age ($t = -1.93, p = 0.06$). Social media participants were more likely to have disseminated sexts than those from survey aggregator sites ($t = 2.24, p = 0.026$), although the absolute value of this difference was small (Facebook 15%, survey aggregators 13%). Social media participants were also more likely to report either cyberbullying perpetration ($t = 5.08, p < 0.001$) or victimization ($t = 2.62, p = 0.009$), although again absolute differences were small (perpetration: Facebook $M = 16.97$, survey aggregators $M = 16.01$; victimization: Facebook $M = 15.33$, survey aggregators $M = 14.56$). Social media participants were less likely to have visited OIBEV sites ($t = -3.50, p = 0.001$; Facebook 14%, survey aggregators 22%).

Across all sites, advertisements informed participants that the study aimed to explore factors that can influence sexting behaviors, was open to adults aged 18–29 years, regardless of whether they had sexted or not, and emphasized response anonymity. Potential participants reviewed a brief online study description and indicated consent by commencing the survey, which took 15–20 min to complete. Participation was voluntary and confidential, with no incentive offered for general social media participants. MTurk participants received a payment

of \$1USD per survey completion, whilst Prolific participants received a payment of £1GBP. Survey responses were gathered during July–October 2019.

Analyses

All analyses were conducted using SPSS V26. Descriptive statistical analyses were used to review sample and variable characteristics. For all inferential analyses, an error level of 5% was used to determine results as significant. Analysis of difference by gender was conducted using chi-squared analyses, and point-biserial correlations between independent variables and sext dissemination were conducted. Binomial multivariate logistical regressions were conducted to understand the impact of behavioral and personality variables on sext distribution. Multivariate regression analyses were used to identify the unique and combined contribution of all variables in explaining variance in OIBEV site visitation. As the same data set was used for all analyses, Bonferroni corrections were employed to adjust for inflated risk of Type 1 errors. A *post hoc* sensitivity analysis using GPower (Erdfelder et al., 1996) identified a minimum required sample size of 761, with the current sample exceeding this (at $N = 1148$). Inductive coding of qualitative responses was conducted by the first author (EC), with a random sample of responses (10%) reviewed by the last author (BK). No discrepancies were noted in this analysis.

RESULTS

Descriptive statistics for key variables are provided in **Table 1**. OIBEV site visitation was significantly more common in the United States sample (23%) than the Australian sample (16%), $\chi^2(1) = 7.93, p = 0.005$, Fisher's $Z_r = 0.19$, indicating a small effect size. Testing Hypothesis 1, we found that rates of visiting OIBEV sites for men were almost double those for women overall, and this was similar across both the Australian and United States samples, with moderate effect sizes. The most common reason provided for visiting these sites was to “check it out,” but this varied depending on gender. Confirming Hypothesis 2, men were most likely (80%) to be visiting the site to “check it out.” Women were equally likely to be visiting to “check it out” (41%) and to see if they were depicted on the site (36%). To see if they were depicted was chosen notably more for women than men and is consistent with Hypothesis 3. Participants had the option to record “other” reasons for OIBEV site visitation and provide a free-text reason if desired. Of participants who had visited OIBEV sites, 36 (16%) selected this, with 30 providing text responses, including 16 men and 20 women. These responses were inductively coded to arrive at themes, with multiple themes noted for some responses. Additional reasons included curiosity ($n = 12, 42\%$ men), with indicative comments including “I was a curious teenager and saw that people were looking at these pages: I had a look and decided it was wrong,” and “stumbled upon it and curiosity got me, just looking at what was on there.” The other relatively common reason was accidental visits ($n = 9, 67\%$ men), e.g., “I came across the page/s unintentionally, several times across several

years,” “Given a link, didn’t know where it led.” Six participants (all women) noted helping a friend ($n = 6$, e.g., “My friend was on the page and I had to go on and report photos”), and self-gratification was also noted by three participants (all men) “For pornographic gratification.”

To test Hypothesis 4, we ran point-biserial correlations to determine whether OIBEV site usage was associated with other key variables of interest including sexting behaviors, cyberbullying and mental health indicators, as presented in **Tables 2** and **3**. Given noted gender disparities in prevalence and viewing reasons, we conducted analyses

using the overall sample and split by gender. Visiting OIBEV sites was significantly associated with gender (men more likely), and positively associated with sext dissemination perpetration and victimization, requesting sexts and receiving disseminated sexts, providing partial support for Hypothesis 4. However, OIBEV site visitation was negatively associated with both cyberbullying victimization and perpetration, in contrast to our hypotheses. When considering mental health, OIBEV site visitation was positively associated with anxiety and depression. However, all significant associations were weak, with the strongest relationship between OIBEV

TABLE 1 | Descriptive statistics and chi square comparisons by gender for OIBEV site visitation and visitation reasons.

TOTAL (N = 1148)	% Men (n = 540)	% Women (n = 608)	Total	Chi-square test
Ever visited OIBEV site (% Y)	26% (139)	14% (86)	20% (225)	$\chi^2 (1) = 24.41, p < 0.001$, Fisher’s $Z_r = 0.34$
Visitation reasons: To check it out (% of OIBEV site visitors)	80% (110)	41% (35)	65% (145)	$\chi^2 (2) = 37.59, p < 0.001$, Cramer’s $V = 0.41$
To see if I was on it	9% (12)	36% (31)	19% (43)	
Other*	12% (16)	23% (20)	16% (36)	
Australia (N = 530)	% Men (n = 233)	% Women (n = 297)	Total	Chi-square test
Ever visited OIBEV site (% Y)	24% (55)	10% (30)	16% (85)	$\chi^2 (1) = 17.68, p < 0.001$, Fisher’s $Z_r = 0.49$
Visitation reasons: To check it out (% of OIBEV site visitors)	70% (38)	30% (9)	56% (47)	$\chi^2 (2) = 16.84, p < 0.001$, Cramer’s $V = 0.45$
To see if I was on it	7% (4)	40% (12)	19% (16)	
Other*	22% (12)	30% (9)	25% (21)	
United States (N = 618)	% Men (n = 307)	% Women (n = 311)	Total	Chi-square test
Ever visited OIBEV site (% Y)	27% (84)	18% (56)	23% (140)	$\chi^2 (1) = 7.72, p = 0.005$, Fisher’s $Z_r = 0.24$
Visitation reasons: To check it out (% of OIBEV site visitors)	86% (72)	46% (26)	70% (98)	$\chi^2 (2) = 24.73, p < 0.001$, Cramer’s $V = 0.42$
To see if I was on it	10% (8)	34% (19)	19% (27)	
Other*	5% (4)	20% (11)	11% (15)	

* respondents could provide additional information, which was manually coded.

TABLE 2 | Point-biserial Correlations between OIBEV site visitation, online behaviors and mental health: full sample.

	Gender	Age	Sexually active	Received sext	Sent sext	Dissem. victim	Requested	Disseminated	Dissem. receipt	Anxiety	Depression	Stress	CBV	CBP
OIBEV site visitation	-0.15**	0.03	-0.04	0.01	0.01	0.14**	0.12**	0.15**	0.19**	0.07*	0.08*	0.04	-0.11**	-0.18**
Gender		-0.09**	0.15**	0.11**	0.15**	0.08**	-0.16**	-0.02	-0.04	0.08*	< -0.01	0.14**	0.10**	0.15**
Age			0.10**	0.06*	-0.03	-0.03	0.11**	0.06	-0.05	-0.09**	-0.06	-0.06	-0.01	-0.04
Sexually active				0.37**	0.29**	0.12**	0.18**	0.07*	0.06	0.03	-0.07*	-0.02	< 0.01	0.01
Received sext					0.51**	0.14**	0.35**	0.16**	0.14**	0.10**	0.06	0.08*	-0.10**	-0.05
Sent sext						0.22**	0.49**	0.13**	0.12**	0.01	< -0.01	0.07*	0.01	0.08*
Diss. victim							0.17**	0.25**	0.22**	0.11**	0.04	0.09*	-0.13**	-0.08*
Requested								0.18**	0.12**	< 0.01	0.01	0.02	-0.06	-0.07*
Dissemination									0.18**	0.10**	0.04	0.10**	-0.16**	-0.22**
Diss. receipt										0.10**	0.06	0.07*	-0.09**	-0.09**
Anxiety											0.71**	0.77**	-0.28**	-0.18**
Depression												0.76**	-0.23**	-0.14**
Stress													-0.20**	-0.11**
CBV														0.69**
CBP														

Dissem, Dissemination; CBV, Cyberbullying Victimization; and CBP, Cyberbullying perpetration. * = <0.05, ** = <0.01.

TABLE 3 | Point-biserial Correlations of OIBEV site visitation, online behaviors and mental health by gender: Upper triangle Men, lower triangle Women.

	OIBEV visitation	Country	Age	Sexually active	Received sext	Sent sext	Victim Victim	Requested	Disseminateds	Dissem receipt	Anxiety	Depression	Stress	CBV	CBP
OIBEV site visitation		0.04	0.03	−0.03	0.01	0.03	0.13**	0.09*	0.21**	0.21**	0.09	0.13**	0.13**	−0.09*	−0.17**
Country	0.11**		0.28**	0.10*	0.13**	0.10*	−0.03	0.09*	0.09*	−0.14**	0.05	−0.02	−0.08	−0.14**	−0.15**
Age	0.01	0.42**		0.24**	0.22**	0.09*	0.10*	0.15**	0.11**	−0.02	0.00	−0.02	−0.01	−0.03	−0.04
Sexually active	0.00	−0.01	−0.03		0.41**	0.24**	0.13**	0.24**	0.12**	0.06	0.01	−0.08	−0.06	−0.03	−0.05
Received sext	0.04	−0.03	−0.09*	0.30**		0.52**	0.13**	0.47**	0.14**	0.18**	0.08	0.03	0.03	−0.10*	−0.08
Sent sext	0.04	−0.05	−0.11**	0.31**	0.49**		0.20**	0.62**	0.17**	0.20**	−0.04	−0.04	−0.02	−0.06	0.01
Dissemination victim	0.19**	−0.03	−0.11**	0.09*	0.14**	0.23**		0.16**	0.24**	0.24**	0.09*	0.04	0.11*	−0.07	−0.08
Requested	0.10*	0.10*	0.05	0.18**	0.26**	0.43**	0.21**		0.24**	0.18**	−0.01	−0.02	0.01	−0.06	−0.07
Dissemination	0.09*	−0.02	0.00	0.02	0.10*	0.11**	0.27**	0.13**		0.26**	0.03	−0.04	0.02	−0.14**	−0.24**
Dissemination receipt	0.17**	−0.11**	−0.08*	0.07	0.10*	0.06	0.21**	0.06	0.10*		0.07	0.03	0.06	−0.07	−0.06
Anxiety	0.09	−0.08	−0.18**	0.03	0.09	0.04	0.12*	0.04	0.16**	0.13**		0.73**	0.78**	−0.31**	−0.27**
Depression	0.01	0.00	−0.11*	−0.05	0.10*	0.03	0.04	0.04	0.13**	0.10*	0.69**		0.77**	−0.23**	−0.16**
Stress	−0.02	−0.09	−0.12*	−0.02	0.11*	0.12*	0.05	0.07	0.19**	0.08	0.76**	0.76**		−0.24**	−0.19**
CBV	−0.10*	−0.10*	0.02	0.00	−0.12**	0.06	−0.19**	−0.03	−0.18**	−0.11*	−0.26**	−0.23**	−0.19**		0.70**
CBP	−0.14**	−0.13**	−0.02	0.05	−0.05	0.12**	−0.11*	−0.02	−0.19**	−0.11*	−0.11*	−0.12*	−0.07	0.66**	

Dissem, Dissemination; CBV, Cyberbullying Victimization; and CBP, Cyberbullying perpetration. * = <0.05, ** = <0.01.

site visitation and dissemination receipt explaining only 4% of variance.

When split by gender, similar patterns were noted, but with some important differences (see **Table 3**). For men, both dissemination perpetration and receipt of disseminated images were most closely associated with OIBEV site visitation, whilst dissemination victimization and requesting sexts were less strongly, although still significantly associated with OIBEV site visitation. Both cyberbullying victimization and perpetration were negatively associated with visiting OIBEV sites, depression and stress were positively associated with visitation, but anxiety was not associated. For women, visiting OIBEV sites was associated with being from the United States rather than Australia, and most strongly and positively associated with dissemination victimization and receipt of disseminated sexts. There were no associations between OIBEV site visitation and mental health variables for women. Given the relatively low frequency of such behaviors, correlational analyses were not split by motivations for OIBEV site visitation.

To determine the most impactful factors associated with visiting OIBEV sites, the sexting, mental health and cyberbullying variables, as well as demographics (gender, age, and country) were entered into a hierarchical regression to predict OIBEV site

visitation (see **Table 4**). The overall model was significant; [$\chi^2(15) = 93.90, p < 0.001$], predicting 17% of variance (Nagelkerke's *R*-square). Unique factors predicting OIBEV site visitation included gender ($\beta = 0.58, p = 0.007$), with women half as likely as men to visit OIBEV sites, and country ($\beta = 1.76, p = 0.011$), Americans more likely than Australians to visit these sites. Considering behavioral associations, dissemination victimization ($\beta = 2.25, p = 0.002$), having requested sexts ($\beta = 1.18, p = 0.012$) and receipt of disseminated images ($\beta = 2.14, p < 0.001$) were associated with increased likelihood of having visited an OIBEV site, whereas cyber-bullying perpetration ($\beta = 0.90, p = 0.009$) was associated with reduced odds of OIBEV site visitation.

When analyzing men and women separately, both models were significant. For men, the overall model predicted 19% of variance (**Table 5**), $\chi^2(14) = 58.35, p < 0.001$. Unique factors which predicted male OIBEV site visitation included having requested sexts ($\beta = 2.17, p = 0.020$), disseminated sexts ($\beta = 2.35, p = 0.012$), receipt of disseminated images: ($\beta = 1.99, p = 0.012$), lower levels of anxiety: ($\beta = 0.92, p = 0.028$), and lower likelihood of cyberbullying perpetration: ($\beta = 0.90, p = 0.042$). For women, the model predicted 17% of variance (**Table 6**), $\chi^2(14) = 41.26, p < 0.001$. Unique factors which predicted female OIBEV site visitation included country: ($\beta = 1.56, p = 0.025$), with American

TABLE 4 | Hierarchical regression results – predictors of OIBEV site visitation overall.

	<i>Chi square</i>	<i>df</i>	<i>P</i>	<i>–2 Log likelihood</i>	<i>Nagelkerke R-squared</i>	
Step 1	21.44	3	<0.001	802.78	0.04	
Step 2 - change	58.77	7	<0.001	744.01	0.15	
Step 3 – change	3.45	3	0.327	740.55	0.15	
Step 4 - change	9.23	2	0.010	731.32	0.17	
Overall model	93.90	15	<0.001	731.32	0.17	
	<i>B</i>	<i>Wald</i>	<i>p</i>	<i>OR</i>	<i>95% CI for OR</i>	
					<i>Lower</i>	<i>Upper</i>
Gender ¹	–0.55	7.30	0.007	0.58	0.39	0.86
Country ²	0.56	6.53	0.011	1.76	1.14	2.71
Age	–0.01	0.10	0.755	0.99	0.91	1.07
Sexually active	–0.45	2.91	0.088	0.64	0.78	1.07
Received sexts	–0.13	0.14	0.711	0.88	0.45	1.72
Sent sexts	–0.16	0.38	0.539	0.84	0.51	1.42
Dissemination victim ³	0.81	9.24	0.002	2.25	1.33	3.81
Requested sext ³	0.60	6.33	0.012	1.82	1.14	2.91
Dissemination receipt ³	0.76	14.18	<0.001	2.14	1.44	3.18
Dissemination ³	0.38	2.17	0.141	1.46	0.88	2.42
Anxiety	0.01	0.01	0.952	1.00	0.97	1.03
Depression	0.02	1.37	0.242	1.02	0.99	1.04
Stress	–0.01	0.14	0.706	0.99	0.96	1.03
CBV	0.02	0.29	0.591	1.02	0.95	1.10
CBP	–0.10	6.83	0.009	0.90	0.83	0.97
Constant	0.18	0.02	0.879	1.20		

Note – coefficients for individual predictors only provided for Step 4 (final solution). Coefficients at earlier steps available from authors.

¹Gender coded Men = 1, Women = 2.

²Country coded Australia = 0, United States = 1.

³All other binary variables coded 0 = No, 1 = Yes.

women more likely than Australian women to visit these sites; sext dissemination victimization ($\beta = 2.53, p = 0.017$), receipt of disseminated images ($\beta = 2.42, p = 0.006$), higher levels of anxiety ($\beta = 1.07, p = 0.009$) but reduced stress ($\beta = 0.94, p = 0.032$).

A final binary logistic regression analysis was used to assess Hypothesis 5, and determine factors associated with the two main reasons for OIBEV site visitation: only those who had reported either having visited to "check it out" or "to see if they were depicted" were included in this analysis due to small numbers in other categories. Potential predictors in the model included age, gender, country, having requested, sent or received sexts, disseminating and receiving disseminated sexts, and mental health and cyberbullying variables. Overall, the model was significant; $\chi^2(13) = 46.02, p < 0.001$, predicting 42% of variance. In contrast to our hypotheses, the only unique predictor was gender ($\beta = 9.15, p < 0.001$), with women nine times more likely to be viewing OIBEV sites to see if they were depicted, compared to men.

DISCUSSION

This study aimed to identify the motivations for OIBEV site visitation across United States and Australian samples, examine differences in ascribed motivations cross-nationally and by gender, examine associations between OIBEV site

visitation and other online behaviors such as sexting and cyberbullying, and associations with mental health. We proposed that men would be more likely than women to visit OIBEV sites overall, and to visit OIBEV sites to view images, whilst women would be more likely than men to visit OIBEV sites to see if they were depicted themselves. We also hypothesized that OIBEV site visitation would be positively associated with sext dissemination and cyberbullying perpetration, and that visiting a site to see if one was depicted would be associated with depression, anxiety, and stress. No *a priori* hypotheses were generated regarding cross-national differences.

Overall, our hypotheses were largely supported. Men were twice as likely to visit OIBEV sites as women across both nations, supporting Hypothesis 1. Of those who did report OIBEV site visitation, men were twice as likely as women to have visited to "check it out," whilst women were 3–4 times more likely than men to have visited to see if they were themselves depicted on the site, consistent with Hypotheses 2 and 3. These results also support prior journalistic reporting (Sales, 2016, 2017) that OIBEV sites largely depict women and are largely created for sharing and consumption amongst heterosexual men. For men, OIBEV may provide gratification needs as proposed by Rubin's (2002) UGT and relate to gratification via sexual arousal or ego needs (Henry and Flynn, 2019), much like revenge pornography (Walker and Sleath, 2017). In contrast, women may be meeting

TABLE 5 | Regression results – predictors of OIBEV site visitation for men.

	<i>Chi square</i>	<i>df</i>	<i>P</i>	<i>–2 Log likelihood (change)</i>	<i>Nagelkerke R-squared</i>	
Step 1	1.166	2	0.435	495.39	0.01	
Step 2 - change	29.62	7	<0.001	434.83	0.14	
Step 3 – change	9.62	3	0.022	425.21	0.17	
Step 4 - change	7.44	2	0.024	417.77	0.19	
Overall model	58.35	14	<0.001	417.77	0.19	
	<i>B</i>	<i>Wald</i>	<i>p</i>	<i>OR</i>	<i>95% CI for OR</i>	
					<i>Lower</i>	<i>Lower</i>
Country ¹	0.24	2.73	0.099	14.27	0.96	1.68
Age	–0.02	0.12	0.727	0.98	0.88	1.09
Sexually active	–0.53	2.77	0.096	0.58	0.31	1.10
Received sexts	0.07	0.03	0.872	1.07	0.46	2.48
Send sexts	–0.45	1.83	0.176	0.64	0.33	1.23
Dissemination victim ²	0.63	2.67	0.102	1.88	0.88	4.02
Requested sext ²	0.77	5.41	0.020	2.17	1.13	4.15
Dissemination receipt ²	0.69	6.27	0.012	1.99	1.16	3.40
Dissemination ²	0.85	6224	0.012	2.35	1.20	4.59
Anxiety	–0.05	4.84	0.028	0.92	0.90	0.99
Depression	0.03	2.59	0.107	1.03	0.99	1.06
Stress	0.03	2.23	0.135	1.03	0.99	1.08
CBV	0.00	0.00	0.964	1.00	0.90	1.11
CBP	–0.11	4.14	0.042	0.90	0.81	0.99
Constant	–0.33	0.05	0.829	0.72		

¹Country coded Australia = 0, United States = 1.

²All other binary variables coded 0 = No, 1 = Yes.

gratification by visiting OIBEV sites to determine if they are depicted on those sites and appease their concerns.

Providing partial support for Hypothesis 4, OIBEV site visitation was positively associated with a range of sexting behaviors, particularly having requested sexts from others, receiving disseminated images, having disseminated images to others, having one's own image disseminated and requesting sexts from others. These findings were consistent for both men and women. However, dissemination perpetration and receipt were stronger predictors for men, whilst dissemination victimization was the strongest multivariate predictor for women and not significant for men. These findings support gendered differences in motivations for OIBEV site visitation, whereby men are more likely to visit OIBEV sites to view those depicted. This supports propositions that these men may also engage in other forms of technology facilitated abuse within peer groups, such as sending and receiving disseminated images (Henry and Powell, 2015).

By contrast, women, who were more likely to visit OIBEV sites to see if they were depicted, were also more likely to have had their own images shared with others. Whilst there was insufficient power to test for this, it is noted from other studies that, of those who are aware that their intimate images have been disseminated, less than 10% of women had given consent for this (Clancy et al., 2020). Our results are consistent with previous suggestions (Garrity and Blinder, 2015; Sales, 2016, 2017) that many OIBEV site images are non-consensually obtained, as well as shared. Of

note, these gendered findings applied across both United States and Australia samples, with no difference by country noted, suggesting similar mechanisms are at work in both nations.

Interestingly, OIBEV site visitation was negatively associated with cyberbullying perpetration, overall and individually for men, but not for women, contrary to Hypothesis 4. Although researchers and policy makers may consider a conceptual overlap, with OIBEV constituting a form of cyberbullying, our results indicate that these behaviors are not correlated in the view of respondents. In fact, participants were less likely to visit OIBEV sites if they had been either a perpetrator *or* a victim of cyberbullying in the 12 months prior. Perhaps motivations associated with cyberbullying, such as harm, revenge, dominance, and entertainment (Tanrikulu and Erdur-Baker, 2019) differ (at least in part) from the motivations for OIBEV site visitation.

Considering the potential associations between OIBEV site visitation and mental health indicators (Hypothesis 5), we found that for men, OIBEV site visitation was associated with reduced anxiety, although effect sizes were small. For women, there was a small association between increased anxiety, but reduced stress, and OIBEV site visitation. These findings are unexpected, given previous journalistic reports regarding OIBEV victims (Sales, 2016, 2017) suggest significant mental health impacts, similar to those reported in association with other forms of technology facilitated sexual abuse (McGlynn et al., 2017; Powell et al., 2018). However, it is likely that lasting mental

TABLE 6 | Regression results – predictors of visiting OIBEV site visitation for women.

	<i>Chi square</i>	<i>df</i>	<i>P</i>	<i>-2 Log likelihood</i>	<i>Nagelkerke R-squared</i>	
Step 1	6.20	2	0.045	326.51	0.03	
Step 2 – change	24.20	7	0.001	302.31	0.13	
Step 3 – change	8.87	3	0.031	293.44	0.17	
Step 4 - change	1.99	2	0.370	291.45	0.17	
Overall model	41.26	14	<0.001	291.45	0.17	
	<i>B</i>	<i>Wald</i>	<i>p</i>	<i>OR</i>	<i>95% CI for OR</i>	
					<i>Lower</i>	<i>Lower</i>
Country ¹	0.44	5.02	0.025	1.56	1.06	2.29
Age	−0.01	0.02	0.885	0.99	0.86	1.14
Sexually active	−0.35	0.38	0.534	0.70	0.23	2.13
Received sexts	−0.26	0.17	0.678	0.77	0.23	2.61
Send sexts	0.34	0.50	0.480	1.40	0.55	3.59
Dissemination victim ²	0.93	5.68	0.017	2.53	1.18	5.44
Requested sext ²	0.31	0.77	0.380	1.36	0.69	2.69
Dissemination receipt ²	0.88	7.42	0.006	2.42	1.28	4.57
Dissemination ²	−0.14	0.10	0.757	0.57	0.35	2.15
Anxiety	0.06	6.86	0.009	1.07	1.02	1.12
Depression	0.01	0.04	0.836	1.01	0.96	1.05
Stress	−0.06	4.60	0.032	0.94	0.89	0.99
CBV	0.02	0.06	0.81	1.02	0.90	1.14
CBP	−0.08	1.63	0.20	0.92	0.81	1.05
Constant	−1.75	0.71	0.401	0.17		

¹Country coded Australia = 0, United States = 1.

²All other binary variables coded 0 = No, 1 = Yes.

health impacts only occur for individuals if they are indeed depicted on a OIBEV site, and not simply investigating their own depiction. Anxiety about potential depiction for women may drive visitation, but reasons for our findings related to stress are unclear. However, these findings may also be indicative of the time elapsed since visiting OIBEV sites, with any distress having dissipated in the interim. Further investigation of the immediate impacts of OIBEV victimization, and confirmation of whether someone was depicted, would be useful additions for advancing understanding of this form of image-based sexual abuse and the impact on victims.

We also analyzed the sample to determine unique factors associated with OIBEV site visitation overall and by gender. Overall, men, people from the United States, those who had requested sexts themselves, received disseminated sexts, and had their own sext disseminated to others were more likely to visit OIBEV sites than women, people from Australia, or those who had never had their own sexts disseminated. However, those who identified as previous cyberbullying perpetrators were less likely to visit OIBEV sites than those who had never cyberbullied. These associations differed somewhat by participant gender. Men who had disseminated sexts, received disseminated sext images, and were lower in anxiety and cyberbullying perpetration were more likely to have visited OIBEV sites than those who had not engaged in these behaviors. For women, increased likelihood of having visited OIBEV sites was associated with being United States residents, having experienced sext dissemination victimization, receiving disseminated images themselves, higher levels of anxiety, but lower levels of stress.

These findings are consistent with prior findings that sext dissemination behaviors themselves are associated with normalization through peer groups, including exchanging (both sending and receiving) disseminated images (Clancy et al., 2019, 2020), and suggest at least some pathways by which images may be shared to then be posted on OIBEV sites. Of note, Clancy et al. (2020) found that disseminated sext images are usually received from someone of a different gender, but shared or circulated to those of the same gender, which may reinforce gender norms (DeKeseredy and Schwartz, 2016) of sharing such images in social groups, including via OIBEV sites.

The only unique predictor to distinguish between OIBEV site visitation to “check out” images and seeing if one was depicted on the site was gender, with women nine times more likely than men to have visited OIBEV sites to see if they were depicted. Whilst other site visitation motivations were relatively infrequent, limiting analytical power, helping out friends was only nominated by women, self-gratification was only endorsed by men, whilst both curiosity and accidental visits were relatively evenly distributed between men and women. These findings provide support for contentions that OIBEV site visitation, at least for the purposes of “checking out” the images, seems to reinforce problematic gender norms, in which women are depicted for the gratification of men (DeKeseredy and Schwartz, 2016). Further, our findings also support conceptualization of image-based sexual abuse, at least in this form, as a gendered behavior, perpetrated by men against women. We do note the potential for nuanced differences in more passive by standing and observing behaviors, as opposed to those who actively

post images on these sites or rate those depicted, which was not specifically explored in this study. However, passive and voyeuristic viewing of images can still be seen as expanding the circle of those consuming the images, and as such, is still a form of image-based abuse, even if less active.

Considering intercultural differences, overall, United States respondents were more likely to have visited OIBEV sites than Australian participants, however, gender-based differences were more noticeable. In the hierarchical regressions, the combined demographic variables did not explain large amounts of variance, with sexting-related variables offering more explanatory power for OIBEV behaviors. Although our sample was not restricted to college or tertiary students, higher OIBEV frequencies in the United States may reflect higher engagement in tertiary residential social societies (e.g., sororities, fraternities) which are more common in United States institutions, and are associated with higher levels of OIBEV use (Maas et al., 2021).

Whilst study findings are novel and informative, some key limitations should be noted. In particular, this study was cross-sectional in design, and based on a convenience sample, and was not population representative for either nation, nor was it representative of broader cross-national groupings, all of which may limit generalizability of our findings. Further, participants were asked to self-report on their own behaviors which may impact accuracy. Whilst all efforts were made to ensure confidentiality of responses, and participants were non-identifiable, some may have been reticent to report engaging in behaviors which they deem at the least socially unacceptable, if not explicitly criminal. Additionally, many behaviors were measured at a dichotomous level, whilst our motivations for OIBEV visitation were relatively limited, and did not include specifically visiting sites to post images, consistent with the exploratory nature of this study. These factors are likely to reduce the power of our analyses. Lastly, some behaviors in this study were relatively infrequent, hence limiting power to investigation of the two most prominent visitation reasons.

Further investigation of OIBEV site visitation is warranted. Such research should focus on larger and potentially representative samples. Further, future research may benefit from more nuanced questionnaires which identify a broader range of OIBEV site uses from more actively pernicious site creation and posting of images, rating and commenting behaviors, through viewing the images of others and checking if oneself or one's friends are depicted. Such research will help to replicate and extend current results and inform prevention efforts.

This study has important implications for those engaged in developing and implementing programs to address forms of image-based sexual abuse. In particular, programs which seek to target and talk about cyberbullying and do not specifically delineate OIBEV as a form of cyberbullying may fail to address problematic OIBEV, as users do not seem to associate these behaviors themselves. Based on our findings, we recommend that image-based sexual abuse prevention programs focus on social and peer norms around the use of online images. Additionally, it is also recommended to explicitly reference OIBEV and “slutpages” as a form of image-based abuse in education and prevention

programs targeting adolescents and young adults, given the potential exposure and harms which could be associated.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Human Research Ethics Committee

Deakin University, Burwood, VIC, Australia. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

EC, BK, and MM: conceptualization and methodology. EC: formal analysis, data curation and analyses, and writing—original draft preparation. EC, BK, and DH: investigation and project administration. EC, BK, EM, MM, and DH: writing—review and editing. All authors contributed to the article and approved the submitted version.

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The Impact of Negative Mood on Event-Related Potentials When Viewing Pornographic Pictures

Charlotte Markert^{1,2,3}, Andreas M. Baranowski^{1,2,3}, Simon Koch^{1,2}, Rudolf Stark^{1,2,3} and Jana Strahler^{1,2,3*}

¹ Department of Psychotherapy and Systems Neuroscience, Psychology and Sport Science, University of Giessen, Giessen, Germany, ² Bender Institute of Neuroimaging, University of Giessen, Giessen, Germany, ³ Center for Mind, Brain and Behavior, Universities of Marburg and Giessen, Giessen, Germany

Background: Negative affective states may increase the risk for problematic pornography use. Underlying neurophysiological mechanisms are, however, not completely understood. Previous research suggests that the participants' emotional state may affect neural processing of sexual stimuli. The aim of this study was to investigate neural correlates of negative affect-induced alterations in sexual cue reactivity in healthy men. The moderating effects of habitual porn consumption, trait sexual motivation, and symptoms of cybersex addiction were also considered.

Method: Sixty-four healthy men engaged in a sexual cue reactivity task (passive viewing of explicit sexual pictures and neutral pictures depicting scenes of social interaction) during negative ($n = 32$) vs. neutral affect ($n = 32$), induced via tailored feedback on a performance task. Self-reported sexual arousal and event-related brain potentials indicated cue reactivity and motivated attention. Symptoms of cybersex addiction and trait sexual motivation were assessed with the help of the short Internet Addiction Test, adapted to online sexual activities, and the Trait Sexual Motivation Questionnaire.

Results: Negative feedback increased negative affect after the performance task. While sexual pictures compared to neutral pictures elicited significantly larger P300 and late positive potential (LPP) amplitudes, there was no general effect of negative feedback on sexual stimuli-related P300 and LPP amplitudes. In the negative feedback group, men with higher solitary sexual motivation levels showed higher P300/LPP difference amplitudes for sexual stimuli compared to men with lower levels of solitary sexual motivation. The opposite effect was found in the group with neutral feedback. There was no link to other aspects of trait sexual motivation and symptoms of cybersex addiction.

Conclusions: Results suggest that higher levels of solitary sexual motivation may enhance motivated attention toward sexual stimuli among men receiving negative performance feedback. Other characteristics of sexual behaviors and traits provided no exploratory value. Future studies extending onto men suffering from compulsive sexual behavior disorder will have to closer look at the neurophysiological bases of why and when some men develop an addictive pornography consumption.

Keywords: event-related potentials, motivated attention, negative affect, pornography addiction, pornography use, sexual cue reactivity

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*Correspondence:

Jana Strahler
jana.strahler@gmail.com

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INTRODUCTION

Digitalization has an impact on a wide range of areas of life, including sexual behaviors. Through mobile devices such as tablets or smartphones it is possible to consume pornography almost anytime and everywhere. Cooper (1998) described the three key characteristics of the Internet (“Triple-A Engine”: access, affordability, and anonymity), which increase the attraction and usage of internet pornography. Today, men between the ages of 35–50 are the largest consumer group (Blais-Lecours et al., 2016; Rissel et al., 2017), but regular usage is also seen among other groups including women (Baranowski et al., 2019; Herbenick et al., 2020), younger adults and adolescents from various socio-economic backgrounds (Mattebo et al., 2013, 2016; Bothe et al., 2020b). This previous research is not free from methodological shortcomings such as small and biased samples or questionable validity of assessment measures. Still, the increase of pornography consumption, particularly among younger people (Price et al., 2016), goes along with rising numbers of individuals who report a problematic or an addictive use with psychopathological consequences (Duffy et al., 2016). This calls for increased efforts to better understand the transition from a recreational to a pathological use, and to provide improved preventive and therapeutic interventions.

Several reviews have shown that, among healthy and clinical samples, visual sexual stimuli are perceived as highly rewarding (Gola et al., 2016b) and that brain areas associated with reward learning respond to sexual stimuli in a similar manner as they respond to other biologically relevant stimuli (Georgiadis and Kringelbach, 2012; Stoléro et al., 2012; Poepl et al., 2014; Strahler et al., 2018). While recreational pornography use focusses on experiencing satisfaction (Ross et al., 2012; Gola et al., 2016a; Wordecha et al., 2018), some people develop a shift toward over-frequent, uncontrolled use, which persists even though it causes disadvantages in interpersonal relationships or for work or leisure activities. If this reaches a clinically relevant level, Compulsive Sexual Behavior Disorder (CSBD) can be diagnosed according to the new classification in ICD-11 (World Health Organization, 2018). Main characteristic of CSBD is the persistent inability to control intense, repetitive sexual impulses or urges resulting in recurring sexual behavior. This pattern negatively affects personal, familial, social, educational and/or occupational areas of functioning. Indeed, the vast majority of consumers show a purely recreational use and problematic symptoms are exhibited in only a small minority. Most studies show a male preponderance regarding prevalence rates for CSBD with a sex ratio of ~1:4 (prevalence in women: 1–3%; prevalence in men: 4–11%; Rissel et al., 2017; Grubbs et al., 2019; Bothe et al., 2020a; Kowalewska et al., 2020). Studies show that addictive internet pornography use (for which there are numerous other terms, e.g., excessive pornography use, pornography addiction, pathological pornography use, etc.) is reported as the most frequent manifestation of CSBD (Reid et al., 2012; Engel et al., 2019a; Bothe et al., 2020a). In the present work, the term “addictive internet pornography use” is therefore used, except when similar but different constructs are addressed.

Different models have been proposed to better understand mechanisms underlying addictive pornography use, including models of motivation, emotion regulation, stage models, and integrated models. Reid et al. (2011) outline typical motives for pornography use, that is emotional avoidance, sexual curiosity, excitement seeking and sexual pleasure. In their sample of treatment-seeking hypersexual men, emotional avoidance, that is to use pornography to avoid unpleasant feelings and relieve stress, correlated positively with trait measures for emotional distress, anxiety, depression, and impulsiveness. This association has since been confirmed by other survey studies in non-treatment seeking young adults and men with hypersexual disorder (Engel et al., 2019b; Pettorruso et al., 2020). In a longitudinal study with adolescents, higher baseline levels for negative emotions and impulsivity predicted addictive pornography use 3 years later (Rousseau et al., 2020). Another study investigated changes of mood and sexual arousal before and after self-determined internet pornography use in a non-clinical male sample (Laier and Brand, 2017). The results showed usage-related mood and arousal changes suggesting reinforcing effects of pornography use. Additionally, participants with a stronger tendency toward cybersex addiction reported a generally worse mood, but greater mood increases were positively linked to the degree of addictive pornography use (Laier and Brand, 2017). Overall, data support theories which suggest emotional instability, impaired stress regulation and impulse control as a prominent pattern in hypersexual individuals (Reid et al., 2014).

The Interaction of Person-Affect-Cognition-Execution (I-PACE) model of specific internet-use disorders (Brand et al., 2016, 2019) distinguishes between earlier and later phases of addiction development with emotion regulation playing a pivotal role in all of them. In earlier phases, pornography use contributes to gratification (e.g., in the form of pleasure). Based on this experience, pornography use may be increasingly used for emotion regulation and thus becomes a reinforcing or perpetuating mechanism of pornography use (Laier and Brand, 2017). Through repeated and possibly increased pornography use, conditioning processes strengthen associations between external triggers and affective/cognitive responses which may lead to compensatory pornography use in response to negative affect and craving in later stages of addiction development.

Different models of addiction development [see also A-B-C model of hypersexual disorder from Stein (2008), or the Brain Disease Model of Addiction from Volkow et al. (2016)] emphasize and specify the role of neural substrates for emotion regulation and adaptation to negative affect and stress in the development of addiction. Research on neurobiological and neural underpinnings of (addictive) pornography use is, however, still rare. Initial neurobiological studies in individuals with addictive sexual behaviors suggest hypothalamic pituitary adrenal (HPA) axis dysregulation (Chatzittofis et al., 2016), oxytocin signaling (Boström et al., 2020), and heightened neuroinflammation (Jokinen et al., 2017) as possible pathophysiological mechanisms. In terms of neural correlates, studies focused on the activity in brain regions located in the reward network and the limbic system. Such studies revealed similar activation patterns for sexual stimuli as for

other drug stimuli (Love et al., 2015; Gola et al., 2016b; Kühn and Gallinat, 2016). Longer hours of internet pornography use correlated with lower gray matter volume in the right caudate nucleus and lower activity to sexual images in the left putamen in healthy men (Kühn and Gallinat, 2014). According to the authors, these findings may indicate a tolerance that has developed due to desensitization. Even fewer studies compared individuals with and without addictive pornography use. Voon et al. (2014) showed higher anterior cingulate cortex (ACC), ventral striatal, and amygdala activity as well as higher functional connectivity of the ACC–striatal–amygdala network during watching of sexually explicit cues in hypersexual individuals. Subjective sexual arousal ratings of pornographic pictures (Brand et al., 2011) as well as the ventral striatal response to preferred pornographic pictures were predicted by symptoms of cybersex addiction as measured by the short Internet Addiction Test Adapted to Online Sexual Activities (s-IATsex). A study by Klucken et al. (2016) found increased amygdala activity during appetitive conditioning with sexual stimuli in men with compulsive sexual behavior vs. healthy controls. This may be indicative of emotional dysregulation in individuals with addictive pornography use. In comparison, the results of a study by Gola et al. (2017) indicate that the anticipation of pornographic pictures is associated with stronger activation of the ventral striatum in persons with addictive pornography use, but not the response to the pornographic pictures themselves.

In addition to fMRI results, electroencephalography (EEG) studies confirm the arousing and motivationally salience nature of pornographic pictures. Presentation of those pictures compared to neutral pictures lead to heightened positive EEG components known to reflect stimulus salience and attentive processing, namely the P300 and the Late Positive Potential (LPP) in both healthy individuals and individuals self-identifying as having problems with regulating their sexual stimuli consumption (van Lankveld and Smulders, 2008; Steele et al., 2013; Prause et al., 2015a). While the P300 appears 300–500 ms post stimulus and is partly generated in the ACC, thus best measurable at centroparietal recording sites, the LPP extends beyond this and reflects sustained increases in attention (Hajcak et al., 2010). The LPP can best be localized at central, parietal, and occipital sites (Foti et al., 2009). Enhanced P300 and LPP elicited by addictive cues are well-replicated in other substance-related and behavioral addictions (Dunning et al., 2011; Wölfling et al., 2011). Such a hypersensitivity to pornographic pictures has been proposed to underlie addictive pornography use (Voon et al., 2014; Brand et al., 2019). The only two studies using EEG to investigate individuals with self-reported addictive pornography use, could however not find support for this assumption. In one study, addictive pornography use was unrelated to the P300 (Steele et al., 2013). Another study of the same research group found lower LPP amplitudes after passively watching pornographic pictures in individuals with addictive pornography use compared to healthy controls (Prause et al., 2015b).

In the search for possible psychological correlates of sexual cue reactivity and risk factors of addictive pornography use, symptoms of cybersex addiction, habitual porn use and trait sexual motivation appear most relevant given available literature.

As described above, prolonged pornography use in healthy men is associated with lower activity in response to pornographic pictures in the left putamen (Kühn and Gallinat, 2014). Whether something similar is also seen in CSBD individuals still remains to be investigated. Concerning sexual motivation, the findings are heterogeneous. In an all-female healthy sample, Demos et al. (2012) showed a positive association between higher sexual motivation and greater sexual cue reactivity in the brain's reward networks. By contrast, the P300 was inversely related to sexual motivation in individuals with addictive pornography use (Steele et al., 2013). However, the authors did not examine sexual motivation as a trait but as a current state. In a previous study in healthy men and women, our group demonstrated that trait sexual motivation correlated with nucleus caudatus activity (but no other ROI) when watching pornographic pictures (Strahler et al., 2018). But there were no significant associations between trait sexual motivation, the extent of porn use and neural responses of the nucleus accumbens toward pornographic pictures in healthy men (Stark et al., 2019).

To summarize, studies implicate considerably similar brain regions involved in addictive pornography use that is reward-associated brain regions like the striatum and nucleus accumbens, but also the amygdala, hippocampus, and hypothalamus. Whether there is also a critical role for the temporal dynamics underlying salience formation and attention allocation to sexual stimuli remains unclear. Evidence of emotion regulatory use of pornography playing a role in addiction development implies that a negative affective state may cater into the salience of and attention directed at pornographic material. Yet, negative mood related alterations in sexual cue reactivity as indicated by electrocortical potentials have not been studied. The purpose of the current study was therefore to investigate the neural correlates of negative affect-induced alterations in sexual cue reactivity in healthy heterosexual men via recording electro-cortical brain response during watching pornographic pictures. We hypothesized that negative affect will induce higher motivational attention, operationalized through the EEG parameters LPP and P300. Our second aim was to examine the moderating effects of habitual porn use, trait sexual motivation, and symptoms of cybersex addiction. Our hypothesis was that these moderators influence cue reactivity to pornographic pictures under negative affect. This may provide further evidence for the relevance of affect regulation in the development and maintenance of addictive porn use and CSBD.

MATERIALS AND METHODS

Participants

Healthy male adults were recruited for this EEG study via university e-mail newsletters, social media advertisement, and by directly addressing pedestrians on the university campus. The study was publicly labeled as study on “General cognitive ability and processing of sexual images.” Affect manipulation was not mentioned to the applicants. The true aims of the study were explained after completion of all experimental procedures. Eligibility criteria were proficiency in the German language to ensure comprehension of instructions and questionnaires,

male gender, absence of acute or anamnestic psychological, neurological, or somatic disorders and medication, right-handedness, body-mass-index between 18 and 35 kg/m², age between 18 and 45 years to minimize the impact of age-related changes in EEG (Hashemi et al., 2016), sexual attraction to females, and no daily alcohol consumption or illegal substance use within the last 6 months. Further, volunteers who underwent diagnostic assessment of their general cognitive ability in the past were excluded to ensure effectiveness of the affect manipulation using tailored feedback on a test for general cognitive ability. Usual EEG contraindications applied (being unable to sit still for a long time, wearing a pacemaker, hearing aids, suffering from claustrophobia, bald head or rasta curls). Initially, 72 men (mean age 24.81 years) were recruited into this trial and completed all study procedures. Due to poor EEG data quality, $n = 8$ data sets ($n = 4$ negative affect condition, $n = 4$ control condition) had to be excluded resulting in a final sample of 64 (mean age 24.94 years). Excluded participants did not differ significantly in age, body-mass-index, relationship status or any of the analyzed moderators from the remaining sample (all $p > .05$, using Mann-Whitney-U test and χ^2 -test, respectively). Participation was voluntary and all participants provided written informed consent. Data was collected in pseudonymized form with individual code words. Participants were compensated with either 8.00€ per hour or course credits. All experimental procedures were conducted in compliance with national legislation and the Declaration of Helsinki and approved by the local ethics committee (reference number: 2019-0005).

Procedures and Design

Interested men were first contacted *via* phone for the screening of eligibility criteria. Eligible men were invited for individual laboratory assessment and asked to avoid use of hair spray/hair gel on the date of the assessment. Study procedures took ~2 h and were conducted by two male experimenters in a quiet windowless room. Participants were randomly assigned into two equal-sized groups with one group undergoing negative affect induction and the other one remaining in neutral mood. Affect manipulation was conducted with tailored feedback on a test for general cognitive ability. Except for the differently tailored feedback, procedures were the same for both groups. Participants were neither aware which group they were assigned to nor that the cognitive test targeted at affect manipulation.

After giving informed consent, momentary affect as well as craving for pornography and masturbation was assessed as a baseline. Participants were prepared for EEG recording. Hereafter, affect manipulation was conducted by means of a negative feedback paradigm as described below. Subsequently, momentary affect and craving were assessed a second time. Participants, then, viewed the sexual cue reactivity paradigm while EEG was continuously recorded. Followingly, the EEG cap was removed and after that, momentary affect and craving were assessed a third time, stimuli were rated, and several questionnaires were answered by the participants. Finally, participants were compensated for participation, they were clarified about the tailored feedback and that their general cognitive ability has not been evaluated for real. In this context,

they were asked whether they questioned their test result during the examination and believed the cover story for the study (yes/no). A schematic depiction of the experimental protocol is shown in **Figure 1**.

Affect Manipulation

Participants completed three subtests of a German diagnostic tool for assessing general cognitive ability (Leistungsprüfsystem 2, LPS-2; Kreuzpointner et al., 2013). To mime an authentic execution, the LPS-2 subtests were conducted as instructed by the test manual. Completion of the subtests took 13 min in total. Participants' performance, however, was not evaluated in real terms. After a latency of 2 min, the participants were handed a predefined standardized feedback sheet. In the negative affect condition, participants received negative feedback, that is they received a feedback sheet indicating they had scored 2.9 out of 10.0 points coupled with the verbal statement that the result was below average. Participants in the neutral feedback group (neutral condition) received a feedback sheet indicating 6.8 out of 10.0 points coupled with the verbal statement that their result was slightly above average.

Sexual Cue Reactivity Paradigm

Thirty neutral and thirty pornographic pictures were presented in a passive viewing paradigm programmed with Presentation Version 20.0 (Neurobehavioral System Inc., Albany, CA, USA). All pictures were 31 cm wide, presented in color on a black background on a 27-inch monitor with 1,920 × 1,080 pixel resolution. All stimuli were derived from Kagerer et al. (2014). Pornographic pictures showed one male and one female adult engaging in partnered sexual behavior, that is oral, vaginal, or anal intercourse. No fetish-relevant content was depicted. In half of the pornographic pictures genitalia were clearly visible whereas in the other half genitalia were masked by bodies or objects. Female breasts were visible in all sexual pictures. Neutral pictures showed two or more fully clothed adult(s) in an everyday situation (e.g., engaging in conversation). Pictures were presented in three blocks. Each block contained all pictures in randomized order with the restriction that the same stimulus category could be presented a maximum of three times in succession. Therefore, each picture was presented three times for 1,000 ms, resulting in 180 stimulus presentations in total. Pictures were intercepted with a jittered presentation of a white fixation cross on black background between 2,000 and 3,000 ms. In total, the paradigm lasted between 9 and 12 min, on average 10 min and 30 s.

EEG Recording and Event Related Potential Data Reduction

Participants' electrocortical activity was continuously recorded with an active 32-channel amplifier (BrainVision actiChamp, Brain Products GmbH, Gilching, Germany) and 32 Ag/AgCl electrodes (EASYCAP GmbH, Herrsching, Germany). For attachment of electrodes participants wore an EEG cap (EASYCAP GmbH, Herrsching, Germany) which assured location of the electrodes in accordance with the international 10–20 system (Klem et al., 1999). Electrodes were attached to

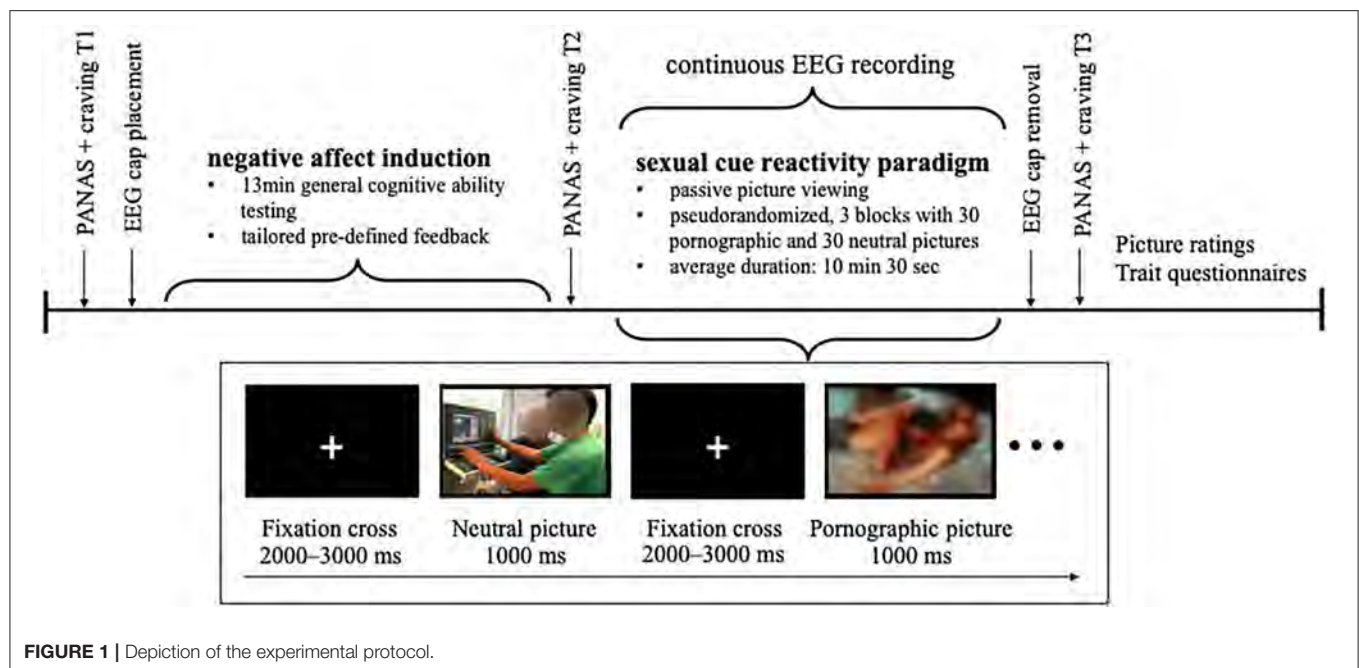


FIGURE 1 | Depiction of the experimental protocol.

the participants' scalp with an electrolyte paste. Impedances of all electrodes were kept below 10 k Ω . Electrode signal was recorded via BrainVision Recorder software (Brain Products GmbH, Gilching, Germany). Sampling rate was 500 Hz, no software filters were applied during recording. Ground electrode was Fpz and electrodes were referenced at Cz. Line noise was kept at minimum by instructing participants to remain calm and relaxed during the paradigm, and to let their gaze rest on the fixation cross between the image presentations.

Data were processed using BrainVision Analyzer 2.2 software (Brain Products GmbH, Herrsching, Germany). First, a high-pass filter of 0.001 Hz and a low-pass filter of 30 Hz were applied. Data were then corrected for ocular artifacts caused by eye blinks or saccades by computing Independent Component Analysis (ICA) and exclusion of components reflective of ocular artifacts. Following reverse ICA, data were visually inspected for remaining artifacts caused by body movements and corresponding epochs were excluded. EEG channels were then re-referenced to linked mastoid activity (TP9, TP10). Data were segmented, i.e., stimulus-locked from –500 to 2,499 ms post stimulus. Segments were baseline corrected from –500 to 0 ms (stimulus onset) and then averaged for the two image categories separately. On average, 85.43 ($SD = 6.23$) out of 90 segments were used to compute individual ERP. Taking into consideration that P300 and LPP temporal windows do partially overlap (Hajcak et al., 2010), P300 was defined as mean ERP amplitude from 300 to 500 ms and LPP as mean ERP amplitude from 500 to 800 ms post-stimulus onset. Defined intervals are in line with studies examining both ERP components following visual sexual stimuli (van Lankveld and Smulders, 2008; Han et al., 2018). Mean ERP amplitudes in the respective temporal windows were averaged across electrodes CP1, CP2, P3, Pz, P4. Electrode selection was based on visual inspection and is in line with findings, that both

ERP components are measurable best at centroparietal recording sites (Hajcak et al., 2010).

Self-Report Measures

Momentary Affect

Momentary affect was assessed with sum scores of the Positive and Negative Affect Schedule (Watson et al., 1988) prior to EEG cap placement, following tailored feedback, and following the sexual cue reactivity paradigm. The two PANAS subscales, namely *positive affect* and *negative affect*, consist of ten items each. The 20 items (negative e.g., upset, guilty, distressed, positive e.g., excited, inspired, proud) were each rated on a 5-point scale ranging from 1 = “very slightly or not at all” to 5 = “very much.” Internal consistency of the *positive affect* scale was acceptable to satisfying throughout assessment (baseline: Cronbach's $\alpha = .771$; after affect manipulation: $\alpha = 0.814$; after the sexual cur reactivity paradigm: $\alpha = 0.857$) and internal consistency of the *negative affect* scale was acceptable to satisfying throughout assessment as well (baseline: Cronbach's $\alpha = .735$, after affect manipulation: $\alpha = 0.870$, after the sexual cur reactivity paradigm: $\alpha = 0.835$, respectively).

Craving

Participants' momentary craving for pornography and masturbation was assessed by one question each (“To what extent do you currently feel the need to consume pornography/masturbate?”) added to the paper-pencil version of the PANAS. The two questions were answered using the same five-point scale ranging from 1 = “very slightly or not at all” to 5 = “very much.”

Stimuli Ratings

Following the sexual cue reactivity paradigm, participants rated all pictures on 9-point Likert scales regarding valence (*very*

unpleasant to very pleasant), arousal (calm and relaxed to very excited), and sexual arousal (not at all to very much). Pictures were rated in randomized order across participants. Participants viewed the pictures one by one again for a maximum of 10 s each, which were then succeeded by the three rating scales. Valence and arousal scales were visually anchored with the Self Assessment Manikin Scale (Bradley and Lang, 1994). Rating of sexual arousal was visualized by blocks of increasing size.

Trait Measures of Sexual Behaviors

Participants' symptoms of cybersex addiction were assessed with the short version of the Internet Addiction Test (Pawlikowski et al., 2013) adapted to online sexual activities (s-IATsex; Laier et al., 2013). Twelve items (e.g., "How often do you find that you stay on sex sites on the internet longer than you intended?") were answered on a scale from 1 = "never" to 5 = "very often" resulting in sum scores ranging from 12 to 60. Sum scores exceeding 30 are classified to be indicative of problematic sexual internet use. Internal consistency was acceptable with Cronbach's $\alpha = .788$. Trait sexual motivation was examined by means of the 45-item Trait Sexual Motivation Questionnaire (TSMQ, Stark et al., 2015). Out of 45 items in total only 35 items are analyzed to compute mean scores of trait sexual motivation. Participants were instructed to indicate to which extent each item described their sexual motivation using a six-point Likert scale ranging from 0 = "not at all" to 5 = "very much." The analyzed items make up four subscales of trait sexual motivation, namely *Solitary Sexuality* (10 items, Cronbach's $\alpha = .856$), *Importance of Sex* (15 items, Cronbach's $\alpha = .901$), *Seeking Sexual Encounters* (4 items, Cronbach's $\alpha = .838$), and *Comparison with Others* (6 items, Cronbach's $\alpha = .871$). The scale *Solitary Sexuality* indicates interest in sexual activities independent of a sexual relationship. Most of this scale's items relate to masturbation and the interest to be sexually aroused by pornographic material. The scale *Importance of Sex* includes several items about the need to be sexually active. The scale *Seeking Sexual Encounters* includes items asking about behaviors with the intention to get in contact with new potential sex partners. The scale *Comparison with Others* consists of items asking how an individual perceives their own sexual motivation compared to others'. Participants' answers were averaged across corresponding items to indicate an individual's mean score on each subscale. Participants' mean scores on each subscale were then averaged again to compute an individual's mean trait sexual motivation. Mean trait sexual motivation had excellent internal consistency with Cronbach's $\alpha = .918$. The single item "How much time did you spend viewing pornographic material within the last month" was used to assess habitual porn use (h/month). Participants were given the option to indicate the time spent viewing pornography either per day, per week, or per month. Answers were then transformed into hours per month (h/month) based on the definitions that a month consists of 30 days, a week of 7 days, a day of 24 h and an hour of 60 min. Sexual orientation of the participants was assessed with the seven-item Kinsey scale (Kinsey et al., 1948) ranging from 0 = "exclusively heterosexual fantasies and behaviors" to 6 = "exclusively homosexual fantasies and behaviors." All participants but one reported a predominantly

heterosexual orientation [Kinsey score 0: $n = 52$ (81.3%); Kinsey score 1: $n = 9$ (14.1%); Kinsey score 2: $n = 2$ (3.1%), Kinsey score 3: $n = 1$ (1.6%)]. Exclusion of the man indicating heterosexual and homosexual behaviors of about the same frequency (Kinsey score 3; negative affect condition) did not change results. This data set was therefore retained in the final analyses.

An accompanying questionnaire gathered data on age, body mass index (BMI), partnership status, smoking (yes, no), and alcohol consumption measured using the Alcohol Use Disorders Identification Test (AUDIT, Babor et al., 2001; Cronbach's $\alpha = .68$).

Statistical Analyses

Descriptive statistics are reported as mean and standard deviation (SD) or numbers and frequency. Group comparisons of continuous data were performed with Student's *t*-test, categorical variables were examined with the Fisher's exact test. To test for differences in sexual cue reactivity, mixed-model ANOVAs were performed with the between-factor group (negative affect, neutral affect) and the within-factor picture category (pornographic, neutral). Separate models were run for each EEG component (P300, LPP) and stimulus rating (valence, arousal, sexual arousal). Effect sizes were reported as Cohen's *d*, ϕ , and η_p^2 , respectively.

The moderating effects of habitual porn use, trait sexual motivation, and symptoms of cybersex addiction on neural responses toward pornographic pictures were exploratively evaluated. We used three-stage hierarchical regressions to predict neural responses toward pornographic pictures with group included at step 1, the group mean-centered trait sexual behavior factor (moderator) entered regression at step 2, and step 3 included the group X group mean-centered moderator product term. As criterion, we calculated the difference amplitudes between neural responses toward pornographic pictures minus neutral pictures. Plotting two-way interaction effects using the z-standardized scores and procedures described by Dawson (2014) eased interpretation of the assumed moderation. The relation between P300/LPP and trait sexual behavior factor was plotted for both conditions, neutral and negative feedback. All assumptions for regression analyses were met (linearity assumption; VIF < 2.39; Cook's distance < 0.02; normally distributed residuals as indicated from normal P-P-plots; homoscedasticity, i.e., no clear distribution pattern in scatterplot of residuals vs. predicted values). Each moderator was tested in a separate model. The level of significance was set at $\alpha = 0.05$ for all testing. All statistical analyses were carried out using SPSS v.23 for Mac (IBM Statistics, IBM Corporation).

RESULTS

Sample Description

The negative feedback group and the neutral feedback group did not differ in age, BMI, partnership, smoking status, alcohol consumption or pornography use (Table 1). The neutral feedback group reported significantly higher scores on the subscale *Importance of Sex* as well as the total score of the TSMQ, and

TABLE 1 | Baseline characteristics of total sample and separately for both groups.

	Total group (N = 64)	Negative affect group (N = 32)	Neutral affect group (N = 32)
Age (years), M ± SD	24.94 ± 4.92	24.97 ± 5.19	24.91 ± 4.73
BMI (kg/m ²), M ± SD	23.60 ± 2.89	23.12 ± 2.70	24.08 ± 3.03
Partnership (yes), n (%)	27 (42.2)	11 (34.4)	16 (50.0)
Smoking (yes), n (%)	16 (25.0)	8 (25.0)	8 (25.0)
AUDIT sum score, M ± SD	7.75 ± 4.62	8.25 ± 4.77	7.25 ± 4.49
Pornography use (h/month) M ± SD	6.29 ± 6.61	4.99 ± 4.11	7.58 ± 8.27
s-IATsex, M ± SD	19.89 ± 5.09	19.97 ± 4.46	19.81 ± 5.73
s-IATsex > 30, n (%)	3 (4.7)	0 (0)	3 (9.4)
TSMQ, M ± SD			
Solitary sexuality	3.44 ± 0.81	3.33 ± 0.74	3.56 ± 0.88
Importance of sex*	3.68 ± 0.76	3.49 ± 0.88	3.87 ± 0.58
Seeking sexual encounters	1.27 ± 1.05	1.03 ± 0.92	1.51 ± 1.12
Comparison with others	1.68 ± 1.09	1.51 ± 1.02	1.85 ± 1.15
Total score*	2.52 ± 0.66	2.34 ± 0.67	2.70 ± 0.61
Sexual image, M ± SD			
Valence	5.67 ± 1.03	5.52 ± 1.13	5.82 ± 0.91
Arousal	3.42 ± 1.67	3.29 ± 1.63	3.55 ± 1.72
Sexual arousal	4.33 ± 1.86	4.06 ± 1.97	4.60 ± 1.74
Neutral image, M ± SD			
Valence	5.05 ± 0.66	5.03 ± 0.69	5.08 ± 0.64
Arousal*	1.70 ± 1.01	1.43 ± 0.78	1.98 ± 1.13
Sexual arousal	1.05 ± 0.09	1.03 ± 0.06	1.07 ± 0.11

BMI, Body Mass Index in kilograms per weight squared; s-IATsex, short version of the Internet Addiction Test adapted to online sexual activities; TSMQ, Trait Sexual Motivation Questionnaire. * $p < .05$.

higher arousal during the rating of neutral pictures. Other group comparisons did not reach significance.

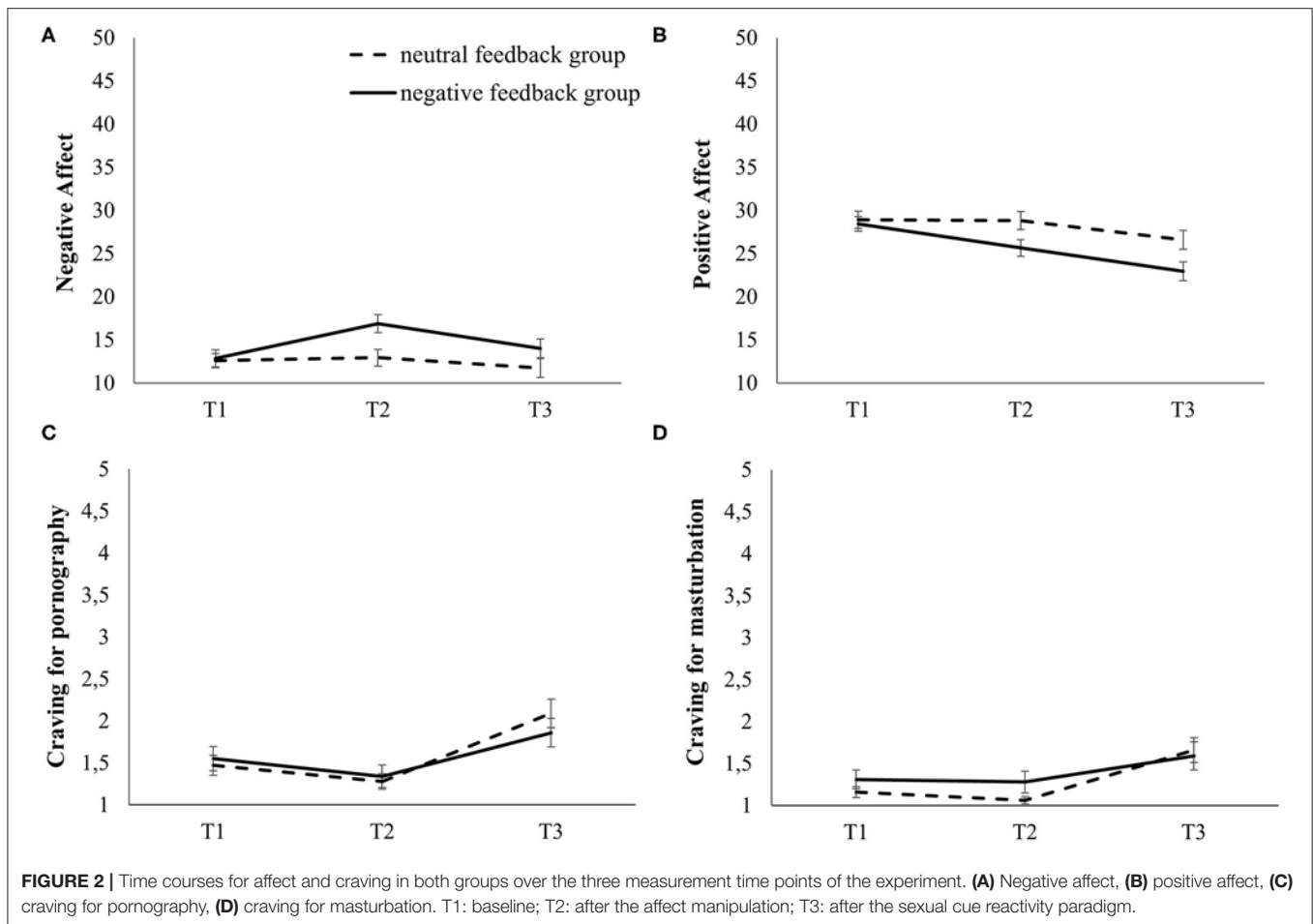
Manipulation Check

Performance-based feedback was believed by significantly fewer people in the negative feedback group ($N = 22$; 68.8%) than in the neutral feedback group [$N = 31$; 96.9%; $X^2_{(1)} = 8.89$, $p = .003$, $\phi = 0.373$]. There was no difference in baseline negative affect between the groups [$t_{(62)} = -0.44$, $p = .665$], but we found an increase in negative affect [$F_{\text{time}(1.7, 108.7)} = 15.65$, $p < .001$, $\eta_p^2 = 0.202$], particularly in the negative feedback group [$F_{\text{time} \times \text{group}(1.7, 108.7)} = 8.94$, $p < .001$, $\eta_p^2 = 0.126$]. Subsequent simple contrasts confirmed an increase from baseline to post-feedback, and a return to baseline level after the sexual cue reactivity paradigm in the negative feedback group while levels in the neutral feedback group appeared stable (see **Figure 2A**). Regarding the manipulation of positive affect, there was no difference in baseline levels between groups [$t_{(62)} = 0.36$, $p = .720$]. We found a decrease in positive affect [$F_{\text{time}(2.0, 122.8)} = 32.75$, $p < .001$, $\eta_p^2 = 0.346$], particularly in the negative feedback group [$F_{\text{time} \times \text{group}(2.0, 122.8)} = 6.14$, $p = .003$, $\eta_p^2 = 0.090$]. Subsequent simple contrasts confirmed a decrease from baseline to post-feedback, and still declining levels after the sexual cue reactivity paradigm in the negative feedback group. Levels in the neutral feedback group appeared stable from baseline to post-feedback, but there was a decline after the sexual cue reactivity paradigm (see **Figure 2B**).

The analyses regarding craving for pornography (of note: 3 missings in the negative feedback group) revealed small but significant changes over time [$F_{\text{time}(1.6, 96.7)} = 28.71$, $p < .001$, $\eta_p^2 = 0.327$] without differences between the feedback groups [$F_{\text{time} \times \text{group}(1.6, 96.7)} = 1.92$, $p = .160$, $\eta_p^2 = 0.031$]. Simple contrasts confirmed a small decrease from baseline to post-feedback, but an increase after the sexual cue reactivity paradigm (**Figure 2C**). There were small but significant changes over time regarding the craving for masturbation [of note: 3 missings in the negative feedback group; $F_{\text{time}(1.4, 84.5)} = 16.65$, $p < .001$, $\eta_p^2 = 0.220$] without differences between the feedback groups [$F_{\text{time} \times \text{group}(1.4, 84.5)} = 1.55$, $p = .220$, $\eta_p^2 = 0.026$]. Subsequent simple contrasts indicated stable levels from baseline to post-feedback, but an increase after the sexual cue reactivity paradigm (**Figure 2D**).

Sexual Cue Reactivity

The mixed-model ANOVA with the between-factor group (negative affect, neutral affect) and the within-factor picture category (pornographic picture, neutral picture) showed substantial stronger P300 amplitudes toward pornographic pictures compared to neutral ones [$F_{\text{category}(1.0, 62.0)} = 362.5$, $p < .001$, $\eta_p^2 = 0.854$], but the groups did not differ [$F_{\text{category} \times \text{group}(1.0, 62.0)} = 2.06$, $p = .157$, $\eta_p^2 = 0.032$; see **Figure 2**]. In general, the P300 levels were comparable between the groups [$F_{\text{group}(1, 62)} = 2.58$, $p = .114$, $\eta_p^2 = 0.040$].



The results of the mixed-model ANOVA for LPP amplitudes displayed analogous results with substantial stronger LPP amplitude toward pornographic pictures compared to neutral ones [$F_{\text{category}(1.0, 62.0)} = 251.20, p < .001, \eta_p^2 = 0.802$], no significant differences between groups [$F_{\text{category} \times \text{group}(1.0, 62.0)} = 0.42, p = .522, \eta_p^2 = 0.007$; see **Figure 3**], and comparable LPP levels between the feedback groups [$F_{\text{group}(1, 62)} = 2.28, p = .136, \eta_p^2 = 0.036$].

Compared to neutral pictures, pornographic pictures were rated as more positive, more arousing and more sexually arousing (all $F > 15.1, p < .001$; valence: $\eta_p^2 = 0.196$; arousal: $\eta_p^2 = 0.519$; sexual arousal: $\eta_p^2 = 0.767$). None of the picture ratings differed between the groups (all $F < 1.23, p > .273$).

Moderator Analyses

Hierarchical multiple regressions indicated that neither pornography use (hours/month) nor symptoms of cybersex addiction (s-IATsex) or their interaction with group contributed significantly to the regression model (all $p > .100$, not shown). The same was true for TSMQ subscales (all $p > .078$) except the *Solitary Sexuality* subscale. Here, step-wise regression first revealed that group did not contribute significantly to the regression model, $F_{(1,62)} = 2.06, p = .157$, accounting for

3.2% ($R^2_{\text{adjusted}} = 0.017$) of the variation in P300 difference amplitude. Introducing *TSMQ Solitary Sexuality* did not explain significant additional variation (2.3%), $F_{(1,61)} = 1.51, p = .224$. When the interaction was added in stage three of the regression model, the interaction was predictive of the P300 difference amplitude. Together, the predictors accounted for 15.0% ($R^2_{\text{adjusted}} = 0.108$) of the variance in P300 difference amplitude, $F_{(3,60)} = 3.54, p = .020$ (**Table 2**). Likewise, LPP difference amplitudes were not predicted by the groups. The stage one regression model was not significant, $F_{(1,62)} = 0.42, p = .522$, accounting for 0.7% ($R^2_{\text{adjusted}} \leq 0.001$) of the variation. No significant additional variation (4.4%) was explained when adding *TSMQ Solitary Sexuality*, the change in R^2 was not significant, $F_{(1,61)} = 2.36, p = .129$. In step 3, the interaction was predictive of the LPP difference amplitude and all three predictors explained 10.6% ($R^2_{\text{adjusted}} = 0.061$) of the variation in LPP difference amplitudes, $F_{(3,60)} = 2.36, p = .080$. **Figure 4** illustrates that in the negative feedback group, men with higher solitary sexual motivation levels showed higher P300/LPP difference amplitudes compared to men scoring lower on this subscale. This was contrasted by results for the neutral feedback group. Here, higher solitary sexuality was related to lower difference amplitudes.

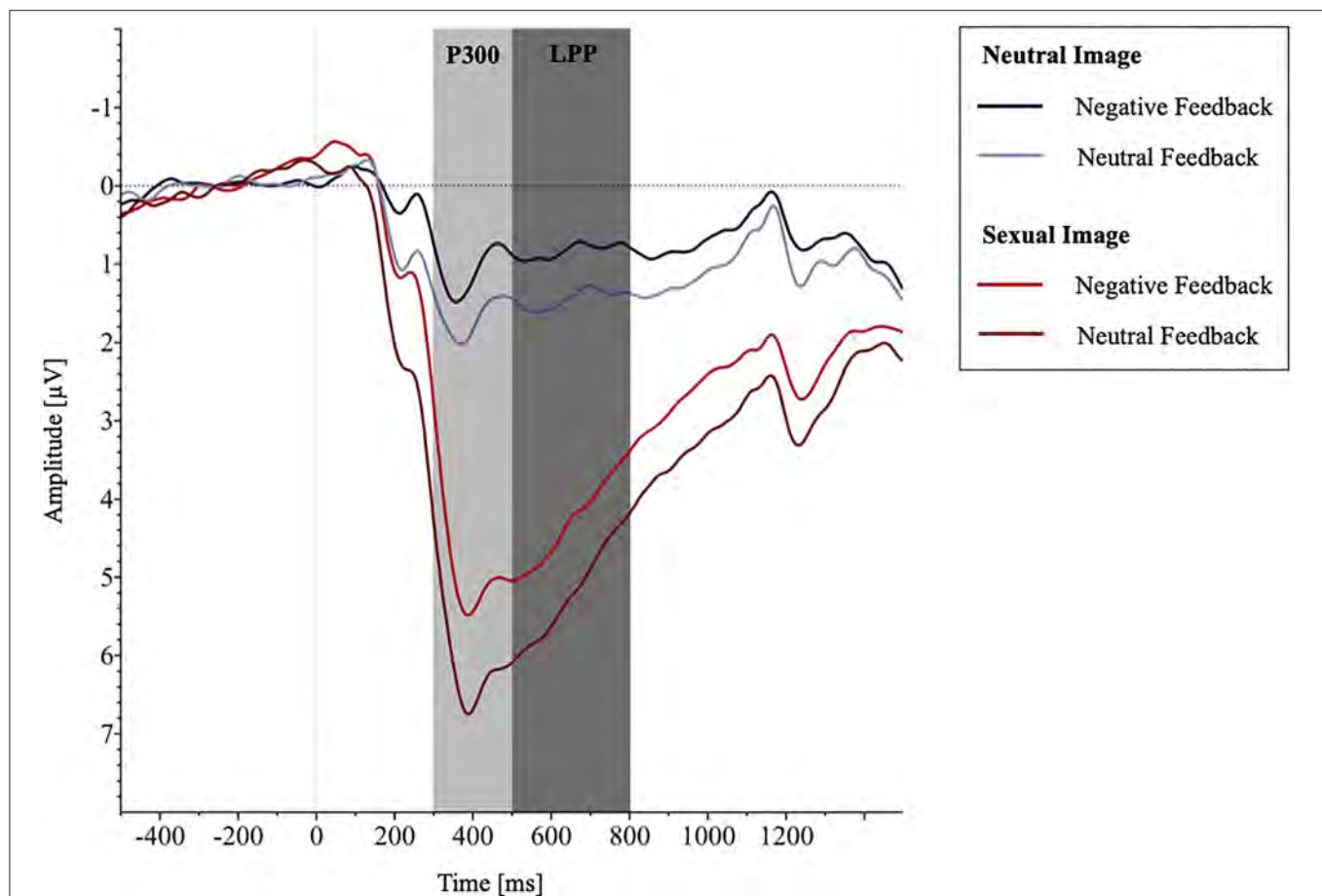


FIGURE 3 | The grand average waveforms averaged across channel CP1, CP2, P3, Pz, and P4 showing the potentials produced in response to the presentation of sexual vs. neutral images depending on group allocation.

DISCUSSION

In this healthy and heterosexual male sample, results confirmed the effectiveness of both negative affect manipulation and sexual cue reactivity as indicated by time-dependent changes in self-reported affect and craving ratings. While there were stronger neural responses toward pornographic pictures as compared to neutral ones, there was no effect of negative feedback. Of the moderators examined, only *Solitary Sexuality* as an aspect of trait sexual motivation had a moderating effect on the neural response, whereas symptoms of cybersex addiction or the extent of pornography use were unrelated. In the neutral feedback group, individuals with higher levels of *Solitary Sexuality* showed smaller amplitude differences of the P300 and the LPP to pornographic pictures in relation to neutral pictures, whereas the opposite was true for individuals with higher levels of *Solitary Sexuality* in the negative feedback group.

The significant increase in negative affect and decrease in positive affect following negative performance feedback provide significant evidence that the affect manipulation succeeded in a hypothesis-consistent way. In both groups, there was a decrease in craving for pornography and masturbation after performance

feedback and a slight increase after the sexual cue reactivity paradigm. However, the groups did not differ in affect and craving responses. This may be traced back to a bottom effect and relatively low scores for negative affect and craving, respectively. Despite this rather low subjectively rated cue reactivity, stronger positive ERP components (for both the P300 and LPP) emerged in response to pornographic pictures compared to neutral pictures. This was consistent with our hypotheses and with prior studies (Schupp et al., 2004, 2006; Hajcak et al., 2010). Both the LPP and the P300 are discussed as indicators of motivational attention (van Lankveld and Smulders, 2008; Steele et al., 2013; Prause et al., 2015a), which in this study argues for higher attention toward pornographic pictures compared to neutral pictures. Correspondingly, pornographic pictures were rated as more pleasant, more arousing, and more sexually arousing than neutral pictures. However, we did not find significant differences between the two feedback groups (neutral, negative) for either ERPs or picture ratings. Consequently, negative affect induction had no significant effect on motivational attention or subjective evaluation of pornographic pictures in our study.

The findings that negative affect has no effect on ERPs and subjective ratings when viewing pornographic pictures

TABLE 2 | Multiple regression on late positive potential amplitudes for pornographic minus neutral pictures based on TSMQ solitary sexuality.

	<i>B</i>	<i>SE</i>	β	<i>p</i>	<i>R</i> ²	<i>R</i> ² change
P300						
<i>Step 1</i>					0.032	0.032
Group	−0.620	0.432	−0.179	0.157		
<i>Step 2</i>					0.055	0.023
Group	−0.620	0.430	−0.179	0.155		
Solitary Sexuality	0.331	0.269	0.153	0.224		
<i>Step 3</i>					0.150	0.095*
Group	−0.620	0.412	−0.179	0.137		
Solitary Sexuality	−0.235	0.338	−0.109	0.489		
Interaction	1.351	0.522	0.404	0.012		
LPP						
<i>Step 1</i>					0.007	0.007
Group	−0.029	0.457	−0.082	0.522		
<i>Step 2</i>					0.044	0.037
Group	−0.294	0.452	−0.082	0.518		
Solitary Sexuality	0.435	0.283	0.193	0.129		
<i>Step 3</i>					0.106	0.062*
Group	−0.294	0.441	−0.082	0.507		
Solitary Sexuality	−0.042	0.362	−0.019	0.908		
Interaction	1.138	0.559	0.384	0.046		

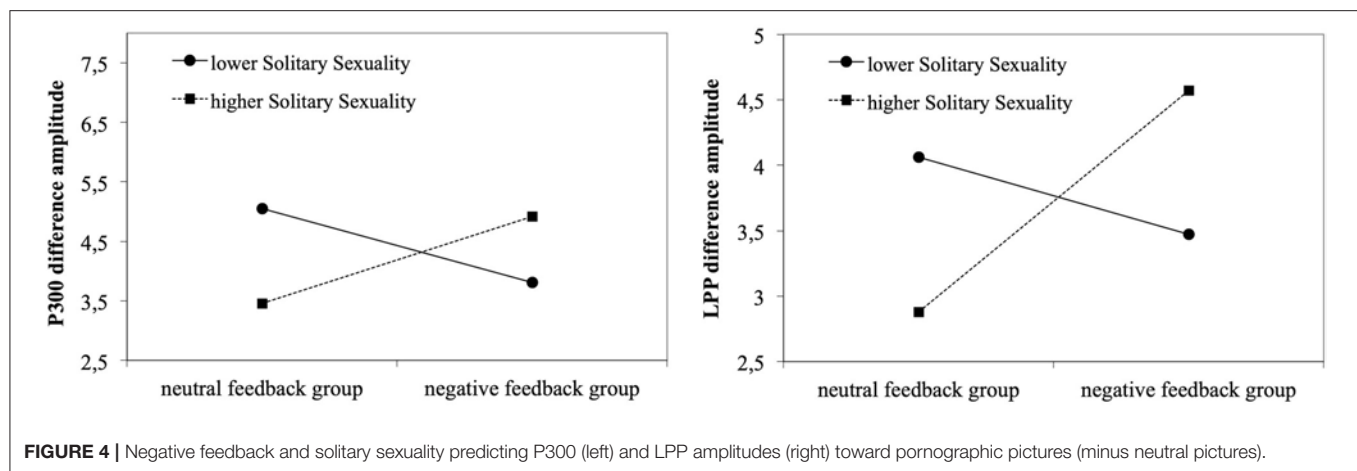
N = 64; Group is coded neutral feedback = 0 and negative feedback = 1; *B*, unstandardized coefficient; *SE*, standard error of *B*; β , standardized coefficient; P300, positive potential 300–500 ms post stimulus; LPP, late positive potential 500–800 ms post stimulus. **p* < .05.

complements the findings of previous studies using other methods. Carvalho et al. (2017) also found no effect of negative affect on visual attention toward pornographic pictures, assessed via eye-movement tracking, in a healthy sample of men and women. In addition, Janssen et al. (2020) found no effects of negative affect induction on physiological (penile tumescence), nor on subjective sexual arousal in hypersexual as well as non-hypersexual homosexual men. These null findings may be related to the flexibility of coping mechanisms in healthy participants, so that an affect-induced effect on the attention toward and the rating of pornographic pictures is only evident in samples with a more severe clinical expression of CSBD. From previous studies, it could be argued that negative affective states, like depression, generally reduce sexual interest and sexual cue reactivity (Bancroft et al., 2003). In some individuals, however, negative affect increases sexual behaviors, what may thus be argued to constitute a symptom of CSBD. Similar to this, missing effects of negative mood on penile tumescence in the Janssen study are discussed to be due to the sample's heterogeneity or there may be subgroups of hypersexual men with different underlying psychopathological mechanisms.

The results of the exploratory hierarchical multiple regressions revealed that neither the extent of pornography use, nor symptoms for cybersex addiction explained neural variance, i.e., neural responses toward pornographic pictures minus neutral pictures. This finding is consistent with previous study results. In

their study investigating individuals with self-reported addictive pornography use, Steele et al. (2013) also found that the P300 did not correlate with addictive pornography use. In another study, participants with self-reported addictive pornography use showed lower LPP amplitudes than control participants (Prause et al., 2015b). However, the latter study involved participants who reported relatively low levels of addictive pornography use who either already had less pronounced levels from the onset of their addiction or had already reduced their use. Another study from Stark et al. (2019) showed no significant correlations between the level of pornography use and neural responses to sexual stimuli in young health men and women. The authors discuss that the processing of sexual stimuli in healthy individuals may be subject to a strong evolutionary biological influence. Given previous assumptions on addictive pornography use, we would have expected a correlation between hypersensitivity to pornographic stimuli and measures of cybersex addiction (Voon et al., 2014; Brand et al., 2019). But sexual traits such as habitual pornography use or addictive symptoms may only slightly influence the processing of sexual stimuli in healthy individuals and clinical samples would be needed to investigate these abnormalities. Of note, the scores for cybersex addiction in the current study are comparable to the scores in the validation study (Laier et al., 2013). Three participants (all from the neutral feedback group) reported values that, according to Pawlikowski et al. (2013), indicate problematic pornography use. This result creates variance between groups that is not attributable to the affect manipulation and thus reduces its effect. As a note, excluding these individuals did not change mixed-model ANOVA findings or regression analyses of the moderators pornography use and cybersex addiction.

For trait sexual motivation, the current study showed a significant interaction between the *Solitary Sexuality* subscale of the TSMQ and group membership (neutral feedback group vs. negative feedback group) with regard to the amplitude difference between pornographic and neutral pictures. In the neutral feedback group, individuals with higher expression of *Solitary Sexuality* responded with smaller amplitude differences (pornographic picture minus neutral picture) of the P300 and the LPP component, whereas in the negative feedback group, individuals with higher expression of *Solitary Sexuality* responded to pornographic pictures with higher amplitude differences of the P300 and the LPP. A higher amplitude difference could be an indicator of sexual hyperresponsiveness, whereas a lower amplitude difference could indicate sexual hyporesponsiveness. The *Solitary Sexuality* subscale consists of items assessing the relationship-independent interest in pornography or sexual fantasies and interest in sexual activities such as masturbation (Stark et al., 2015). The interaction result suggests that individuals with higher levels of *Solitary Sexuality* may present stronger motivational attention to pornographic stimuli during negative affect, which could be indicative of higher sexual reward sensitivity. Whether such a link between higher relationship-independent interest in sexual activities and hyperresponsivity to pornographic stimuli under negative affect underlies addictive pornography use, has now to be shown in clinical samples. Interestingly, the graphic illustration of this



interaction also indicated that men scoring lower on *Solitary Sexuality* responded with higher amplitude differences under neutral feedback. For these men, pornographic images seem to represent a stronger motivationally relevant stimulus than for men with a higher relationship-independent interest in sexual activities. Overall, the effect of negative affect on cue reactivity was found to dependent on the level of *Solitary Sexuality*. At low levels of this trait, negative affect has a dampening effect on cue reactivity, while at higher levels it has an enhancing effect. The result of the relationship between the neural correlates and sexual motivation is consistent with findings of previous fMRI studies. Stark et al. (2019) found a positive association between sexual motivation and neural responses to the contrast between sexual and neutral stimuli in the occipital/parietal region. Consistent with this, the study of Strahler et al. (2018) reported positive associations between sexual motivation and caudate nucleus activity. What needs to be added here is that the exclusion of the three men self-reporting problematic pornography use led to an in this case significant main effect of TSMQ *Seeking Sexual Encounters* on LPP difference amplitudes ($B = -0.671$, $\beta = -0.354$, $p = .045$). Individuals with higher expression of *Seeking Sexual Encounters* responded with smaller amplitude differences possibly indicating sexual hypo-responsiveness. We do not want to interpret this post analysis too prominently but a process of habituation to greater sexual experiences may explain this (Bancroft et al., 2009).

Limitations and Suggestions for Future Studies

We have to mention some important limitations of the current study. Since participants completed the trait questionnaires after the cue reactivity paradigm, it cannot be ruled out that the affect induction had an impact on the completion of the questionnaires. This should be avoided in future studies by changing the study procedure accordingly. In addition, it is possible that viewing pornographic material evokes feelings of shame (or other negative feelings) in recipients which then again may impact how pornographic material is attended to

(Maskeliunas and Raudonis, 2016). For ethical reasons, it was mentioned at the beginning of the recruitment process that this study is about the processing of sexual images. This may have introduced some selection bias as men who feel, e.g., ashamed when watching pornographic material would not participate. Whether the current sample felt ashamed throughout testing has not been evaluated, though the pornographic stimuli were rated with an average valence of 5.67 indicating neutral to positive feelings. While shame should not have played a role in the testing of our hypotheses, this may limit validity of findings for the general population. The generalizability of the results is also limited by the fact that this study focused on an all-male, healthy, heterosexual sample given the known gender differences in habitual pornography consumption, experienced problems with pornography consumption, and gender-specific interactions between negative affect and sexual reactivity (Cooper et al., 1999; Hald, 2006; Lykins et al., 2006; Ross et al., 2012; Carvalho et al., 2017). In addition, pornographic pictures depicted heterosexual content due to known effect of sexual orientation on brain responses toward pornographic pictures (Paul et al., 2008). Moreover, the laboratory setting may not only limit the transferability of the results to everyday life but could also bias self-report data (e.g., shame, social desirability). The choice of the affect induction can be regarded as a strength. Comparable to everyday situations, the performance test involves ego-involvement of the participants (Nummenmaa and Niemi, 2004) and compared to other affect induction methods (e.g., music, videos) they did not know that their affect was manipulated. At the end of the survey, significantly more participants from the negative feedback group compared to the neutral feedback group reported that they did not believe the cover story. The hypothesis-compliant decrease in positive affect and increase in negative affect nevertheless suggest that the cover story even if doubted still affected the participants. A possible explanation for these contradictory data could be that the questioning of the cover story occurred later. Manipulating task difficulty instead of manipulating feedback may improve the credibility of such cover stories in future studies (Nummenmaa and Niemi, 2004).

Conclusions

The results support a role for solitary sexual motivation in motivated attention toward pornographic pictures among men receiving negative performance feedback. From this findings, some aspects of trait sexual motivation might be understood as factors predisposing to increased motivated attention toward pornographic cue stimuli under negative mood. Findings partly support theories which suggest pornography use to be increasingly used for emotion regulation, which then becomes a reinforcing or perpetuating mechanism for repeated and possibly increased pornography use. Other characteristics of sexual behaviors and traits provided no exploratory value and there was no general effect of negative affect in the processing of pornographic pictures. Since aspects such as the extent of pornography consumption or symptoms of cybersex addiction only become of relevance at a clinical stage, patient studies are necessary to explore neurophysiological mechanisms of CSBD. Overall, findings suggest reinforcing effects of pornography use and contribute to our understanding of neuropsychological mechanisms of sexual cue reactivity and addiction development.

DATA AVAILABILITY STATEMENT

The dataset presented in this study can be found in an online repository. The name of the repository and accession link (URL),

and doi can be found below: JLUpub <http://dx.doi.org/10.22029/jlupub-12.2>.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the local ethics committee of the Department of Psychology and Sports Science, University of Giessen, Giessen, Germany (reference number: 2019–0005). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JS, SK, and RS conceived the study. SK collected the data. JS, SK, and CM analyzed the data and drafted the manuscript. JS, SK, AB, CM, and RS interpreted the data and revised the article for important intellectual content. All authors contributed to the article and approved the submitted version.

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Unsolicited Pics and Sexual Scripts: Gender and Relationship Context of Compliant and Non-consensual Technology-Mediated Sexual Interactions

Erin Leigh Courtice*, Konrad Czechowski, Pari-Gole Noorishad and Krystelle Shaughnessy

Faculty of Social Sciences, School of Psychology, University of Ottawa, Ottawa, ON, Canada

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Johanna M. F. Van Oosten,
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Rohangis Mohseni,
Technische Universität
Ilmenau, Germany
Anja Schultze-Krumbholz,
Technical University of
Berlin, Germany

*Correspondence:

Erin Leigh Courtice
ecour048@uottawa.ca

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Technology-mediated sexual interaction (TMSI) refers to any partnered interaction that involves sending or receiving self-created, sexually explicit content using communication technology (e. g., sexting, cybersex). Most research on TMSI assumes that experiences are desired and consensual. However, it is likely that some people do not desire all their TMSI experiences but consent to them anyways (*compliance*), or experience *non-consensual* TMSIs. People also engage in TMSIs with different types of partners. According to the traditional sexual script (TSS), other-gender attracted women and men's non-consensual TMSI experiences should differ overall and depending on the relationship context of the experience. The goal of this study was to examine the role of sexual scripts in other-gender attracted women and men's non-consensual and compliant TMSI experiences with committed romantic partners (CRPs), known non-partners (KNPs), and strangers (Ss). Women ($n = 331$) and men ($n = 120$) completed an online survey with questions about lifetime prevalence of experiencing seven types of compliant and non-consensual TMSIs in each relationship context. Results of mixed ANOVAs revealed significant interactions: overall, more participants reported compliant TMSI with CRPs. More women than men had received a non-consensual TMSI from someone they were not in a committed relationship with, and more men than women reported sending non-consensual TMSIs to a stranger. Tests of unpaired proportions suggested that the prevalence of sending and receiving non-consensual TMSIs was discordant in the KNP and S contexts: both women and men received more non-consensual TMSIs from KNPs and Ss than the other-gender reported sending. Our findings suggest that gendered sexual scripts are evident in some, but not all, aspect of other-gender attracted women and men's compliant and non-consensual TMSI experiences.

Keywords: technology-mediated sexual interaction, sexting, sexual compliance, sexual consent, gender differences, relationships, traditional sexual script, token resistance

INTRODUCTION

Over the past two decades, people's use of digital technology for interpersonal sexual communication has become common (Benotsch et al., 2013). We use the term *technology-mediated sexual interaction* (TMSI) to refer to any interaction with a specified other person(s), that includes sending and/or receiving self-created, sexually explicit content using communication technology (Courtice and Shaughnessy, 2017). Technology-mediated sexual interaction is a behavioral domain that integrates popular constructs such as sexting, cybersex, and phone sex. Researchers have found a wide prevalence of TMSI in research with young adults (ranging from <25% to over 80% of all participants; e.g., Ferguson, 2011; Delevi and Weisskirch, 2013). This wide range is likely due in part to limitations in evaluating the context of TMSI. Specifically, people's TMSI activities can be: (i) desired and consensual (*consensual*); (ii) undesired and consensual (i.e., *compliant*); and/or (iii) undesired and non-consensual (i.e., *non-consensual*; Döring, 2014; Drouin and Tobin, 2014; Morelli et al., 2016; Krieger, 2017). People also engage in TMSI with committed romantic partners, known non-partners (someone who is known, but not a committed partner; e.g., casual sex partner), and strangers—but may do so at different prevalence rates (Shaughnessy and Byers, 2014). Sexual script theory suggests that women and men's experiences with non-consensual TMSIs may differ, such that women receive, and men send, more non-consensual TMSIs overall (Shaughnessy and Byers, 2014; Courtice and Shaughnessy, 2018). Information about the consent, partner, and gender context of TMSI will clarify the prevalence of TMSI overall and improve knowledge on the circumstances in which TMSI may lead to different outcomes. Thus, the purpose of this study was to examine cisgender, other-gender attracted¹ women and men's non-consensual and compliant TMSI experiences with committed romantic partners, known non-partners, and strangers.

Prevalence of TMSI

It appears likely that TMSI is a common experience among young people and adults. Researchers have examined the prevalence of various forms of TMSI—particularly, cybersex and sexting. Overall, researchers have found conflicting information about the proportion of people who have engaged in some form of TMSI. For instance, in their 2017 systematic review of TMSI research, Courtice and Shaughnessy found that the reported prevalence estimates of TMSI among young adults range from 20.5% in a sample of American 16–25 year-olds (Ferguson, 2011) to 89.1% in a sample of American 18–30 year-olds (Delevi and Weisskirch, 2013). In their recent meta-analysis, Mori et al. (2020) found that the mean prevalence for sexting among emerging adults was 38.3% for sending, 41.5% for receiving, and 47.7% for exchanging sexts. Among adolescents, reported TMSI prevalence estimates range from 4.6% in a sample of American 10–15 year-olds (Rice et al., 2014) to 57.1% in a sample of Belgian 15–18 year-olds (Van

Ouytsel et al., 2014). In their 2018 meta-analysis, Madigan and colleagues found that the mean prevalence for sexting among adolescents was 14.8% for sending and 27.4% for receiving sexts. These aforementioned ranges and mean prevalence rates do not take into account the consent or relationship context of TMSI. Indeed, it is not currently clear what proportion of people's TMSI experiences are fully desired and consensual.

Consent Context of TMSI

Compliant TMSI

People can have TMSI experiences that are *compliant*: consented to, but not desired, by at least one person involved in the interaction. In our review of the research, we found only one study in which researchers distinguished between TMSIs that are enthusiastically consented to vs. compliant. Drouin and Tobin (2014) found that about half (52.3%) of their cisgender men and cisgender women in committed relationships had ever engaged in compliant sexting with current or previous partners. This finding is consistent with offline research that suggests that sexual compliance may be slightly higher for adults in committed romantic relationships compared to prevalence estimates that do not consider relationship context (e.g., Vannier and O'Sullivan, 2010). For instance, among a sample of sexually active college students, prevalence estimates of sexual compliance range from 6 to 38% (Vannier and O'Sullivan, 2010; Viscione, 2015); in Vannier and O'Sullivan's (2010) a daily diary study, 46% of heterosexual people in committed relationships reported sexual compliance at least once over a 2-week period. To our knowledge, no researchers have examined the prevalence of compliant TMSIs outside of the committed relationship context. Thus, it is unclear how common or uncommon compliant TMSI experiences are.

Non-consensual TMSI

There are several ways that TMSIs can be *non-consensual*. First, like offline sexual activity, people can be the victim (or recipient) of sexual activity for which they did not explicitly consent. Conversely, people can also be the perpetrator (or sender) of sexual activity that was not consented to. In other words, just like someone can sexually assault (and be sexually assaulted), someone can also send (and receive) non-consensual TMSIs. Second, the "technology-mediated" nature of TMSI yields new forms of non-consensual activities. Recently, Mori et al. (2020) defined non-consensual sexting as "forwarding of sexts without consent and those who were victims of the forwarding of sexts without consent." This definition is narrow; there are other forms of non-consensual TMSI, including when someone shares a TMSI that was sent to them, without the sender's permission (non-consensual sharing) and when someone posts a TMSI that was sent to them online, without the sender's permission ("revenge porn" or non-consensual posting). It is possible that some people actually share or post TMSIs that they have received non-consensually as a way to respond to, perhaps cope with, this experience. Essentially, when someone receives a non-consensual TMSI, they may cope with that experience by involving others, sharing it to seek support, or posting it to shame the person who sent it (e.g., Waling and Pym, 2019; Naezer and van Oosterhout, 2020). Although all of these activities are distinct, they all have

¹We use the term "other-gender attracted" so as not to exclude/erase those who are attracted to people that do not share their gender identity, but who are not heterosexual—for example, people who identify as bisexual, pansexual, and/or queer.

something in common: one person has not provided consent for the activity to occur.

Few researchers have examined the consent context of TMSI within studies on sexting or cybersex. In recent literature reviews, Krieger (2017) noted that only 28.1% of articles explicitly included non-consensual acts in researcher's operational definitions of sexting; Walker and Sleath (2017) identified only 18 empirical papers that examined the prevalence of non-consensual sharing of TMSIs. More recent research findings suggest that around 50% of adults reported receiving an unsolicited sexual message/image or genital image (Valiukas et al., 2019; Marcotte et al., 2020) and slightly fewer reported sending one (Oswald et al., 2019). In their literature review, Walker and Sleath (2017) found that between 1.1 and 6.3% of adult participants reported being the victim of non-consensual sharing (having a TMSI that one sent shared by someone else without the sender's consent), and between 1.4 and 16.3% reported sharing a TMSI they received from someone else without the sender's consent. There was only one study of non-consensual posting among adults; Hudson et al. (2014) found that 63.7% of participants reported ever having a TMSI posted online without their consent. Notably, these examinations have not looked at gender differences in people's experiences with non-consensual sharing and posting of TMSIs. Men are more likely than women to perpetrate sexual assault in person (Black et al., 2011)—thus, it is possible that men might also be more likely to share or post [women's] TMSIs without consent. On the other hand, some researchers have suggested that women may share or post TMSIs that they non-consensually received from men as a means of deterring men from perpetuating a non-consensual TMSI again in the future (Waling and Pym, 2019; Naezer and van Oosterhout, 2020). Thus, the gender context of non-consensually sharing and posting TMSIs to the internet is currently unclear. To address this gap, we explored the prevalence of women and men's experiences with sharing and posting TMSIs without the sender's consent, and having had their own TMSI shared and posted without consent (Research Questions 1 and 2).

There are a number of methodological limitations in the existing non-consensual TMSI research. First, as with the majority of research on TMSIs (e.g., Courtice and Shaughnessy, 2017), researchers have not used consistent terminology or methodology to measure non-consensual TMSI experiences. For instance, some researchers have limited their definitions of non-consensual sharing to images only (e.g., Bloom, 2014; Matsui, 2015), while others include both images and videos (e.g., Cecil, 2014; Cannon, 2015; Walker and Sleath, 2017). Indeed, restricting operational definitions of TMSI to one specific medium can lead to an inaccurate understanding of the extent to which people have experienced or engaged in the *behavior* of TMSI as a whole. To collect the most accurate information possible, it is important for researchers to include multiple mediums in their operational/conceptual definitions of the behavior itself. Additionally, there is some confusion about what behaviors actually constitute non-consensual TMSI. Some researchers include sending or receiving unsolicited sexual content in their definitions (e.g., Krieger, 2017); others limit their definitions to non-consensual sharing or posting of TMSIs (e.g.,

Morelli et al., 2016; Mori et al., 2020). Inconsistent definitions of non-consensual TMSI likely contribute to confusion about the overall prevalence of TMSI experience, and create difficulties for researchers who wish to make comparisons across studies. Second, no researchers (to our knowledge) have examined all forms of non-consensual TMSI within a single sample. As such, it is difficult to know how prevalent different forms of non-consensual TMSI are, relative to one another. Third, researchers have not compared the prevalence of receiving to sending of non-consensual TMSIs within a single population. It is possible that there are discrepancies in whether or not people experience TMSI as non-consensual depending on whether they are the perpetrator or receiver of the message. That is, someone may believe that a TMSI is consensual when they send it, even if it is not experienced as consensual by the person who receives the TMSI. We cannot understand the multiplicity of experiences if we focus only on one side of the interaction.

Gender Differences in Mixed-Gender TMSI Experiences

Sexual Script Theory

Women and men likely differ in their non-consensual and compliant TMSI experiences. Sexual script theory is one approach for explaining how people learn about, internalize, and enact sexual behaviors—particularly social sexual behaviors (Wiederman, 2015). According to sexual script theory, people learn cultural-level scripts that act as guidelines for typical behaviors within a particular social-cultural context for sexual behaviors (Simon and Gagnon, 1984, 2003; Wiederman, 2015). These learned scripts tend to guide people's interpersonal sexual behavior, as well as inform expectations for their sexual experiences (Abelson, 1981; Simon and Gagnon, 1984, 2003; Simon, 1996).

In North America, the Traditional Sexual Script (TSS) is the dominant script guiding heterosexual, cisgender women, and cisgender men's sexual interactions (Crawford and Popp, 2003; Bartoli and Clark, 2006; Petersen and Hyde, 2010; Eaton and Rose, 2011; Sakaluk et al., 2014). Relevant studies published after 2015 suggest that university students do still endorse the TSS (Hust et al., 2017; Quinn-Nilas and Kennett, 2018; Rhodes, 2020; Marshall et al., 2021). Some researchers have suggested that the TSS also guides sexual minority people's sexual interactions (see Courtice and Shaughnessy, 2017; Gauvin and Pukall, 2018). The TSS emphasizes traditional gender roles for men and women in their sexual interactions (Wiederman, 2005; Masters et al., 2013). In doing so, the TSS places greatest acceptance on: (i) sexual behaviors within romantic relationships, (ii) men taking active roles and women passive roles, and (iii) using largely non-verbal communications of consent (Crawford and Popp, 2003; Bartoli and Clark, 2006).

Partner Context and the Traditional Sexual Script

According to the TSS, it is most acceptable for people to engage in sexual activity with a committed, and (often) monogamous partner (Byers, 1996; Wiederman, 2015; Gagnon and Simon, 2017). People do engage in consensual sexual activity outside of committed relationships; according to the TSS, these experiences

can be acceptable as long as those involved are not in a committed relationship with someone else (Byers, 1996; Wiederman, 2015; Gagnon and Simon, 2017). Researchers have suggested that heterosexual people expect to and do engage in consensual sexual activity with people they know better (e.g., a committed partner or “friend with benefits”) compared to people they know less well (e.g., a casual acquaintance or stranger; Waite and Joyner, 2001; Birnie-Porter and Hunt, 2015). Furthermore, some researchers have suggested that heterosexual people’s (presumably) consensual TMSIs follow this same pattern; people report the highest prevalence of TMSI with a committed romantic partner, followed by a known non-partner, and then a stranger (Shaughnessy and Byers, 2014). Because women are most likely to comply with and initiate sexual activity within the relationship context that is most acceptable for them, women should report the highest instances of TMSI in the committed romantic partner context. On the other hand, the TSS dictates that men should comply with and initiate sexual activity in all partner contexts (Byers, 1996; Wiederman, 2015). Because the committed romantic partner context is the most accessible for men to engage in sexual activity (and the context in which women are most likely to initiate), men are most likely to engage in TMSI in this context—even if the TMSI is undesired. Therefore, we hypothesized that more people would report compliant (consensual but unwanted) TMSI exchanges with a committed romantic partner, followed by a known non-partner, and then a stranger (Hypothesis 1).

Gender and the Traditional Sexual Script

A central tenet of the TSS is that men and women learn and enact different sexual scripts that place them in complementary yet opposing roles (Simon and Gagnon, 1984; Willetts et al., 2004; Sakaluk et al., 2014). Some researchers have highlighted how these scripted roles likely contribute to “token resistance” on the part of women, and persistence on the part of men (e.g., Muehlenhard and Lisa, 1988). Specifically, the script guiding women’s sexual behaviors dictates that they should, at least initially, resist sexual activity even when they do wish to engage in it. This translates to a woman’s initial sexual refusals being taken as merely tokenistic, and part of the script—a “no” can become a “yes” with additional persistence. Some men, then, respond to a woman’s “no” with subsequent persistence, aiming to receive a “yes”—this male persistence, in turn, becomes part of the sexual script. The flip side of this token resistance script may be difficulty for women to continue saying “no” when they have already refused, and difficulty for men to hear refusals as final (Frith and Kitzinger, 2001). This difficulty may be particularly true within committed romantic relationships because of the cultural level script’s acceptance of sexual behavior in these relationship contexts. Therefore, we hypothesized that more women than men would report lifetime prevalence of exchanging compliant TMSIs in all partner contexts (Hypothesis 2).

The TSS also is more accepting of men’s sexual expression compared to women’s. At the cultural level, men are encouraged to take an active role and desire, engage in, and thus pursue sexual behaviors with a wide range of partners—including with committed partners, known non-partners (e.g., “friends with

benefits”), and strangers (Byers, 1996; Wiederman, 2015). In contrast, women are discouraged from desiring and engaging in sexual activity outside of a committed relationship context, such as with a known non-partner or stranger (McHugh et al., 2012). Applied to TMSIs, men should also pursue a variety of partner contexts, whereas women should only pursue TMSI with a committed romantic partner. Indeed, researchers have found that more men than women engage in TMSI with a wider variety of partner contexts; men also report more TMSI experience outside of the committed relationship context compared to women (Shaughnessy and Byers, 2014; Courtice and Shaughnessy, 2017). These findings suggest that men are more likely than women to initiate a TMSI exchange in known non-partner and stranger contexts. They also suggest that women are equally as likely as men to initiate a TMSI exchange in the committed relationship context only. With all the above in mind, we hypothesized that women would report greater lifetime prevalence of receiving (Hypothesis 3), and men would report a greater lifetime prevalence of sending (Hypothesis 4), non-consensual TMSIs in known non-partner and stranger contexts.

THE PRESENT STUDY

The goal of this study was to examine the partner context of other-gender attracted women and men’s compliant and non-consensual TMSI experiences, as an indicator of interpersonal sexual scripts. To address these aims, we examined the prevalence of non-consensual and compliant TMSIs as indicators of interpersonal sexual scripts. Specifically, we examined multiple forms of TMSIs: non-consensual sending, receiving, sharing, and posting, as well as compliant exchanges (i.e., back-and-forth sending and receiving). We also examined the prevalence of men and women’s experiences in three relationship contexts: committed romantic partners, known non-partners (someone who is known, but not a committed partner; e.g., casual sex partner), and strangers. Based on sexual script theory, token resistance theory, and past research on TMSIs and offline sexual coercion, we examined the following four hypotheses:

1. Participants will report greater lifetime prevalence of exchanging compliant TMSIs with a committed romantic partner, then a known non-partner, followed by a stranger.
2. Relative to men, women will report greater lifetime prevalence of exchanging compliant TMSIs in all partner contexts.
3. Relative to men, women will report greater lifetime prevalence of receiving non-consensual TMSIs in the known non-partner and stranger contexts
4. Relative to women, men will report greater lifetime prevalence of sending non-consensual TMSIs in the known non-partner and stranger contexts.

Because of the lack of research with adults on non-consensual sharing and posting, we explored the following two research questions:

1. Do women and men differ in their experiences of having ever had someone share their TMSIs with another person or post their TMSI publicly across the three relationship contexts?

2. Do women and men differ in their experiences of non-consensually sharing or posting another person's TMSI across the three relationship contexts?

We also explored potential discrepancies between women and men's reported prevalence of sending, receiving, sharing, and posting non-consensual TMSIs. Our goal here was to examine the concordance/discordance of reporting for each activity (and in each partner context), to explore the possibility that women and men's perceptions of consensual/non-consensual TMSIs might differ. Specifically, we posed the following additional research questions:

3. In each partner context, will women and men report prevalence rates of receiving non-consensual TMSIs that are similar to those for sending non-consensual TMSIs?
4. In each partner context, will women and men report prevalence rates of having had a TMSI non-consensually shared and/or posted that are similar to those for non-consensually sharing and/or posting someone's TMSI?

METHODS

Participants

A total of 671 people completed this online survey study. We identified 56 participants as duplicate responders and only their first response was retained for analyses. We excluded an additional 71 participants from analyses because they either completed the survey in under 5 min ($n = 47$) or in over 24 h ($n = 24$; Huang et al., 2012; Meade and Craig, 2012). We excluded 20 participants because they responded "no" to a question asking if their survey answers were honest. Because of the hetero- and cis-centric nature of our hypotheses, we included only cisgender women and men (4 participants excluded), and people with mostly/entirely other-gender sexual attraction (97 participants excluded).

Of the 451 participants retained for analyses, 331 (73.4%) identified as cisgender women and 120 (26.6%) as cisgender men. Participants ranged in age from 16 to over 30 years old ($M = 19.7$, $SD = 3.0$). Most participants identified as heterosexual (95.8%) and entirely sexually attracted to another (binary) gender (76.5%). Most were not in a committed relationship (55.7%). Additional sample demographic and background characteristics are reported in Table 1.

Procedure

Participants were recruited from a large University in Ontario, Canada to take part in an online survey about their "perspectives on sexual behaviors, dating habits, and dating scripts" from September 2017 to April 2018. All participants were university students enrolled in an introductory psychology course, who voluntarily registered for this study (from a list of open research studies) in exchange for course credit. Upon registering, participants received a link to the study survey, hosted on Qualtrics.

The first page of the survey was an Informed Consent Form, which provided information about the study, participants' rights, privacy, confidentiality, and information about data

TABLE 1 | Demographic and background characteristics of sample retained for analyses.

	Subsample size (<i>n</i>)	Proportion of total sample (%)
Gender		
Man	120	26.6
Woman	331	73.4
Sexual Attraction		
Entirely to other gender	345	76.5
Mostly to other gender	106	23.5
Sexual Orientation		
Heterosexual	432	95.8
Bisexual	6	1.3
Other	13	2.9
Relationship Status		
Committed relationship	191	42.4
Single and dating	58	12.9
Single and not dating	196	43.5
Prefer not to answer	6	1.3
Country of Birth		
Canada	362	80.3
China	17	3.8
Haiti	5	1.1
Other (e.g., France, Mexico, Egypt)	62	13.7
Prefer not to answer	5	1.1
Age		
16–17	17	3.0
18	209	36.8
19	143	25.2
20	74	13
21	52	9.2
22–24	38	6.7
25–29	18	3.3
30+	11	1.9

Participants who endorsed the maximum "30+" option for age and were coded as 30 years old for mean and standard deviation calculations.

management and storage. Participants actively clicked to indicate their consent and were then directed to the online survey. Next, consenting participants completed background/demographic questions, which included questions about participant's gender and other sexual experiences that were not related to this study's objectives. Then, participants were asked about their experiences with non-consensual and compliant TMSIs in different partner contexts. On the final page of the survey, we provided participants with debriefing information. This study was approved by our institution's Research Ethics Board.

Measures

Background Questionnaire

Participants responded to closed-ended questions based on previous research that assessed demographic and background information, including participants' gender, sexual identity, gendered sexual attraction, relationship status, sexual experience,

TABLE 2 | Items comprising our measure of compliant and non-consensual TMSI experiences and their corresponding TMSI subtype.

Original item	Compliant/non-consensual TMSI subtype
1. Exchanged sexually explicit text messages via mobile phone or computer with another person when you did not want to	Compliant TMSI (1)
2. Exchanged sexually explicit photo or video messages via mobile phone or computer with another person when you did not want to	Compliant TMSI (1)
3. Sent a sexually explicit text message via mobile phone or computer when the person you sent it to did not ask for it	Non-consensual sending (2)
4. Sent a sexually explicit photo or video message via mobile phone or computer when the person you sent it to did not ask for it	Non-consensual sending (2)
5. Received a sexually explicit text message via mobile phone or computer when you did not ask for it	Non-consensual receiving (3)
6. Received a sexually explicit photo or video message via mobile phone or computer when you did not ask for it	Non-consensual receiving (3)
7. Shown a sexually explicit text message that you received from someone else to another person, without the sender's permission	Non-consensual sharing perpetration (4)
8. Shown a sexually explicit photo or video message that you received from someone else to another person, without the sender's permission	Non-consensual sharing perpetration (4)
9. Had a sexually explicit text message that you sent to someone else shared with another person without your permission	Non-consensual sharing victimization (5)
10. Had a sexually explicit photo or video message that you sent to someone else shared with another person without your permission	Non-consensual sharing victimization (5)
11. Posted a sexually explicit text message that you received from someone else to the Internet, without the sender's permission	Non-consensual online posting perpetration (6)
12. Posted a sexually explicit photo or video message that you received from someone else to the Internet, without the sender's permission	Non-consensual online posting perpetration (6)
13. Had a sexually explicit text message that you sent to someone else posted to the Internet without your permission	Non-consensual online posting victimization (7)
14. Had a sexually explicit photo or video message that you sent to someone else posted to the Internet without your permission	Non-consensual online posting victimization (7)

When responding to the original items, participants were able to select as many options as applied from the following list: (1) Yes, with a primary partner; (2) Yes, with a known non-partner; (3) Yes, with an unknown non-partner; (4) No, I have never experienced this; (5) Prefer not to answer.

and online dating app use. The questions about gender, sexual identity, and relationship status all had open-ended response options if the options available did not appropriately address one's identity or status. Participants were also able to skip any questions that they did not wish to answer.

Compliant and Non-consensual TMSI Experience

We created a 14-item measure to evaluate whether or not participants had ever engaged in a compliant TMSI exchange and/or sent, received, shared, or posted TMSIs that were non-consensual with each of three types of partners (i.e., committed romantic partner, known non-partner, and unknown other; see **Table 2**). We assessed each subtype of non-consensual/compliant TMSI experience using a checklist response format presented as a matrix table; participants selected each of the activities that they had experienced in their lifetime, as well as the type(s) of partner(s) they had experienced each activity with. We provided the definition for each type of partner in the instructions based on those used in previous research (Shaughnessy and Byers, 2014). For each activity, we used two items: one item specified *text* messages and the other item specified *photo/video* messages within this matrix to create dichotomous scores (0 = no, 1 = yes) for prevalence of compliant and non-consensual experience of TMSIs in each partner context. We combined responses to the text and photo/video items to create one dichotomous prevalence

score (0 = no to both text and photo/video experiences; 1 = yes to either/both a text or photo/video experience; also reported as mean scores in **Table 3**) for each partner type, based on their conceptual face validity. Our focus was on assessing the compliant context rather than the specific medium of the experience. Thus, this summary prevalence score from multiple items ensured we asked about more than one mode, and allowed us to focus on whether the experience was compliant, or non-consensual (or not). Thus, we examined seven subtypes of non-consensual/compliant TMSI experience: (1) compliant TMSI (e.g., exchanged sexually explicit messages with another person when you did not want to), (2) non-consensual sending (e.g., sent a sexually explicit message to someone when they did not ask for it), (3) non-consensual receiving (e.g., received a sexually explicit message from someone when you did not ask them for it), (4) non-consensual sharing perpetration (e.g., showed a sexually explicit message that you received from someone else to another person, without the sender's permission), (5) non-consensual sharing victimization (e.g., had a sexually explicit message that you sent to someone else shared with another person without your permission), (6) non-consensual online posting perpetration (e.g., posted a sexually explicit message that you received from someone else to the internet, without the sender's permission), and (7) non-consensual posting victimization (e.g., had a sexually explicit message that you sent to someone else

TABLE 3 | Prevalence of compliant and non-consensual TMSI experiences by gender.

	Overall (<i>N</i> = 451) (%)	<i>M</i> (<i>SD</i>)	Women (<i>n</i> = 331) (%)	<i>M</i> (<i>SD</i>)	Men (<i>n</i> = 120) (%)	<i>M</i> (<i>SD</i>)	<i>p</i>	ηp^2
Compliant TMSI								
With a committed romantic partner	16.4	0.16 (0.37) _a	15.1	0.15 (0.36) _a	20.0	0.20 (0.40) _a	0.216	0.00
With a known non-partner	15.7	0.16 (0.37) _a	17.8	0.18 (0.38) _a	10.0	0.10 (0.30) _{ab}	0.044	0.01
With a stranger	5.3	0.05 (0.23) _b	5.7	0.06 (0.23) _b	4.2	0.04 (0.20) _b	0.512	0.00
Received a Non-consensual TMSI								
From a committed romantic partner	17.7	0.18 (0.38) _a	15.7	0.16 (0.36) _a	23.3	0.23 (0.43) _a	0.061	0.01
From a known non-partner	31.9	0.32 (0.47) _b	35.6	0.36 (0.48) _b	21.7	0.22 (0.41) _a	0.005	0.02
From a stranger	33.3	0.33 (0.47) _b	40.2	0.40 (0.49) _b	14.2	0.14 (0.35) _a	<0.001	0.06
Sent a Non-consensual TMSI								
To a committed romantic partner	22.0	0.22 (0.41) _a	23.9	0.24 (0.43) _a	16.7	0.17 (0.37) _a	0.103	0.01
To a known non-partner	7.1	0.07 (0.26) _b	8.2	0.08 (0.27) _b	4.2	0.04 (0.20) _b	0.145	0.01
To a stranger	2.7	0.03 (0.16) _b	1.5	0.02 (0.12) _c	5.8	0.06 (0.24) _a	0.012	0.01
Non-consensually sharing a TMSI								
From a committed romantic partner	7.3	0.07 (0.26) _a	7.6	0.08 (0.27) _a	6.7	0.07 (0.25) _a	0.750	0.00
From a known non-partner	17.3	0.17 (0.38) _b	18.1	0.18 (0.39) _b	15.0	0.15 (0.36) _a	0.439	0.00
From a stranger	9.1	0.09 (0.29) _a	10.6	0.11 (0.31) _a	5.0	0.05 (0.22) _a	0.069	0.01
Had a TMSI Non-consensually shared								
By a committed romantic partner	5.5	0.06 (0.23) _a	6.0	0.06 (0.24) _b	4.2	0.04 (0.20) _a	0.443	0.00
By a known non-partner	10.4	0.10 (0.31) _b	10.3	0.10 (0.30) _b	10.8	0.11 (0.31) _a	0.863	0.00
By a stranger	3.5	0.04 (0.19) _a	2.7	0.03 (0.16) _a	5.8	0.06 (0.24) _a	0.115	0.01
Non-consensually posted a TMSI								
From a committed romantic partner	0.9	n/a	0.6	n/a	1.7	n/a	n/a	n/a
From a known non-partner	0.9	n/a	0.6	n/a	1.7	n/a	n/a	n/a
From a stranger	0.9	n/a	1.2	n/a	2.5	n/a	n/a	n/a
Had a TMSI Non-consensually posted								
By a committed romantic partner	1.6	n/a	0.9	n/a	1.7	n/a	n/a	n/a
By a known non-partner	1.1	n/a	0.9	n/a	1.7	n/a	n/a	n/a
By a stranger	0.9	n/a	1.6	n/a	2.5	n/a	n/a	n/a

Prevalence rates are reported by percentage. Means and their standard deviations are for lifetime prevalence scores on the measure of compliant and non-consensual TMSI experience. Response options are reported as 0 (never) and 1 (at least one time). Significant *p*-values ($p \leq 0.01$) indicate significant gender differences, and different subscripts down a column within gender indicate a significant partner context difference ($p \leq 0.01$). *M*(*SD*) scores represent mean scores for the dichotomous (0 = no, 1 = yes) prevalence for each category of compliant/non-consensual TMSI experience.

posted to the internet without your permission). We have presented the original items and their corresponding subtype in **Table 2**.

Analytic Approach

We hypothesized, broadly, that people's prevalence of experiencing compliant and non-consensual TMSI would differ based on participant gender and across partner contexts (Hypotheses 1–4). We used the same analytic approach to test each of these four hypotheses; we report means and standard deviations in **Table 3**. We were unable to examine our research questions about non-consensual posting in this way, because the proportion of participants with these experiences was too low (require >5 cases per cell; Kroonenberg and Verbeek, 2018); however, we were still able to report the overall prevalence of having a TMSI non-consensually posted by someone else, and non-consensually posting another person's TMSI. For

the remaining five subtypes, we conducted a 2 (gender) \times 3 (partner context) mixed analysis of variance (ANOVA) using the prevalence of the TMSI experience. For each ANOVA, we used the corresponding subtype item (from our seven items measuring compliant and non-consensual TMSI experience) as the repeated dependent variable (Lunney, 1970; Myers et al., 1982). Because Mauchley's test of sphericity was violated for all analyses, we used the Huynh-Feldt correction to interpret results. Lüpsen and Rechenzentrum (2019) also recommend using the Huynh-Feldt correction when conducting an ANOVA with a binary dependent variable with unequal cell counts. As per Overall (1980), it is appropriate to use a between-within ANOVA for dichotomous variables with unequal cell sizes, but that a more conservative alpha level should be used—therefore, we used a cutoff of $\alpha = 0.001$ for our five omnibus tests. We followed up significant interactions in two ways. First, to examine whether women and men differed in their

prevalence of the TMSI experience within each partner context, we conducted follow-up comparisons using a Bonferroni correction. Second, we tested simple main effects for the effect of partner context for both women and men. For significant simple effects we used follow-up multiple comparisons to locate the differences between partner context within gender. For all tests, we used 95% confidence intervals with a 5% error level and a Bonferroni correction. A *post-hoc* sensitivity analysis with an $\alpha = 0.01$ and power = 0.80 indicated that the minimum detectable effect size (Cohen's f) for our sample was 0.066.

We examined the concordance/discordance between participants' self-reported receiving and sending of non-consensual TMSIs (Research Question 3), and prevalence of having had TMSIs non-consensually shared and non-consensually sharing another person's TMSIs (Research Question 4). For each relationship context, we conducted $2 (\text{gender}) \times 2 (\text{RQ3: sending/receiving, RQ4: had shared/sharing})$ unpaired proportion comparisons (Campbell, 2007; Richarson, 2011). We defined concordance as one gender (e.g., women) reporting a statistically similar (indicated by $\%_{\text{diff}}$ absolute value scores close to 0) prevalence of receiving non-consensual TMSIs relative to the other gender (e.g., men) reported prevalence of sending in a given relationship context. We defined discordance as one gender (e.g., women) reporting a statistically significant difference (indicated by $\%_{\text{diff}}$ absolute value scores above 0) in prevalence of receiving non-consensual TMSIs relative to the other gender (e.g., men) reported prevalence of sending in a given relationship context.

RESULTS

Preliminary Analyses

Initial cleaning and screening procedures revealed no missing data on key background items (gender, sexual orientation, and sexual attraction) or the items used to measure compliant and non-consensual TMSI prevalence. We did not identify any univariate or multivariate outliers on the measure of compliant and non-consensual TMSI experience.

Prior to testing our hypotheses, we examined the percentage of participants who indicated they had a compliant or non-consensual TMSI experience. The majority of participants (68.5%) reported at least one experience with complaint or non-consensual TMSIs. Of these, 49.9% reported more than one experience with compliant or non-consensual TMSIs. Overall, the prevalence of compliant and non-consensual TMSI experiences ranged from 0 to 14 experiences (out of a possible 21) across all relationship contexts ($M = 2.12$, $SD = 2.30$). The percentage of women and men who had each type of experience for each partner context is reported in **Table 3**. Overall, few had engaged in compliant TMSI with a committed romantic partner (16.4%), known non-partner (15.7%) or stranger (5.3%). Some participants had received a non-consensual TMSI from a committed romantic partner (16.7%), known non-partner (31.9%) or stranger (33.3%), and some had sent a non-consensual TMSI to a committed romantic partner (22.0%), known non-partner (7.1%) or stranger (2.7%).

Prevalence of Exchanging Compliant TMSIs

We tested whether more participants reported engaging in compliant TMSI with a committed romantic partner compared to a known non-partner or stranger (Hypothesis 1), and whether more women reported a compliant TMSI experience, in all partner contexts, compared to men (Hypothesis 2). The main effect for gender was not significant, $F_{(1,449)} = 0.41$, $p = 0.524$, $\eta_p^2 = 0.001$; the main effect for partner context was significant, $F_{(1.95,874.56)} = 17.10$, $p < 0.001$, $\eta_p^2 = 0.037$. The interaction between gender and partner context was not significant, $F_{(1.95,874.56)} = 4.11$, $p = 0.018$, $\eta_p^2 = 0.009$. Multiple comparisons revealed that significantly more people reported prevalence of engaging in a compliant TMSI exchange with a committed romantic partner compared to with a stranger ($M_{\text{CRP-S}} = 0.126$, $p < 0.001$, 95% CI [0.074, 0.178], $\eta_p^2 = 0.081$), and with a known non-partner compared to with a stranger ($M_{\text{KNP-S}} = 0.090$, $p < 0.001$, 95% CI [0.040, 0.139], $\eta_p^2 = 0.081$). There were no significant differences between the committed romantic partner and known non-partner contexts (see **Table 3**). Thus, our findings partially supported Hypothesis 1: significantly more men and women reported a compliant TMSI experience with a committed partner compared to a stranger, but not compared to a known non-partner. In contrast to Hypothesis 2, there were no significant gender differences in committed romantic partner or stranger contexts.

Prevalence of Receiving Non-consensual TMSIs

We tested whether more women reported receiving non-consensual TMSIs compared to men in the known non-partner and stranger contexts (Hypothesis 3). The main effects of both gender and partner context were significant, $F_{(1,449)} = 13.97$, $p < 0.001$, $\eta_p^2 = 0.030$ and $F_{(1.98,888.46)} = 4.85$, $p = 0.008$, $\eta_p^2 = 0.011$, respectively. The interaction between partner context and gender was also significant, $F_{(1.98,888.46)} = 14.65$, $p < 0.001$, $\eta_p^2 = 0.032$.

Follow up analyses revealed that significantly more women than men reported receiving non-consensual TMSIs from known non-partners ($M_{\text{Women-Men}} = -0.14$, $p = 0.005$, 95% CI [-0.24, -0.04], $\eta_p^2 = 0.018$) and from strangers ($M_{\text{Women-Men}} = -0.26$, $p < 0.001$, 95% CI [-0.356, -0.164], $\eta_p^2 = 0.060$); thus, the interaction qualified the main effect of gender. In line with Hypothesis 3, significantly more women than men reported receiving a non-consensual TMSI from a known non-partner and from a stranger. There were no significant gender differences in the committed romantic partner context.

Because scripts also vary along partner context, we conducted a *post-hoc* follow-up analysis to explore the interaction by way of the partner context main effect as well. The follow up revealed that the main effect of partner context was significant only for women [$F_{(2,448)} = 35.326$, $p < 0.001$, $\eta_p^2 = 0.14$] and not for men [$F_{(2,448)} = 1.519$, $p = 0.220$, $\eta_p^2 = 0.007$]. Significantly more women reported prevalence of receiving non-consensual TMSIs within the known non-partner context ($M_{\text{KNP-CRP}} = 0.20$, $p < 0.001$, 95% CI [0.13, 0.27], $\eta_p^2 = 0.136$) and within the stranger

context ($M_{S-CRP} = 0.26$, $p < 0.001$, 95% CI [0.17, 0.32], $\eta_p^2 = 0.136$) relative to the committed romantic partner context. There were no significant differences for women between the known non-partner and the stranger context (see Table 3).

Prevalence of Sending Non-consensual TMSIs

We tested whether more men reported sending non-consensual TMSIs compared to women in the known non-partner and stranger contexts (Hypothesis 4). The main effect for gender was not significant, $F_{(1,449)} = 1.30$, $p = 0.254$, $\eta_p^2 = 0.003$; the main effect for partner context was significant, $F_{(1.63,733.27)} = 36.11$, $p < 0.001$, $\eta_p^2 = 0.074$; the interaction between gender and partner context was not significant, $F_{(1.63,733.27)} = 3.99$, $p = 0.027$, $\eta_p^2 = 0.010$. Multiple comparisons revealed that significantly more people reported prevalence of sending a non-consensual TMSI to a committed partner compared to a known non-partner ($M_{CRP-KNP} = 0.141$, $p < 0.001$, 95% CI [0.084, 0.198], $\eta_p^2 = 0.103$) and a stranger ($M_{CRP-S} = 0.166$, $p < 0.001$, 95% CI [0.110, 0.222], $\eta_p^2 = 0.103$). There were no significant differences between the known non-partner and stranger contexts (see Table 3). Thus, we did not find support for Hypothesis 4; there were no differences in women and men's prevalence of sending non-consensual TMSIs.

Prevalence of Non-consensual Sharing of TMSIs

We explored whether women and men differed in their experiences of having ever had TMSIs they sent to another person non-consensually shared by that person, across the three relationship contexts (Research Question 1). The main effect for gender was not significant, $F_{(1,449)} = 0.130$, $p = 0.719$, $\eta_p^2 = 0.000$; the main effect for partner context was significant, $F_{(1.94,869.90)} = 7.648$, $p = 0.001$, $\eta_p^2 = 0.017$; (1.92, 869.90) = 1.024, $p = 0.358$, $\eta_p^2 = 0.002$. There were no significant differences between the committed romantic partner and stranger contexts (see Table 3).

We also explored whether women and men differed in their experiences of having ever non-consensually shared TMSIs they had received from another person across the three relationship contexts (Research Question 2). The main effect for gender was not significant, $F_{(1,449)} = 2.272$, $p = 0.132$, $\eta_p^2 = 0.005$; the main effect for partner context was significant, $F_{(1.92,862.05)} = 11.181$, $p < 0.001$, $\eta_p^2 = 0.024$; the interaction between gender and partner context was not significant, $F_{(1.92,862.05)} = 0.533$, $p = 0.569$, $\eta_p^2 = 0.001$. There were no significant differences between the committed romantic partner and stranger contexts (see Table 3).

Concordance/Discordance of Non-consensual Receiving, Sending, and Sharing TMSIs

A side-by-side comparison of prevalence for sending and receiving non-consensual TMSIs and summary statistics for each unpaired proportion calculation are presented in Table 4. The prevalence of sending and receiving non-consensual TMSIs was

concordant in the committed romantic partner context: women received as many non-consensual TMSIs from a committed romantic partner as men reported sending to a committed romantic partner ($\chi^2 = 0.017$, $p = 0.895$), and men received as many non-consensual TMSIs as women reported sending ($\chi^2 = 0.065$, $p = 0.798$). The prevalence of sending and receiving non-consensual TMSIs was discordant in the known non-partner context: women received more non-consensual TMSIs from known non-partners than men reported sending to known non-partners ($\chi^2 = 43.71$, $p < 0.001$), and men received more non-consensual TMSIs than women reported sending ($\chi^2 = 15.40$, $p < 0.001$). The prevalence of sending and receiving non-consensual TMSIs also was discordant in the stranger context; women received more non-consensual TMSIs from strangers than men reported sending to strangers ($\chi^2 = 48.58$, $p < 0.001$), and men received more non-consensual TMSIs than women reported sending ($\chi^2 = 30.54$, $p < 0.001$).

We examined the concordance/discordance between participants' self-reported non-consensual sharing and having TMSIs non-consensually shared (Research Question 4). A side-by-side comparison of prevalence for sharing and having shared non-consensual TMSIs and summary statistics for each unpaired proportion calculation are presented in Table 5. The prevalence of non-consensually sharing and having TMSIs non-consensually shared was concordant between women and men in all three partner contexts. That is, a similar percentage of women reported sharing someone else's TMSI as men reported having had their TMSI shared, and vice versa within committed romantic partner, known non-partner, and stranger contexts separately. However, a *post-hoc* comparison within the overall sample revealed that the prevalence of non-consensually sharing and having TMSIs non-consensually shared was discordant in both the known non-partner ($\chi^2 = 0.899$, $p = 0.003$) and stranger ($\chi^2 = 11.97$, $p < 0.001$) contexts. In both partner contexts, more people reported non-consensually sharing TMSIs than people reported having had them shared.

DISCUSSION

The goal of this study was to examine the partner context of other-gender attracted women and men's compliant and non-consensual TMSI experiences, as an indicator of interpersonal sexual scripts. To our knowledge, this study is the first examination of multiple types of compliant and non-consensual TMSIs alongside the relationship context of these experiences. Our results revealed that people's experiences with compliant and non-consensual forms of TMSI vary as a function of gender, relationship context, and role within the exchange (e.g., as a sender vs. receiver). Specifically, we found that women and men's experiences were somewhat in line with the TSS, offline sexual consent research, and our hypotheses. However, we also identified important ways that our findings diverged from what is predicted by the TSS. These findings extend and improve upon the small body of research on compliant and non-consensual TMSIs.

TABLE 4 | Prevalence of sending and receiving non-consensual TMSIs.

	Men sending	Women receiving	Women sending	Men receiving	Overall sending	Overall receiving
With a committed romantic partner						
Prevalence (%)	16.7	15.7	23.9	23.3	22.0	17.7
% _{diff} (95% CI)	1.0 (−6.08; 9.45)		0.60 (−8.76; 8.86)		4.30 (−0.91; 9.49)	
χ ²	0.065		0.017		2.62	
p	0.798		0.895		0.106	
With a known non-partner						
Prevalence (%)	4.2	35.6	8.2	21.7	7.1	31.9
% _{diff} (95% CI)	31.4 (24.19; 37.21)		13.50 (6.20; 22.06)		24.80 (19.84; 29.68)	
χ ²	43.71		15.40		88.26	
p	<0.0001		<0.0001		<0.0001	
With a stranger						
Prevalence (%)	5.8	40.2	1.5	14.2	2.7	33.3
% _{diff} (95% CI)	34.4 (26.72; 40.53)		12.70 (7.20; 20.12)		30.60 (25.98; 35.22)	
χ ²	48.58		30.54		142.90	
p	<0.0001		<0.0001		<0.0001	

TABLE 5 | Prevalence of non-consensually sharing and having TMSIs non-consensually shared.

	Men shared	Women had shared	Women shared	Men had shared	Overall sharing	Overall had shared
With a committed romantic partner						
Prevalence (%)	6.7	6.0	7.6	4.2	7.3	5.5
% _{diff} (95% CI)	0.7 (−3.80; 7.00)		3.4 (−2.35; 7.53)		1.8 (−1.44; 5.09)	
χ ²	0.074		1.63		1.22	
ρ	0.785		0.202		0.270	
With a known non-partner						
Prevalence (%)	15.0	10.3	18.1	10.8	17.3	10.4
% _{diff} (95% CI)	4.7 (−1.79; 12.69)		7.3 (−0.49; 13.59)		6.9 (2.40; 11.41)	
χ ²	1.90		3.46		8.99	
ρ	0.168		0.063		0.003	
With a stranger						
Prevalence (%)	5.0	2.7	10.6	5.8	9.1	3.5
% _{diff} (95% CI)	2.3 (−1.28; 7.93)		4.8 (−1.59; 9.61)		5.6 (2.45; 8.90)	
χ ²	1.45		2.40		11.97	
ρ	0.228		0.122		< 0.0001	

Prevalence of Compliant and Non-consensual TMSIs

Our findings substantially improve TMSI research by showing that compliant and non-consensual TMSIs occur across multiple relationship contexts and in many ways. Most researchers have not included the consent context of experiences in their measures of TMSI, even as a precaution to ensure that they are evaluating consensual TMSI (Krieger, 2017). Our findings suggest that researchers who have not distinguished the consent context of TMSIs in their studies have potentially reported inaccurate results—that is, researchers may have overestimated the extent to which people experience consensual TMSIs by also capturing compliant and non-consensual experiences. Indeed, we found that compliant and non-consensual TMSIs appear

to be common experiences that researchers must account for. We found that the majority (68.5%) of our sample reported at least one experience with a compliant or non-consensual TMSI. Furthermore, research on compliant and non-consensual TMSI is almost always focused on only one or two behaviors (e.g., non-consensual sharing of TMSIs or receiving unsolicited sexual messages; Marcotte et al., 2020; Mori et al., 2020) or one relationship context (e.g., compliance in committed romantic relationships; Drouin and Tobin, 2014). In asking about many two-way (compliance) and one-way (non-consensual) experiences, we learned that many people have multiple experiences. Indeed, we found that about 57% of participants reported more than one compliant or non-consensual TMSI, and participants overall reported an average of three experiences

across all relationship contexts. These statistics are similar to the prevalence range for analogous offline experiences (Vannier and O'Sullivan, 2010; Viscione, 2015). Thus, our results suggest that people's experiences with compliant and non-consensual TMSI likely are as prevalent as offline compliant and non-consensual sexual experiences—at least among young adults in Western, urban settings.

We also found that some types of non-consensual TMSI were not very prevalent: non-consensually sharing or posting someone else's TMSI and having a TMSI non-consensually shared or posted were uncommon experiences overall, and for both women and men. Thus, most people do not report this type of non-consensual TMSI despite some researchers focusing on the harms of TMSI as tied to non-consensual sharing (e.g., Mori et al., 2020). It is possible that participants struggled to answer our questions about being the victim of non-consensual TMSI sharing and posting because of the likely hidden nature of these experiences. In Canada—where our participants resided—it is illegal to both non-consensually share and post sexually explicit content that was intended to be a two-way exchange (Protecting Canadians from Online Crime Act, 2014). Therefore, it is unlikely that someone would directly inform another person that they had done either of these activities. Indeed, it is possible that some participants had been victims of these activities, but were not aware that they were victims. This is especially likely in the stranger context, where there may not have been further contact after the TMSI was sent/received initially. Similarly, despite the anonymous context of our survey, it remains possible that our participants would not admit to perpetrating these behaviors due to fear of possible legal repercussions. In future studies, researchers may need to use targeted sampling strategies or develop ways of disguising the questions to accurately evaluate and understand people's experiences.

Sexual Script Theory and Sexual Compliance in TMSI

The results of our study provide some evidence that the TSS and token resistance theory characterize aspects of compliant TMSI experiences. Consistent with the relationship context of sexual experience in the TSS, we found that many of our participants reported compliant TMSI with someone that they knew—either a committed romantic partner or a known non-partner. This finding partially aligns with a focus on committed romantic relationships in compliant sexual activity research—both offline and in technology-mediated contexts (e.g., Vannier and O'Sullivan, 2010; Drouin and Tobin, 2014; Viscione, 2015). Our findings indicate that people do engage in compliant TMSI within and outside of committed romantic relationships. However, the findings were not consistent with our expectations for compliant TMSI based on the sexual script and token resistance theory. First, we did not find evidence of an overall difference between the prevalence of men and women's compliant TMSIs. This suggests that, in contrast to what token resistance scripts would predict, women and men may experience equal amounts of pressure to comply when a TMSI is initiated,

especially when the partner is known to them (i.e., a known non-partner or committed romantic partner). Second, we found that about as many people reported engaging in compliant TMSI with a committed romantic partner as with a known non-partner—however, more people reported compliant TMSI in these contexts relative to the stranger context. This finding stands in contrast to previous offline research suggesting that sexual compliance may be slightly higher for adults in committed romantic relationships (e.g., Vannier and O'Sullivan, 2010; Viscione, 2015)—however, it is somewhat consistent with the TSS and token resistance scripts for people in general. That is, people—regardless of gender—may be just as likely to comply with partnered sexual activity when the other person is known to them—not just when they are in a committed relationship with that person. It is possible that a person may feel more pressure to engage in compliant sexual activity with a known non-partner relative to a stranger because of the added accountability that the known non-partner context creates. That is, it may be easier to brush off a stranger's solicitations, but more difficult to resist the solicitations of someone who is known. Overall, these findings suggest that aspects of women and men's sexual scripts related to sexual compliance may somewhat differ online. Conducting a closer examination of people's experiences with compliant TMSI in each of these relationship contexts might explain why compliant exchanges occur.

Sexual Script Theory and Non-consensual TMSI

The results of our study provide evidence that the TSS can explain some—but not all—aspects of women and men's non-consensual TMSI experiences. Consistent with the TSS, we found that more women than men reported receiving non-consensual TMSIs from known non-partners and strangers. Similarly, we found that more men than women reported sending non-consensual TMSIs to strangers. These findings are consistent with researcher's focus on men sending and women receiving “unsolicited dick pics” (Marcotte et al., 2020), and the script that directs men to pursue sexual activity in multiple relationship contexts. We also found that women and men's reported prevalence of sending and receiving was discordant in the known non-partner and stranger contexts. That is, both men and women received more non-consensual TMSIs than they sent to known non-partners and strangers. There are several explanations for these findings.

First, it is possible that there is discordance between what the senders and receivers perceive to be a signal of consent. People who send non-consensual TMSIs to known non-partners and strangers may not believe that the TMSIs they sent were non-consensual, whereas the receivers do perceive those TMSIs as non-consensual. This presupposes that sending a non-consensual TMSI is an attempt to initiate sexual activity, and that senders may intend their messages to be subtle, non-verbal technology-mediated sexual initiations. Indeed, it is unclear how people navigate consent for or during TMSIs. In fact, no researchers (to our knowledge) have examined or theorized on how people navigate consent for sending and receiving TMSIs generally. Because traditional indicators of non-verbal consent (e.g., direct

eye contact, pulling someone closer) or non-consent (e.g., shaking head “no,” pushing someone away) are less available in TMSI, people may be more likely to bypass the consent process entirely and instead rely on what they expect based on the TSS—such as by sending a sexually explicit TMSI without asking directly. However, it is possible that subtlety is lost when communicating via technology rather than in-person. People—especially men—do seem to use mostly non-verbal cues when communicating sexual consent, particularly outside of the committed romantic partner context and with strangers (Muehlenhard et al., 2016). We also found that there were no gender differences in sending or receiving non-consensual TMSIs from committed romantic partners. This suggests that people may have a better understanding of a committed partner’s sexual consent signals, both in terms of knowing a partner’s intent and when they would be violating each other’s consent.

Second, it may have been difficult for participants to admit to perpetrating non-consensual TMSI against known non-partners or strangers when they were completing this study. However, because the TSS dictates that pursuing sexual activity in a committed romantic context is permissible for both men and women, people may have been more honest in reporting their non-consensual TMSIs in this context, perhaps not viewing non-consensual TMSIs as a transgression. Indeed, according to the TSS, it is unacceptable for women to initiate sexual activity outside of a committed romantic relationship; knowledge of this script may prompt women to respond dishonestly, by reporting that they have not pursued sexual activity in known non-partner and stranger contexts. However, this explanation does not hold for men. On the other hand, it is also possible that only a small proportion of women and men may be responsible for sending the majority of non-consensual TMSIs in known non-partner and stranger contexts.

Finally, it is plausible that people send non-consensual sexual material to assert dominance over another, or as a hostile act of violence (Oswald et al., 2019). Indeed, when women and men reported non-consensual sharing and victimization, it was more likely with a known non-partner than a committed romantic partner or a stranger. It is unlikely that a large proportion of people would non-consensually share an image sent to them by a committed partner, with whom they have established relationship norms and trust. Of course, non-consensual sharing can be perpetrated by a committed romantic partner, but this is not likely to be a common behavior for a current and ongoing relationship. However, it seems that there may be something about the known non-partner context that is related to a lower respect for another person’s privacy relative to strangers. It is possible that people are more likely to be honest about having non-consensually shared a known non-partner’s TMSIs compared to the other two contexts—for instance, because known non-partners (e.g., possibly a former committed partner) might have more desire to hurt or enact vengeance upon the victim relative to committed romantic partners and strangers. Our findings about non-consensual sharing may also be an artifact, stemming from the generally low prevalence of people who reported sending non-consensual TMSIs to strangers.

LIMITATIONS AND FUTURE DIRECTIONS

The present study is not without limitations. First, our sample consisted of young adults who were attending a large Canadian University. As a result, we don’t know if these results generalize to older people who live outside of Canada and who have different levels of education. Future studies should examine the compliant and non-consensual TMSI experiences among more diverse (in age, gender, sexual identity, country of residence, education level, and sexual experience) groups of adults. Second, our methodology relied on a self-report measure of compliant and non-consensual TMSI experiences and was therefore susceptible to reporting bias. Indeed, we identified discordant responses between items measuring non-consensual sending and receiving and non-consensual sharing and having TMSIs non-consensually shared. It is unclear whether or not this discordance is a result of dishonest reporting by participants. However, the anonymous context for our survey likely decreased the potential for this particular bias. Third, the three relationship contexts we examined are limited in capturing with whom people might experience compliant or non-consensual TMSI. We did not account for the possibility that different relationship contexts could apply to the same person—for example, people might have engaged in compliant TMSI with someone who was a committed romantic partner at first, but who then became a known non-partner over time. It is possible that participants reported experience with both types of relationship contexts, even if the activity occurred with only one person. In future studies, researchers could examine compliant and non-consensual TMSI experiences throughout the course of people’s relationships. We also only accounted for the gender of participants in our analyses—we did not collect information about the other person involved in the compliant or non-consensual TMSIs. Researchers examining the potential role that gender plays in people’s TMSI experiences should aim to collect information about the gender of all people involved in a compliant or non-consensual TMSI exchange. Similarly, because our focus was solely on people’s compliant and non-consensual TMSI experiences, we did not ask participants about their experiences with desired and consensual TMSIs. In the future, researchers should aim to collect information about people’s experiences with TMSI in all consent contexts; this information could shed further light on who is most likely to report TMSI in each context and the relative prevalence of each experience. Fourth, although our questions were framed to address non-consensual sending and receiving from a sexual partner, it is possible that people interpreted our questions to be about sending and receiving non-consensual TMSIs from anyone. For example, someone might share a received sexual image with a friend, without consent from (a) the person depicted in the image, nor (b) the friend that the image was sent to. It is possible that a misinterpretation of our question could partly explain our results related to gender differences in non-consensual sending and receiving of TMSIs. However, researchers have previously found that there are no differences between men and women in non-consensual sharing of TMSIs (Garcia et al., 2016; Madigan et al., 2018; Molla-Esparza et al., 2020). We also did not find

gender differences in the prevalence of non-consensual sharing of TMSIs. Finally, although our results can be explained by the TSS and sexual script theory, this is one theory of many that could be useful in understanding these results. Indeed, we used people's gender and experiences with compliant and non-consensual TMSIs in multiple partner contexts as an indicator of sexual script endorsement. In the future, researchers may wish to directly assess people's endorsement of the TSS alongside their experiences with compliant and non-consensual TMSIs.

CONCLUSION

To our knowledge, this is the first study that includes multiple consent contexts of TMSI, as well as the different relationship contexts in which people have experienced them. The results of our study indicate that both participant gender and the relationship context of the interaction are important factors in understanding people's compliant and non-consensual TMSI experiences. As such, our findings extend and contextualize previous research by highlighting the importance of addressing consent and relationship context when examining TMSI. By ignoring the possibility of non-consensual and compliant TMSIs, researchers have neglected the full scope of people's experience. Indeed, it is possible that the prevalence of *consensual* TMSIs—including sexting and cybersex—could be lower than researchers have previously reported. In a world where sexual interactions are increasingly mediated through technology, researchers must include the offline relationship context in their examinations of people's TMSI experiences. It is only in acknowledging the offline, technology-mediated, consensual, and non-consensual contexts of people's experiences that researchers can understand the full scope of people's technology-mediated sexual behaviors.

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DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because unfortunately, at the time of data collection we did not include open science protocol in our informed consent procedures. Because our participants did not consent to having their raw data shared with other researchers, we are not able to ethically provide open data. We have added our measure of compliant and non-consensual TMSI experiences in-text (see **Table 2**), and would also be willing to provide our study materials to other researchers if contacted. Requests to access the datasets should be directed to krystelle.shaughnessy@uottawa.ca.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Ottawa Research Ethics Board. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

EC conceptualized the study and research methods, collected the data, conducted data analyses, wrote and edited all drafts of the manuscript, and prepared the manuscript for submission. KC conceptualized the study and research methods, collected the data, and edited several drafts of the manuscript. P-GN cleaned the data and ran some data analyses. KS assisted with study conceptualization, data analyses, supervised the project, and edited all drafts of the manuscript. All authors contributed to the article and approved the submitted version.

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But What's Your Partner Up to? Associations Between Relationship Quality and Pornography Use Depend on Contextual Patterns of Use Within the Couple

Taylor Kohut^{1*}, Kiersten A. Dobson¹, Rhonda N. Balzarini¹, Ronald D. Rogge²,
Amanda M. Shaw², James K. McNulty³, V. Michelle Russell³, William A. Fisher¹ and
Lorne Campbell¹

¹ Department of Psychology, Western University, London, ON, Canada, ² Department of Psychology, University of Rochester, Rochester, NY, United States, ³ Department of Psychology, University of Florida, Tallahassee, FL, United States

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*Correspondence:

Taylor Kohut
taykohut@gmail.com

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It is commonly assumed that exposure to pornography harms relationships because pornography changes the way that individuals think, feel, and behave in problematic ways. In the current research, we contribute to a small but growing body of work that challenges this assumption by carefully scrutinizing the relational context of pornography use. In contrast to dominant theoretical explanations in this field, we argue that at least some of the apparent negative “impacts” of pornography use on relationship quality may reflect partner dissimilarity in pornography use behavior rather than the consequences of exposure to such materials. Moreover, we further examine a particular type of pornography use – shared use with a partner – which previous evidence suggests may be positively associated with relationship quality. To this end, we sought to test whether dyadic patterns of pornography use, and related attributes, were associated with sexual and relationship satisfaction in two cross-sectional ($N_1 = 200$; $N_3 = 207$) and two longitudinal ($N_2 = 77$; $N_4 = 277$) samples of heterosexual couples. Across these samples, we found consistent evidence that partners who watch pornography together report higher relationship and sexual satisfaction than partners who do not, and notably, this association was not moderated by gender. Independent of this association, we also found evidence of a similarity-dissimilarity effect, such that the solitary pornography use of one partner was negatively associated with their own relationship and sexual satisfaction, but only in cases where their romantic partners used little or no pornography alone. Further consideration of several correlates of pornography use established comparable patterns of results for dissimilarity in attitudes toward pornography, erotophobia-erotophilia, sexual preferences, and sex drive. Importantly, only dissimilarity in sex drive statistically accounted for dissimilarity

in solitary pornography use, suggesting that differences in sex drive may be implicated in the associations between pornography use and relationship quality. These findings demonstrate that links between pornography use and relationship health are partially a function of different dyadic patterns of pornography use within couples and do not always suggest relational harm.

Keywords: pornography, romantic relationship, relationship satisfaction, sexual satisfaction, erotica

INTRODUCTION

Media (Montgomery-Graham et al., 2015) and academic (Zillmann, 2000; Manning, 2006) claims that pornography use undermines romantic relationships are widespread. However, recent failed replications (Balzarini et al., 2017), conceptual and empirical critiques (Campbell and Kohut, 2017; Perry, 2019; Fisher and Kohut, 2020; Kohut et al., 2020), and opposing findings (Kohut et al., 2018) are increasingly challenging this view. In the current research, we focus on different patterns of pornography use within adult relationships in an effort to reconcile evidence that pornography use may be related to both enhanced and diminished relationship functioning.

Pornography Use and Relationship Functioning

Although pornography use is a simple behavior to engage in, it has proven to be a difficult concept to define. While many definitions have been proposed, we have adopted the empirically informed conceptual definition described by Kohut et al. (2020) for the current paper because it attempts to embed the understanding of this construct within a complex network of potential antecedent-consequent relationships. At the heart of this theoretical definition, pornography use is understood to be a “common but stigmatized behavior, in which one or more people intentionally expose themselves to representations of nudity which may or may not include depictions of sexual behavior” (Kohut et al., 2020, 732).

Several theories have been advanced to explain pornography's impacts on relationships (e.g., 3AM, Social Learning Theory, Social Comparison Theory, the Confluence Model, the Elaboration Likelihood Model/Heuristic-Systematic Theories, etc.). At its core, Wright et al. (2014) 3AM, for example, argues that viewing pornography will contribute to the acquisition of new sexual scripts, the activation of previously acquired scripts, and/or the application of such scripts with respect to decisions about one's own behavior or judgments about the behavior of others. Other perspectives, such as those that apply Social Comparison theory (Festinger, 1954) or similar theories to the issue pornography (Kenrick et al., 1989; Muusses et al., 2015; Wright et al., 2019), focus more on how pornography users compare themselves and their romantic partners to what they see in pornography and change how they feel about their own sexual lives as a result. These are just two examples of many theoretical approaches to explaining pornography's effects, but what nearly all explanations of the effects of pornography have in common is that they assume that *exposure* to the content of sexual media precipitates personal or interpersonal change (see

Davis and Bauserman, 1993; Hogben and Byrne, 1998; Malamuth et al., 2000; Fisher and Barak, 2001; Wright et al., 2014; Muusses et al., 2015; Leonhardt et al., 2019). While few of these theories argue that the impacts of pornography *must* be harmful, specific applications of such theories have typically asserted that the content of pornography drives the acquisition of sexual scripts; influences sexual attitudes, standards, and expectations; or changes perceptions of personal or partner characteristics in ways that are deleterious to relationship functioning.

From this exposure-based perspective researchers have sought – and frequently found – evidence that pornography use is related to relationship dysfunction. Examples include studies that have found that pornography use is associated with decreased sexual and relationship satisfaction, particularly among men (Wright et al., 2017), impaired love for, and attraction to one's relationship partner (Weaver et al., 1984; Zillmann and Bryant, 1988; Kenrick et al., 1989), reduced relationship commitment (Lambert et al., 2012), increased extra-dyadic sexual behavior (Yucel and Gassanov, 2010; Maddox et al., 2011; Lambert et al., 2012), and relationship dissolution (Perry and Davis, 2017; Perry and Schleifer, 2018). With this accumulated empirical evidence and the underlying exposure-based theoretical rationales that accompany it, it is tempting to conclude that pornography does indeed undermine the well-being and stability of romantic relationships.

There remain, however, several reasons to be cautious about strong conclusions regarding pornography's negative impacts on relationships. For example, there is ongoing concern across the social sciences that many, perhaps most, of our previously accepted scientific findings are not reliable (Spellman, 2015). Close replications of research in this specific area are rare, but the only published attempt that we are aware of has not corroborated evidence that exposure to sexual images reduces love for or attraction to men's romantic partners (Balzarini et al., 2017), and such findings confirm older, rarely cited, conceptual replications that have not found such effects either (Dermer and Pyszczynski, 1978; Amelang and Pielke, 1992).

There is also a clear disparity between the conclusions reached by studies that examine the relationship correlates of pornography use and studies that ask pornography users – and importantly, the romantic partners of pornography users – about their perceptions of the effects of pornography. The former tend to find negative correlations between pornography use and relationship functioning, as outlined above, but most individuals who are in relationships in which pornography is used do not believe that pornography has harmed their relationships (Bridges et al., 2003; Hald and Malamuth, 2008; Grov et al., 2011; Rissel et al., 2016; Kohut et al., 2017b). While some have suggested

motivated reasoning may lead pornography users to under-report the harms of their use (Hald and Malamuth, 2008; Vandenbosch, 2019) available evidence for this view is sparse, and some lines of inquiry actually indicate influence in the opposite direction. It appears, for example, that negative attitudes toward pornography among pornography users may be biasing their perceptions of their use toward rather than away from harm (Grubbs et al., 2019). There is clearly much to learn here, but at present, the lack of correspondence between these two literatures should raise important questions and suggests to us that pornography's impact on relationship functioning may be more complex than it seems.

Finally, conceptual and methodological critiques of this literature emphasize the need to be cautious when making inferences about the effects of pornography on relationship quality (Campbell and Kohut, 2017; Fisher and Kohut, 2020; Kohut et al., 2020). Such concerns run the gamut from the evident harm bias in field, to the much less discussed effects-bias among many researchers (for an apparent defense of the view that correlates of pornography frequently represent causal effects, see Wright, 2021a,b), to more general problems with sampling, measurement, and generalizability across research. Most critical for this discussion is the concern expressed by Kohut et al. (2020) that researchers do not always fully understand and reflect on the complex nature of pornography use, and as a consequence, risk making inferential errors about pornography's presumed effects.

Antecedents, Context, and Effects of Pornography Use

In an effort to explain some of the discrepant and divergent findings, Campbell and Kohut (2017) have encouraged researchers to adopt an Antecedents-Context-Effects (ACE) perspective in this field of research. According to the ACE approach, the causal effects of pornography use may vary as a function of different *contexts* of pornography use within relationships (e.g., solitary vs. shared use, hidden vs. open use, the consumption of pro- vs. anti-social content, etc.), which in turn may indicate unique *antecedents* of use (e.g., sex drive, erotophobia-erotophilia, sexual attitudes, etc.¹; see also Leonhardt et al., 2019). Suppose, for example, that a relationship is characterized by large discrepancies in erotophobia-erotophilia. Erotophilic individuals are theorized to have had a lifetime of socialization experiences that reinforce a tendency to approach sexual cues in their environment and respond to such cues with positive affect (Fisher et al., 1988). In contrast, erotophobic individuals are expected to have been socialized to avoid such cues, and respond to such cues with negative affect. An erotophilic individual in such a couple would be more likely to be drawn to pornography use, would likely keep their use hidden from the more erotophobic partner who might respond to knowledge of such use with anger and disgust, and will be unlikely to use pornography with their partner. The relationship sequelae of this pattern of pornography use

are likely quite different from cases where both partners are erotophilic, as such couples may be more open and honest about their pornography use, and may be more likely to use it together in addition to their solitary use.

Solitary vs. Shared Pornography Use

One prominent division that has been proposed with respect to different relationship *contexts* of pornography use is the distinction between solitary and shared pornography use (Campbell and Kohut, 2017). In general, studies have found that relationship quality is positively correlated with the extent that relationship partners use pornography together (Kohut et al., 2018; Huntington et al., 2020; Willoughby and Leonhardt, 2020). Other research designs also suggest that relationship quality is higher among individuals who use pornography together with a romantic partner compared to individuals who only use pornography alone (Bridges and Morokoff, 2011; Maddox et al., 2011).

Explanations for such effects have been sparse and poorly developed, but one possibility, echoed by both the perceptions of pornography users themselves (Kohut et al., 2017b), as well as clinicians (Manning, 2006), is that shared pornography use provides opportunities to learn about each other's sexual likes and dislikes and build intimacy together (Kohut et al., 2018). This process can be understood from theoretical perspectives that emphasize the importance of the shared nature of novel and exciting activities which provide opportunities for "self-expansion" (Aron et al., 2000) and personal self-disclosures (Reis and Shaver, 1988). Exposure-based theories of pornography's impact may also play a role, in that joint exposure to the same sexual media may enhance the similarity of partners' sexual attitudes, scripts, and expectations over time. In particular, Leonhardt et al. (2019) have suggested that exposure to scripts in sexual media should reinforce the pursuit of physical sexual pleasure and variety at the expense of affection, attachment, and commitment toward one's partner. Others believe that this position mischaracterizes the nature of sexual scripts in pornography (Kohut and Campbell, 2019), pointing out that even the depiction BDSM practices – which Leonhardt et al. (2019) include in their description of the most detrimental materials for relationships – exhibit relationship enhancing scripts.

Similarity and Dissimilarity

Until recently, research in this area has frequently failed to consider dyadic patterns of solitary pornography use across both partners (Campbell and Kohut, 2017). What is often overlooked is that within a relationship involving two people, partners can be similar in their extent of solitary pornography use or non-use, or they can be dissimilar in their solitary pornography use, as when one partner uses pornography alone very frequently and the other does not. Although dyadic research which collects data from both relationship partners is beginning to accumulate, most studies still do not consider how partner similarity-dissimilarity in solitary pornography use is related to relationship functioning. Among studies that have, evidence suggests that pornography use tends to be more strongly associated with sexual and relationship dysfunction when one partner uses it and the other does not

¹ Note that while these examples are framed as antecedent factors for the purpose of illustration, these same factors could also be influenced by pornography use and thus be framed as effects in the ACE model. In that case, such consequents may "feed-forward," setting subsequent antecedent conditions that encourage pornography use (or non-use) in the future.

(Daneback et al., 2009; Yucel and Gassanov, 2010; Willoughby et al., 2016; Kohut et al., 2018).

The possibility that similarity-dissimilarity in solitary pornography use may be relevant to relationship quality should not be surprising. It has long been known in the study of close relationships that similarity in attitudes (Byrne, 1971; Montoya and Horton, 2013), personality, demographic variables (Buss, 1985), and recreational interests (Werner and Parmalee, 1978; Boer et al., 2011) promotes interpersonal liking. Within the specific context of romantic relationships, research also suggests that similarity in sexual preferences (Purnine and Carey, 1999), sexual ideals (Balzarini et al., 2021), erotophobia-erotophilia (Fisher et al., 1988; Smith et al., 1993), and sex drive (Eysenck and Wakefield, 1981) are all related to increased attraction and/or relationship functioning. With respect to such effects, it has long been believed that similar others validate our worldview and that this validation facilitates liking through positive reinforcement (Byrne, 1971). Emerging research, however, favors an alternative information-processing perspective where traits that are similar to one's own are viewed positively in and of themselves, and this is what drives attraction (Montoya and Horton, 2013). According to this perspective, traits that are dissimilar from one's own are viewed less positively, or even negatively, which leads to disliking.

On the basis of this literature, similarity and dissimilarity in dyadic patterns of solitary pornography use within relationships should also be differentially related to relationship functioning even if exposure to pornography fails to influence people thoughts, feelings, and behaviors. It could be, for example, that the discrepancy in pornography use between partners is a direct source of conflict in some relationships. Non-using individuals, if they are aware of their partners' pornography use, may have difficulty understanding it, view the behavior as infidelity, feel "replaced" as a romantic partner, or have self-doubts or personal insecurities as a result (Clark and Wiederman, 2000; Bergner and Bridges, 2002; Kohut et al., 2017b). Similarly, if the pornography user expects a negative response from their non-using partners, they may hide their use and lie about it to their partners (Resch and Alderson, 2014; Kohut et al., 2017b) which would likely place boundaries on intimate self-disclosures and interpersonal closeness in the relationship (Kohut et al., 2018). Under such conditions, it is likely that dissimilarity in pornography use, and not just exposure to such materials, may be undermining relationships.

Considering the ACE model, it is also possible that similarities or dissimilarities in sexual attitudes, sexual preferences, erotophobia-erotophilia, and sex drive – all of which are correlated with pornography use (Fisher et al., 1988; Davis and Bauserman, 1993; Baer et al., 2015) – may drive different patterns of pornography use within relationships. From this perspective, relationship conflicts over dissimilar pornography use may be proximal behavioral manifestations that mediate connections between broader similarity-dissimilarity in sexual attitudes (or other characteristics) and relationship functioning. Alternatively, however, Campbell and Kohut (2017) also warn that the antecedents of pornography use themselves may be the true proximal causes of the *assumed effects* of pornography use

on relationship functioning. If this is true, similarity-dissimilarity in couple members' pornography use may simply act as an observable marker of more fundamental differences between partners (for an explicit denouncement of this view, see Wright, 2021a). Lastly it is also possible that similarity-dissimilarity in sexual attitudes, erotophobia-erotophilia, and/or sex-drive may be the result of differences in pornography use (Wright, 2021a,b). Regardless of the causal mechanism that is at play, there are evident reasons to consider whether similarity-dissimilarity in factors like sexual attitudes, sexual preferences, erotophobia-erotophilia, and sex drive may be implicated in the expected associations between similarity-dissimilarity in solitary pornography use and relationship functioning.

Gender

It is very well established in pornography research that men are more likely to report using pornography and do so at a higher frequency than women (Petersen and Hyde, 2010; Carroll et al., 2017). Furthermore, Wright et al. (2017) meta-analysis found that while men's use of pornography is generally associated with lower sexual and relationship satisfaction, women's pornography use is not. Such findings have reinforced speculations about gender-specific processing of pornographic content (see, for example, Wright et al., 2017).

There is, however, another possibility. Because of gender differences in base rates of pornography use, within heterosexual relationships, the probability that male pornography users are in relationships in which both people use pornography is not the same as the probability that female pornography users are in relationships in which both people use pornography. Indeed, when Kohut et al. (2018) checked their data they found that while over 80% of the female pornography users in their sample were in relationships where both partner's used pornography alone, only half of the male pornography users were in such relationships. While this is just one sample, a general difference in conditional probabilities of this magnitude would suggest that on average, female solitary pornography use is more likely to occur within relationships in which both members use pornography than male solitary pornography use. If this is the case then gender differences in the correlates of pornography use might reflect the consequences of similarity-dissimilarity in addition to or instead of any gender-specific processing of pornography that may occur.

Research Overview

In summary, we propose that divergent patterns of association between pornography use and relationship quality are partially a function of different dyadic patterns of pornography use within adult romantic relationships. Specifically, we argue that similarity-dissimilarity in couple members' solitary pornography use as well as shared pornography use differentiates positive from negative relationship functioning. One question that remains is whether associations between relationship quality and similarity-dissimilarity in solitary pornography use exist independently of associations between relationship quality and shared pornography use. Although it is clear that men are more likely to use pornography than women (Petersen and Hyde, 2010; Carroll et al., 2017), and that shared pornography use is

less frequent than solitary pornography use (Kohut et al., 2018; Willoughby and Leonhardt, 2020) less is known about the co-occurrence of similarity in solitary pornography use and shared pornography use within relationships. In one of the few studies to describe basic dyadic patterns of pornography use it appears that shared pornography use is particularly common within relationships in which both partners use pornography individually (Kohut et al., 2017a). Under such conditions, associations between similarity-dissimilarity in solitary pornography use and relationship functioning might partially, or even wholly, reflect associations between shared pornography use and relationship functioning (or vice versa). Although several studies have indicated that relationship quality is higher when partners are more similar rather than dissimilar in their pornography use (Daneback et al., 2009; Yucel and Gassanov, 2010; Willoughby et al., 2016; Kohut et al., 2018), and when partner's report more shared pornography use (Kohut et al., 2018; Huntington et al., 2020; Willoughby and Leonhardt, 2020), only one study to our knowledge has examined such associations in the same statistical model. In this case, Kohut and colleagues (Kohut et al., 2018) found that such associations were independent of one another, but their examination was limited to correlations with sexual communication and interpersonal closeness. Whether these associations remain independent when correlations with other measures of relationship quality are considered remain to be seen.

We further argue that pornography use may be one of many attitudinal and/or motivational dimensions on which couple dissimilarity is related to relationship dysfunction, either because it mediates the impact of other ultimate causes of relationship dysfunction, or because it stems from such causes but is only spuriously associated with relationship dysfunction, or because such variables are themselves impacted by pornography use, ultimately mediating associations between pornography use and relationship dysfunction. While it is not possible to definitively determine which causal mechanisms is at play with cross-sectional or even longitudinal designs (Fisher and Kohut, 2020), it is still worth considering whether similarity-dissimilarity in factors like attitudes toward pornography use, sexual ideal preferences, erotophobia-erotophilia, and sex drive may be statistically confounded with similarity-dissimilarity effects for solitary pornography use. Information about such confounds gleaned from correlational designs may prove relevant for understanding causal relationships between dyadic patterns of pornography use and relationship functioning in subsequent research.

What follows is a description of an inter-laboratory collaboration that sought to determine if dyadic patterns of pornography use were related to differences in sexual and relationship satisfaction within adult relationships. Across the studies presented below we expected that the frequency of shared pornography use should be positively associated with both sexual and relationship satisfaction. Further, we expected that independent of this association, partners' reports of solitary pornography use would interact, such that couple members who were similar in their frequencies of solitary pornography use would report greater sexual and relationship satisfaction than

couple members who were dissimilar in their frequencies of solitary pornography use. In so doing, we also explored, where we could, whether similarity in attitudes toward pornography use, sexual ideal preferences, erotophobia-erotophilia, and sex drive could statistically account for associations between patterns of pornography use and sexual and relationship satisfaction. In sum, this research was guided by the following hypotheses and research question:

H1: The frequency of shared pornography use should be positively correlated with (a) relationship and (b) sexual satisfaction.

H2: The frequencies of each partners' solitary pornography use should interact positively, such that (a) relationship and (b) sexual satisfaction would be lowest when partners were most dissimilar in their solitary pornography use.

RQ1: Are interactions between partners' reports of solitary pornography use partially or wholly confounded with interactions between partners' attitudes toward pornography, sexual ideal preferences, erotophobia-erotophilia, or sex-drive?

Given the theoretical positions adopted in the current paper, there are no compelling reasons to expect that the anticipated similarity-dissimilarity effects of solitary pornography use or the effects of shared pornography use should be moderated by gender. Indeed, past research that has adopted a similar theoretical approach did not find evidence of such moderation when correlations between pornography use, sexual communication, and interpersonal closeness were considered (Kohut et al., 2018). However, gender is a commonly examined variable in pornography research, and at least one other study of similarity-dissimilarity in pornography use reported some gender-specific effects (Willoughby et al., 2016), so we considered possible interactions with gender in the current research as well.

The data that serve as the basis for the current analyses are drawn from four dyadic datasets of adult couples, collected by three independent laboratories. They are presented in the order in which the data became available to the first author, as this best represents the actual development of this research project. Study 1 tested H1 and H2 in a sample of $N = 200$ married heterosexual couples. Study 2 concerned a preliminary and somewhat limited examination of RQ1 by exploring whether or not similarity-dissimilarity in attitudes toward one's own pornography use were related to relationship and sexual satisfaction in longitudinal sample of $N = 77$ newlywed couples. Study 3 replicated tests of H1 and H2 and further examined RQ1 more thoroughly by considering whether similarity-dissimilarity in sexual ideals and erotophobia-erotophilia confounded associations with similarity-dissimilarity in solitary pornography use in a cross-sectional sample of $N = 207$ heterosexual couples. Finally, Study 4 tested H1 and H2 once again, and further scrutinized RQ1 by determining whether or not associations with similarity-dissimilarity in solitary pornography use were statistically confounded with similarity-dissimilarity in attitudes toward a partners' use of

pornography and sex drive in a longitudinal sample of $N = 277$ heterosexual couples. Apart from Study 1, where there was an administrative error, we pre-registered our hypotheses and analytic plans prior to conducting our planned analyses but after the data were collected for other purposes.

STUDY 1: PORNOGRAPHY USE AND SEXUAL AND RELATIONSHIP SATISFACTION

Research has previously found that comfort with sexual communication and interpersonal closeness are independently associated with both the frequency of shared pornography use and partners' similarity in solitary pornography use (Kohut et al., 2018). Based upon such findings, it seemed likely that patterns of pornography use should also be associated with the closely related constructs of sexual and relationship satisfaction. Consequently, Kohut et al.'s (2018) data were used to test H1 and H2 and to examine RQ1 (registered materials: <https://osf.io/p9ut3>; data and syntax²). Details of related ancillary research questions concerning curvilinear associations between pornography use and relationship quality and their results can be found in Supplementary Data Sheet 1.

Study 1: Method

Study 1: Participants

The sample consisted of $N = 200$ American heterosexual couples consisting of 400 individuals. These couples were quota sampled through Qualtrics Panel LLC so that women in the sample better reflected the distribution of age and political affiliation of married American women between 25 and 44 years of age. Estimates for these distributions were derived from the General Social Survey (Smith et al., 2019). Full details concerning the sampling approach and data exclusions can be found in Kohut et al. (2018). Couple members were predominately middle-aged ($M = 41.81$), Caucasian (83.5%), Christians (54.25%), with a range of political viewpoints, and were in married or common-law relationships (96.50%) of a mean duration of nearly 15 years.

Study 1: Materials and Procedure

After informed consent was verified in an online procedure, participants were asked to complete demographic items and established measures of relationship satisfaction, sexual satisfaction, interpersonal closeness, sexual communication, attachment orientation, and pornography use. Participants were then debriefed and provided token compensation. The local research ethics board reviewed and approved the materials and procedures before study initiation. Means and standard deviations for the following measures can be found in **Table 1**.

Study 1: relationship satisfaction

Relationship satisfaction was measured with the four item short-form of the Couples Satisfaction Index (Funk and Rogge, 2007). Participants were asked to respond to items such as, "Please

indicate the degree of happiness, all things considered, of your relationship" with 6- or 8-point scales. As a result of a programming error on the survey platform, the item "In general, how satisfied are you with your relationship?" had seven rather than the intended six response options. An additional response option "Very Satisfied" was erroneously included after the six typical response options for this scale (which range from "Not at all" to "Completely"). Despite this error, responses to this item were strongly correlated with the summed-aggregate of the other three items, $r = 0.86$, and thus were retained for use in this study. Because the number of response options varied across items, responses to each item were standardized independently prior to being mean aggregated to create a composite measure of relationship satisfaction ($\alpha = 0.89$). Scores on the resulting aggregate ranged from -3.13 (low relationship satisfaction) to 1.01 (high relationship satisfaction).

Study 1: sexual satisfaction

Sexual satisfaction was measured with Lawrence and Byers' (1998; as cited in Byers, 2005) five-item Global Measure of Sexual Satisfaction. Participants rated their sexual relationships on five 7-point bivalent scales: good-bad, pleasant-unpleasant, positive-negative, satisfying-unsatisfying, valuable-worthless. Responses to these items were mean averaged to create a measure of sexual satisfaction ($\alpha = 0.97$) that ranged from 1 (low sexual satisfaction) to 7 (high sexual satisfaction).

Study 1: pornography use

Participants were instructed that pornography use was "intentionally looking at, reading, or listening to: (a) pictures or videos of nude individuals, (b) pictures or videos in which people are having sex, or (c) written or audio material that describes nude individuals, or people having sex." Participants were told to exclude sexually interactive online and offline behaviors from their reports of pornography use. Following these instructions, participants were asked about their solitary pornography use ("How frequently do you use pornography while alone (i.e., without your partner)?") and their shared pornography use ("How frequently do you use pornography together with your partner?"). Response options for both items included (1) – "Never"; (2) – "Almost Never"; (3) – "Less than Once a Month"; (4) – "1–3 Times Per Month"; (5) – "1–2 Times Per Week"; (6) – "3–4 Times Per Week"; (7) – "About Once a Day"; (8) – "More than once a day." Non-use of pornography was common and responses were positively skewed in this sample: 47.00% of the sample reported never using pornography alone ($S = 1.08$, $p < 0.001$) while 54.00% reported never using it with a partner ($S = 1.57$, $p < 0.001$). Reports of shared pornography use by each partner were strongly correlated, $r = 0.76$, $p < 0.001$, and were mean averaged to create a dyadic index of shared pornography use. To aid interpretability, both the measure of solitary pornography use and the measure of shared pornography use were independently standardized for use in the primary analyses described below. In addition, following recommended practice for response surface analysis (RSA; Shanock et al., 2010) the standardized measure of solitary pornography use was re-centered at the midpoint of the scale range.

²https://osf.io/unf74/?view_only=fcb67be7a0142d591a9bb87dcc994b0

TABLE 1 | Summary of the correlations, means, and standard deviations of the focal variables for Study 1 ($N = 200$ couples).

	1	2	3	4	5	6	7	8	<i>M</i>	<i>SD</i>
1. Relationship Satisfaction Male									0.12 ¹	0.81
2. Relationship Satisfaction Female	0.65**								−0.12	0.93
3. Sexual Satisfaction Male	0.66**	0.52**							5.97 ¹	1.29
4. Sexual Satisfaction Female	0.44**	0.70**	0.52**						5.70	1.50
5. Solitary Porn. Use Male	−0.22**	−0.14*	−0.10	−0.13					3.01 ¹	2.01
6. Solitary Porn. Use Female	−0.08	−0.02	−0.04	0.03	0.38**				1.89	1.28
7. Shared Porn. Use Male	0.06	0.14*	0.12	0.09	0.37**	0.35**			1.77	1.19
8. Shared Porn. Use Female	0.06	0.10	0.06	0.06	0.29**	0.48**	0.76**		1.76	1.14
9. Mean Shared Porn. Use	0.06	0.13	0.10	0.08	0.35**	0.44**	0.94**	0.94**	1.77	1.10

*Signifies significant correlations $p < 0.05$; **signifies significant correlations, $p < 0.01$.

¹Men report significantly higher relationship satisfaction, $p < 0.001$, sexual satisfaction, $p = 0.005$, and pornography use, $p < 0.001$, than women.

For interpretability, all *M* and *SD* are presented in the original scale metric.

Study 1: Analytic Plan

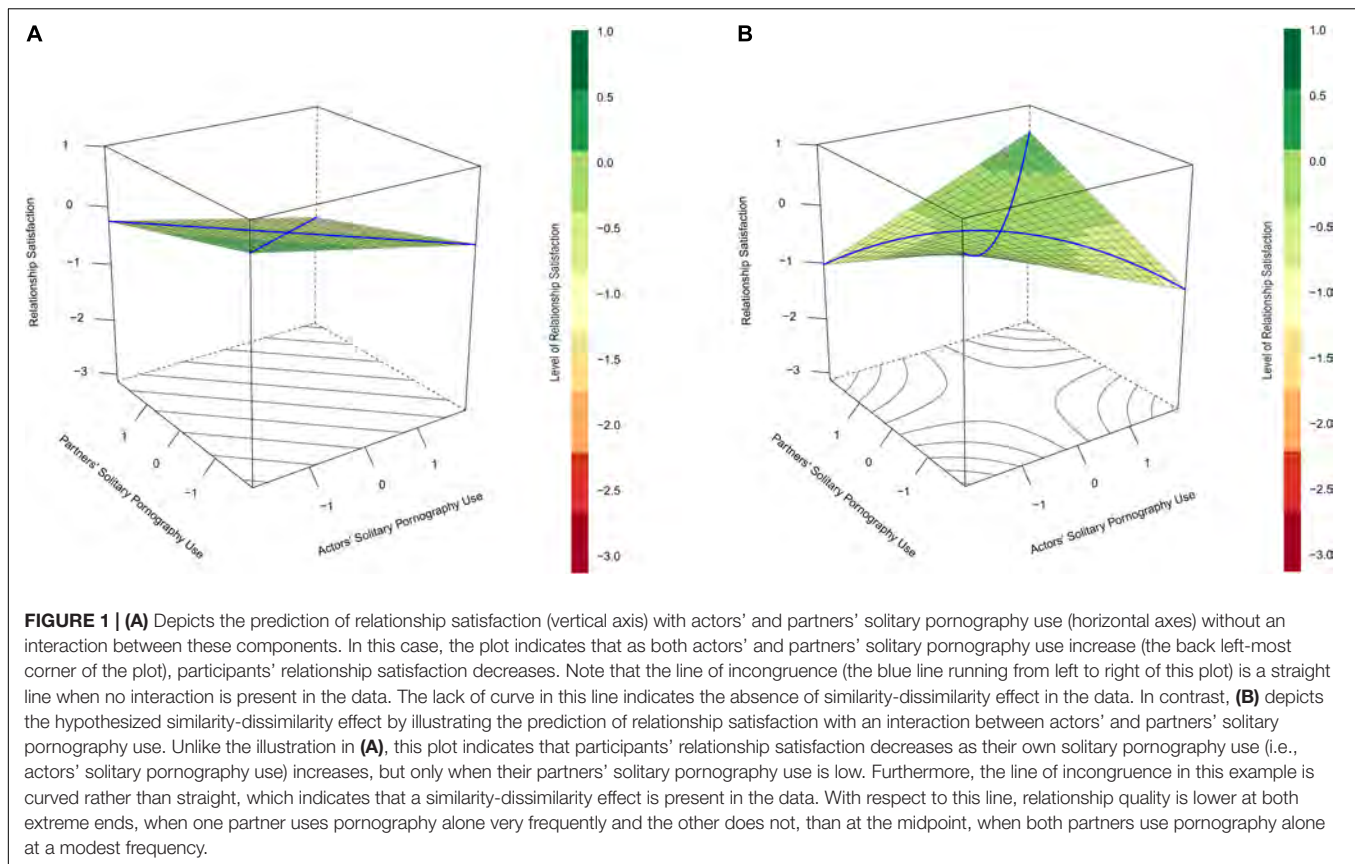
Associations between pornography use and relationship and sexual satisfaction were examined with a response surface analysis (Shanock et al., 2010) applied to a linear mixed modeling approach to the actor-partner independence model (APIM; Kenny et al., 2006). This was done by testing a series of increasingly complex APIMs (as described below) using the MIXED command in IBM SPSS Statistics 25 (IBM Corporation, 2017). All APIMs were estimated with maximum likelihood estimation so that differences between nested models could be tested with likelihood-ratio tests. The resulting output from the most complex model supported by the data was then subjected to an RSA using the formula's outlined by Shanock et al. (2010) and plotted with the plotRSA function of the RSA package (Schönbrodt and Humberg, 2020) for R (R Core Team, 2020). RSA is a better method for testing similarity-dissimilarity effects than traditional approaches using difference scores (Edwards, 1994, 2002; Shanock et al., 2010). Please note that measures of pornography use were standardized before they were re-centered so that the unstandardized fixed effects coefficients for pornography use reported below can be interpreted as relative effect sizes within each respective model. Standard scores were then re-centered at the midpoint of the scale range to facilitate interpretation in the RSA.

The initial model involved the prediction of relationship satisfaction using actors' and partners' solitary pornography use and their interaction. In this case, residuals were modeled by nesting partner within couple and estimating an unstructured residual covariance matrix. In the next step, we added shared pornography use as a between-dyad factor to see if the interaction still held while controlling for shared use. Although we did not anticipate interactions with gender based on our theorizing and findings from previous research, we tested gender effects by adding a main effect and interaction components for gender in a following step. Next, we checked to see if quadratic effects for actors' and partner's solitary pornography use improved the prediction using log-likelihood ratio tests. The inclusion of these quadratic components is common practice in RSA. In the current study, the addition of these components did not improve model fit (see **Supplementary Data Sheet 1**) so similarity-dissimilarity

effects were examined in the more parsimonious interaction model, which is how such effects have been tested in previous studies involving pornography use (Willoughby et al., 2016; Kohut et al., 2018). These steps were then repeated to examine the associations between pornography use and sexual satisfaction.

To understand RSA it is useful to recognize that all general linear models in which two predictors are regressed on an outcome can be thought of as a prediction surface which describes the anticipated outcome (Z) at different levels of each predictor (X and Y). In the absence of an interaction between predictors ($Z' = b_0 + b_1X + b_2Y$) the prediction surface is flat plane where the "tilt" or "orientation" is determined by the main effects of the predictors (defined by b_1 and b_2 ; see **Figure 1A**). In the presence of an interaction though ($Z' = b_0 + b_1X + b_2Y + b_3XY$), the specific associations between each predictor and the outcome vary as a function of the other predictor, and this results in a curvilinear distortion of the prediction surface, defined by b_3 , that can take one of several constrained forms (for one such example see **Figure 1B**).

An RSA builds on this logic by using simple algebra to recombine coefficients (and their associated standard errors) from an expanded polynomial regression of the form, $Z' = b_0 + b_1X + b_2Y + b_3X^2 + b_4XY + b_5Y^2$. This recombination is done to test four new parameters that describe the attributes of two arbitrary lines that run through the prediction surface: the line of congruence (defined as the line where $X = Y$) and the line of incongruence (defined as the line where $X = -Y$). With respect to the current study, the line of congruence describes the predicted levels of relationship (and sexual) satisfaction for cases where partners report the same frequencies of solitary pornography use or non-use (actors' solitary pornography use = partners' solitary pornography use). In contrast, the line of incongruence defines the predicted levels of relationship (and sexual) satisfaction when partners' patterns of pornography use range from cases where participants use pornography alone more than once a day (actors' solitary pornography use = 1.97) but their partners do not use pornography alone (partners' solitary pornography use = −1.97), through cases where both participants and their partners use pornography about once a week (actors' solitary pornography use



use = 0 and partners' solitary pornography use = 0), to cases where the participants do not use pornography alone (actors' solitary pornography use = -1.97) and but their partners do so more than once a day (partners' solitary pornography use = 1.97). The line of incongruence plots a course on the prediction surface that ranges from one form of extreme dissimilarity, to a point of similarity, to another form of extreme dissimilarity (see the blue line running from the left to right side of **Figure 1B**).

The goal of RSA is to test slopes (indicated by coefficients a_1 and a_3) and curvilinear components (indicated by coefficients a_2 and a_4) for the line of congruence and the line of incongruence, and each component has a specific interpretation. With respect to the focal predictions of this study, coefficient a_4 is most relevant because it describes the curvature along the line of incongruence. When a_4 is significant it means that a similarity-dissimilarity effect is present in the data. If this coefficient is negative, it describes a convex shape. In the context of the current study a convex curve along the line of incongruence would mean that predicted satisfaction scores are higher when partners both report using pornography alone about once a week than when they report extreme dissimilarity in solitary pornography use (see **Figures 1A,B**). A significant slope along the line of incongruence denoted by coefficient a_3 , describes the degree of tilt that is present in the curve. Depending on the direction of this slope, this will enhance the magnitude of the effect of one type of extreme dissimilarity while diminishing the magnitude of the other (e.g., relationship satisfaction is lower when participants frequently

use pornography alone and their partners do not than when participants do not use pornography alone but their partners do so frequently).

Study 1: Results

Correlations between primary measures can be found in **Table 1**. Notable correlations existed between men's and women's reports of relationship satisfaction, $r = 0.65$, $p < 0.001$, sexual satisfaction, $r = 0.52$, $p < 0.001$, and shared pornography use, $r = 0.76$, $p < 0.001$, as well as between the within-subject reports of sexual and relationship satisfaction provided by men, $r = 0.66$, $p < 0.001$, and women, $r = 0.70$, $p < 0.001$.

The initial model predicted relationship satisfaction using actors' and partners' reports of solitary pornography use and their interaction. In subsequent steps, model fit was improved, $\chi^2(1) = 8.46$, $p = 0.004$, by adding shared pornography use as a between-dyad covariate, and gender as a within-dyad factor, $\chi^2(1) = 15.96$, $p < 0.001$. Consistent with H1a, frequency of shared pornography use was significantly related to relationship satisfaction, $b = 0.17$, $p = 0.004$, such that couples who reported more frequent shared pornography use reported higher relationship satisfaction. However, with respect to the expected similarity-dissimilarity effect (H2a), the positive interaction term was in the anticipated direction but dropped from significant, $b = 0.10$, $p = 0.042$, to non-significant, $b = 0.10$, $p = 0.061$, when the main effect for gender was added to the model (see **Figure 2A** and **Table 2**). Adding further

interactions between gender and the other components of the model did not significantly improve model fit, $\chi^2(4) = 3.31$, $p = 0.508$.

Sexual satisfaction was analyzed in the same way. In this case, adding the main effect for shared pornography use significantly improved fit, $\chi^2(1) = 6.08$, $p = 0.014$, but adding the main effect for gender did not $\chi^2(1) = 3.10$, $p = 0.078$. Within this model, the interaction between actor's and partners' solitary pornography use was significant when predicting sexual satisfaction, $b = 0.16$, $p = 0.043$, as was the frequency of shared pornography use, $b = 0.23$, $p = 0.014$ (see **Table 2** and **Figure 2B**). The RSA (Shanock et al., 2010) of the solitary pornography use components of this model further revealed significant curves along the lines of congruence, $a_2 = 0.16$, $p = 0.043$, and incongruence, $a_4 = -0.16$, $p = 0.043$, as well as a positive slope along the line of incongruence, $a_3 = 0.20$, $p = 0.009$. In sum, as we predicted, sexual satisfaction tended to be higher among participants who reported more shared pornography use (H1b) and lower among participants who reported high dissimilarity in their frequencies of solitary pornography use (H2b). However, the significant slope for a_3 indicated that the effects of dissimilarity on sexual satisfaction were particularly pronounced in cases where participants used little to no pornography alone but their partners frequently used pornography alone (see **Figure 2B**). Model fit was not improved further by adding interactions between gender and the other components of the model, $\chi^2 = 0.964$, $p = 0.915$.

Additional region of significance tests (Preacher et al., 2018) for simple slopes of actors' solitary pornography use at different values of a partners' solitary pornography use indicated a break point at -1.74 . In this case, participants' own pornography use was negatively related to their sexual satisfaction, but only among participants whose partner almost never used pornography, otherwise, pornography use was unrelated to their sexual satisfaction.

Study 1: Discussion

The results of Study 1 extended the previously established positive associations between shared pornography use and relationship quality (e.g., open sexual communication and closeness; see Kohut et al., 2018) to measures of relationship and sexual satisfaction. The results suggest that relationship

and sexual satisfaction was higher among couples who use pornography together on a more frequent basis. The associations between similarity-dissimilarity in solitary pornography use and satisfaction, however, were more nuanced. Sexual satisfaction varied, as predicted, by the degree of similarity-dissimilarity in partners' frequencies of solitary pornography use. Specifically, sexual satisfaction was lower when one partner used pornography alone while the other did not, and this effect was more pronounced among the partner who did not use pornography alone than among the partner who used pornography alone. With respect to relationship satisfaction, the pattern of effects was similar but weaker, and did not remain after an effect for gender was added to the model. This gender difference in relationship satisfaction was unexpected as previous analyses of this dataset have not found gender effects in the other measures of relationship quality once indicators of pornography use were controlled for (Kohut et al., 2018).

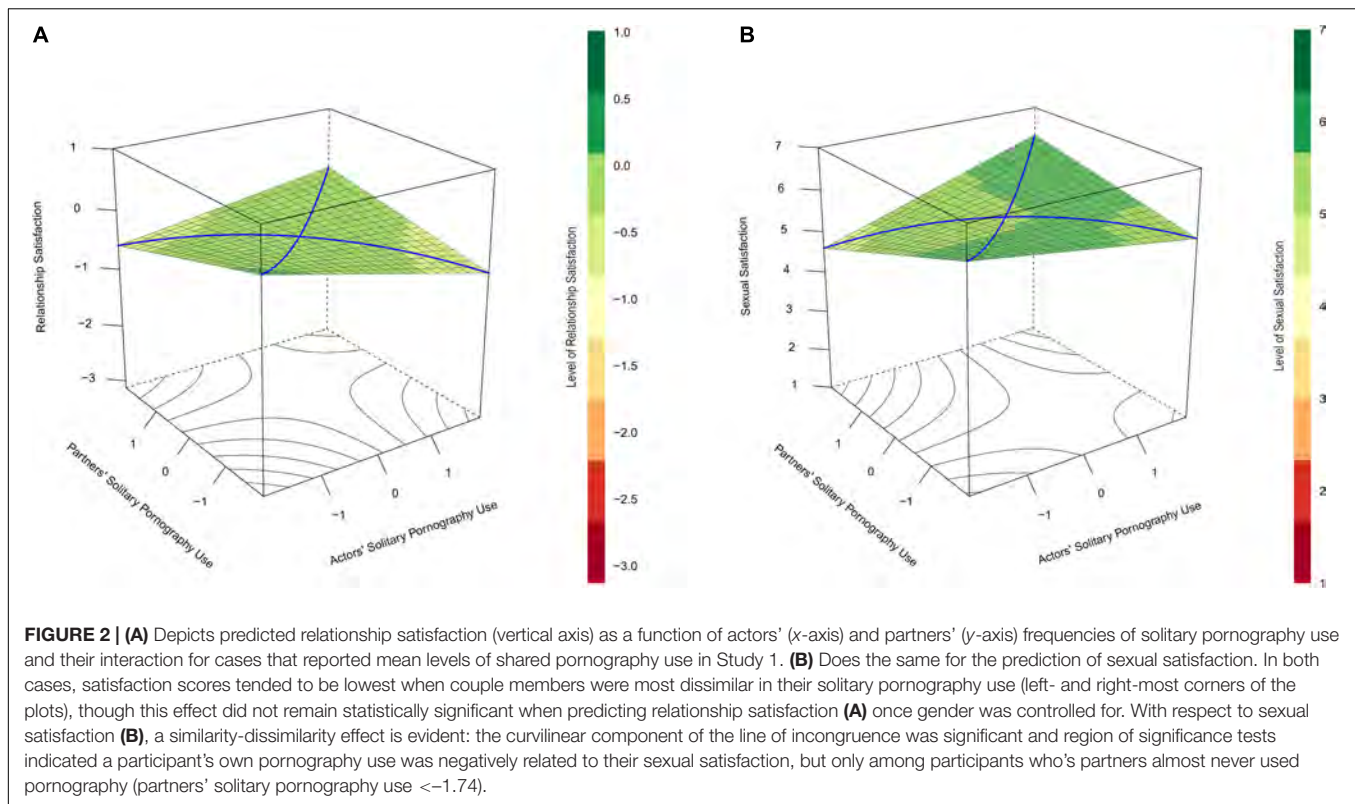
STUDY 2: ATTITUDES TOWARD ONE'S OWN PORNOGRAPHY USE

Although the correlates of shared pornography use are important in their own right, the theoretical mechanism underlying the correlates of similarity-dissimilarity in solitary pornography use is of particular interest to us. One possibility is that such associations stem from partner dissimilarity in attitudes toward pornography use. Within the literature, attitudes toward pornography use have been operationalized in a variety of different ways including the degree that people believe that pornography is arousing (Haavio-Mannila, 2003), the degree that they believe pornography is exciting and entertaining (Træen et al., 2004), the degree that they believe that it is beneficial or harmful (Træen et al., 2004; Poulsen et al., 2013) and the degree that they approve or disapprove of the use of others (Carroll et al., 2008). Men have notably more positive attitudes toward pornography use than women in that they tend to report that using pornography is more exciting, entertaining, and self-enhancing (Træen et al., 2004), and are also more approving of the use of others (Carroll et al., 2008, 2017). People with more positive attitudes toward pornography also tend to report using it more frequently (Træen et al., 2004; Poulsen et al., 2013), and because men are more likely to use pornography than women (Petersen and Hyde, 2010), it is likely that partners in many heterosexual relationships have dissimilar attitudes in this regard. Given previous findings concerning sexual similarity-dissimilarity (Eysenck and Wakefield, 1981; Smith et al., 1993; Purnine and Carey, 1999; Montoya and Horton, 2013), it seemed likely that partner similarity-dissimilarity in attitudes toward pornography use should also be related to relationship and sexual satisfaction. Finding such effects would lend credit to the possibility that similarity-dissimilarity in constructs related to pornography use may be statistically confounded with the similarity-dissimilarity effects of solitary pornography use (RQ1).

To the extent that attitudes toward using pornography oneself serve as a marker for actual pornography use (more positive attitudes reflect more pornography use), a harm-focused

TABLE 2 | Linear mixed models predicting relationship and sexual satisfaction for Study 1 ($N = 200$ couples).

	Relationship Satisfaction		Sexual Satisfaction	
	<i>b</i>	<i>p</i>	<i>b</i>	<i>p</i>
Fixed Effects				
Intercept	-0.24	0.029	5.63	>0.001
Actors' Solitary Porn. Use	-0.05	0.493	0.11	0.305
Partners' Solitary Porn. Use	-0.04	0.608	-0.09	0.399
Actors' by Partners' Solitary Porn. Use	0.10	0.061	0.16	0.043
Shared Porn. Use	0.17	0.004	0.23	0.014
Gender	-0.12	>0.001	—	—



exposure-based approach would argue that positive attitudes should correlate with a decline in relationship and sexual satisfaction over time. To this point, some existing longitudinal studies have found that pornography use precedes changes in relationship functioning (Perry, 2017a,b; Wright et al., 2017), though few of these studies have been dyadic in nature and at least some evidence indicates that relationship dysfunction can precede changes in pornography use (Muusses et al., 2015). To our knowledge no longitudinal studies have examined the role similarity-dissimilarity in partners' pornography use – or more relevantly here, partners' attitudes toward using pornography themselves – as an important moderating influence.

From an attitudinal similarity perspective, however, alternative expectations for the association between attitudes toward pornography use and changes in relationship and sexual satisfaction are possible. In a new couple, for example, one might expect that full awareness of differences in attitudes between partners may have yet to emerge, especially with respect to attitudes toward sexual interests like pornography use. If that were true, the magnitude of expected positive interaction between partners' attitudes toward pornography use could increase over time, reflecting increasingly negative impacts of dissimilarity in attitudes (relative to similarity in attitudes) as partners learn more about one another. On the other hand, in the West, sexual interactions frequently begin in the early stages of relationships, with few people waiting for the commitment of marriage (Wu et al., 2017), so partners may become aware of similarities and differences in each other's attitudes toward pornography use (or other closely related attitudes) relatively early on. In such

circumstances, the magnitude of the associations between the relationship and sexual satisfaction and the interaction between partners' attitudes toward using pornography themselves could either remain constant across time or decrease over time, depending largely on the (a) stability of attitudes, and (b) the stability of the relationship between attitudes toward pornography and sexual satisfaction.

Such questions were examined with a subset of data drawn from an 8-wave longitudinal study of American newlyweds that tracked relationship and sexual satisfaction over three and a half years in approximately 6-month intervals. Data were restricted to assessments at waves 5 through 8 because this study did not measure attitudes toward pornography use until wave 5, roughly 2 years from study initiation. Unfortunately, this measure of attitudes was not repeated in subsequent waves, which restricted the nature of temporal questions that could be examined with this data. With the previous findings in mind, we generally expected that partners' attitudes would moderate the associations between actors' attitudes toward using pornography themselves and relationship and sexual satisfaction such that satisfaction would be lower when actors and partners were discrepant in their attitudes toward using pornography. Because existing similarity-dissimilarity effects of pornography use have generally not been moderated by gender, we did not believe that the actor, partner, or the actor by partner interaction effects of attitudes would be further moderated by gender in this case either. Given the lack of the previous time-relevant dyadic research to draw on, coupled with divergent theoretical expectations, we had no firm expectations about whether the anticipated interaction effects

would be further moderated by time (registered materials: <https://osf.io/846vp>; data and syntax^{3,4}). Details of related ancillary research questions concerning curvilinear associations between attitudes toward pornography use and relationship quality can be found in Supplementary Data Sheet 1.

Study 2: Method

Study 2: Participants

Participants were drawn from a larger eight-wave longitudinal study of 135 American newlywed couples. Data analysis was restricted to data from waves 5 through 8 of the study because the assessment of attitudes toward using pornography did not occur until the 5th wave. In the latter half of this study, only 154 members of 77 couples had provided data that could be analyzed (recruitment details can be found in McNulty, 2016).

Of the $N = 154$ participants who had complete assessments of attitudes toward their own pornography use and at least one of the two dependent variables for both themselves and their partners, one hundred and forty-six (94.81%) reported relationship satisfaction at least twice; 120 (77.92%) reported relationship satisfaction at least three times, and eighty reported relationship satisfaction (51.95%) on all measurement occasions (reports of sexual satisfaction followed a similar pattern). Missing data analysis indicated that attitudes toward pornography use were somewhat more positive among those with missing relationship and sexual satisfaction data at wave 2, but there was no evidence of non-random missingness. As a consequence, we assumed that data were “Missing at Random” rather than “Missing at Complete Random” and proceeded with the planned linear mixed models (described below).

At study baseline, approximately 2 years before the 5th wave of the study, the husbands examined here were 25.79 years old ($SD = 4.13$) and had completed 16.19 years of education ($SD = 2.08$). The median of husbands’ reported income range was \$20,001 to \$25,000 per year. Wives were 23.95 years old ($SD = 3.28$) and had completed 17.25 years of education ($SD = 1.60$). The median of wives’ reported income ranged from \$10,001 to \$15,000 per year. Eighty-seven percent of husbands and 91% of wives identified as Caucasian. Husbands who were retained for analysis were significantly more educated than those who were not, $t(133) = 2.51$, $p = 0.013$, but these groups did not differ in age, $t(133) = 0.33$, $p = 0.745$, race, $\chi^2(8) = 13.06$, $p = .794$, or income, $t(132) = -1.30$, $p = 0.197$. Wives that were retained for analysis did not differ from those who were excluded in terms of education, $t(133) = -0.46$, $p = 0.648$, age, $t(133) = 0.95$, $p = 0.346$, race, $\chi^2(3) = 2.74$, $p = .434$, and income, $t(132) = -0.19$, $p = 0.847$.

Study 2: Materials and Procedure

As part of the broader aims of the original study from which these data were drawn, couples attended a laboratory session. Before that session, they were mailed a packet of questionnaires

to complete at home and bring to their appointment. This packet included a consent form approved by the local human subjects review board, questionnaires beyond the scope of the current analyses (e.g., personality, stress, self-esteem, etc.), and a letter instructing participants to complete all questionnaires independently of their partners and to bring their completed questionnaires to their upcoming laboratory session at which they completed other tasks that are not relevant to the current analyses (see McNulty and Russell, 2010; McNulty, 2016). Couples were paid US\$80 for participating in this phase of the study.

At approximately 6- to 8-month intervals subsequent to the initial assessment, couples were re-contacted by phone or email and again mailed further questionnaire packets. At the fifth wave of assessment, the packet contained questions about relationship satisfaction, sexual satisfaction, and attitudes toward pornography use. The sixth, seventh, and eighth wave of assessment contained the same measures of relationship and sexual satisfaction but not attitudes toward pornography use. Couples were mailed a US\$50 check for participating in each of these follow-up phases. Means and standard deviations for the following measures can be found in Table 3.

Study 2: relationship satisfaction

Relationship satisfaction was assessed with the Quality Marriage Index (Norton, 1983) at waves 5 through 8. It consists of five items that ask participants the extent to which they agree or disagree with general statements about their marriage (e.g., “We have a good relationship”) on a scale from “Very strong disagreement” (1) to “Very strong agreement” (7), and one item that asks spouses to answer the question “All things considered, how happy are you with your marriage?” on a scale from “Very unhappy” (1) to “Perfectly happy” (10). Scores were summed so that higher scores indicated more satisfaction. Reliability was high; Cronbach’s α was above 0.90 for both husbands and wives across all waves.

Study 2: sexual satisfaction

The degree of spouses’ sexual satisfaction was assessed at waves 5 through 8 with the Index of Sexual Satisfaction (Hudson, 1998). This inventory measures partners’ satisfaction with their sexual relationship by asking them to indicate the extent to which 25 statements described their current sexual relations with their partner (e.g., “I think that our sex is wonderful”; “Our sex is monotonous”) on a scale from “None of the time” (1) to “All of the time” (7). Responses to these items were reversed where appropriate and summed to form aggregate scores which ranged from 25 to 175, with higher scores indicating higher levels of sexual satisfaction. Internal consistency of this measure was high ($\alpha > 0.90$) across all study waves for both partners.

Study 2: attitudes toward one’s own pornography use

Participants’ attitudes toward using pornography themselves were assessed with a single item on a broader scale of sexual attitudes (Wenner et al., 2011) at wave 5 of the study. This item asked each member of the couple to report the extent to which they agreed with the following statement: “I enjoy viewing pornography,” using a scale ranging from “Very strong

³https://osf.io/652jg/?view_only=086e2336279f4f70bf6477e3f20503c8

⁴Initially, relationship satisfaction was omitted from our registered rationale and analytic plan for this study because of a miscommunication between the authors. Once this error was discovered by the first author, it was analyzed following the same plan that was employed to examine models of sexual satisfaction, detailed below.

TABLE 3 | Summary of the correlations, means, and standard deviations of the focal variables for Study 2 ($N = 77$ couples).

	1	2	3	4	5	M	SD
1. Relationship Satisfaction Male						40.08	4.95
2. Relationship Satisfaction Female	0.49**					39.62	6.74
3. Sexual Satisfaction Male	0.47**	0.43**				140.22	27.06
4. Sexual Satisfaction Female	0.40**	0.64**	0.54**			139.39	23.94
5. Attitudes Toward Porn Male	−0.24*	−0.30**	−0.26*	−0.26*		3.47 ¹	2.01
6. Attitudes Toward Porn Female	−0.07	−0.08	−0.09	−0.14	0.44**	2.27	1.68

*Signifies significant correlations $p < 0.05$; **signifies significant correlations, $p < 0.01$.

¹Women report significantly more negative attitudes toward pornography than men, $p < 0.001$.

For interpretability, all M and SD are presented in the original scale metric.

disagreement” (1) to “Very strong agreement” (7). As before, attitudes toward pornography use were standardized and then re-centered at the midpoint of the range for use in the analyses described below.

Study 2: Analytic Plan

Both relationship and sexual satisfaction were analyzed with RSA applied to a linear mixed-modeling approach to the actor-partner growth model where actors’ and partners’ attitudes toward pornography use, their interaction, and gender served as time invariant predictors of either relationship or sexual satisfaction measured over 4 waves (waves 5 through 8). The initial models considered only the actor and partner effects for attitudes toward pornography use, as well their interaction, and in the following steps, fixed effects of gender and time were considered in subsequent models. Following Kenny et al.’s (2006) advice for repeated measures dyadic data, we modeled correlated errors in the residuals by nesting time crossed with partner within couples and constraining the resulting covariance matrix with a heterogeneous auto-regressive structure. This approach allows residuals to correlate between partners and across time and assumes larger correlations between measures that are more temporally proximate. Analyses were conducted with the MIXED command in IBM SPSS Statistics 25 (IBM Corporation, 2017) and all models were estimated with maximum likelihood estimation so that differences between nested models could be tested.

Study 2: Results

Baseline correlations between primary measures can be found in Table 3. Moderate correlations existed between relationship partners’ reports of relationship satisfaction, $r = 0.49$, $p < 0.001$, and sexual satisfaction, $r = 0.54$, $p < 0.001$. Importantly, small negative correlations also emerged between men’s attitudes toward using pornography themselves and both their own, $r = -0.25$, $p = 0.032$, and their partners’ relationship satisfaction, $r = -0.30$, $p = 0.007$. The same was true with respect their own, $r = -0.26$, $p = 0.023$, and their partners’ sexual satisfaction, $r = -0.26$, $p = 0.020$.

The initial model predicted relationship satisfaction with actors’ and partners’ reports of attitudes toward pornography use and their interaction. Contrary to our expectations, the interaction effect was not significant, $b = 0.03$, $p = 0.933$ (see Table 4). The lack of interaction resulted in a flat prediction surface which does not indicate similarity-dissimilarity effects

(see Figure 3A). Neither of the subsequent models involving gender, $\chi^2(4) = 5.46$, $p = 0.243$, and time, $\chi^2(4) = 4.39$, $p = 0.356$, improved model fit further.

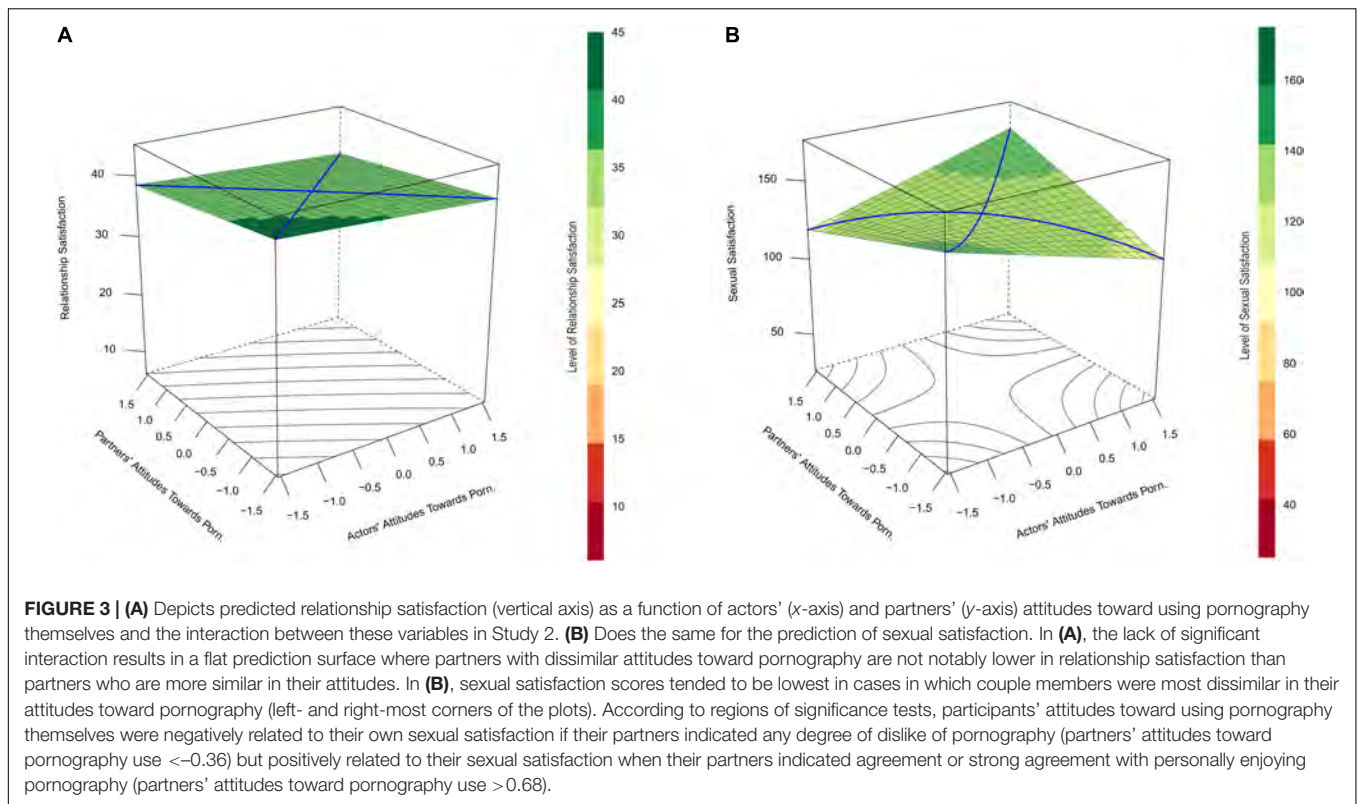
Sexual satisfaction was predicted by actors’ and partners’ reports of attitudes toward pornography use and their interaction. As we suspected, this model indicated a significant positive interaction between actors’ and partners’ attitudes toward pornography use, $b = 8.11$, $p < 0.001$ (see Figure 3B and Table 4). A RSA further indicated significant curves along the lines of congruence, $a_2 = 8.11$, $p < 0.001$, and incongruence, $a_4 = -8.11$, $p < 0.001$, but no significant slopes along these lines: $a_1 = 1.17$, $p = 0.711$, and $a_3 = -1.21$, $p = 0.507$. Such findings suggested a similarity-dissimilarity effect for partners’ attitudes toward pornography use when predicting sexual satisfaction. The lack of slope for a_3 in this analysis indicated that the effect of similarity-dissimilarity was the same regardless of which partner’s attitudes toward pornography were positive and which were negative.

Region of significance tests indicated significant slopes for actors’ attitudes toward pornography use when partners’ attitudes toward pornography use were less than -0.36 and greater than 0.68 . These results suggested that participants’ attitudes toward using pornography themselves were negatively related to their sexual satisfaction if their partners indicated any degree of dislike of pornography but positively related to their sexual satisfaction when their partners indicated agreement or strong agreement with personally enjoying pornography.

Consistent with our prediction, adding a gender component and interactions between gender and the other fixed effects in the

TABLE 4 | Linear mixed models predicting relationship and sexual satisfaction for Study 2 ($N = 77$ couples).

	Relationship Satisfaction		Sexual Satisfaction	
	b	p	b	p
Fixed Effects				
Intercept	39.17	>0.001	136.2	>0.001
Actors’ Attitudes Toward Porn (ATP)	−0.63	0.133	−0.02	0.991
Partners’ ATP	−1.01	0.011	1.19	0.521
Actors’ ATP by Partners’ ATP	0.03	0.933	8.11	>0.001



model did not improve model fit further, $\chi^2(4) = 3.23, p = 0.520$. Interestingly, adding a time component and interactions between time and the other fixed effects in the model also failed to improve model fit, $\chi^2(4) = 3.23, p = 0.495$, indicating that the association between similarity-dissimilarity in attitudes toward pornography and sexual satisfaction did not change from wave 5 to wave 8, which occurred approximately 18 months later.

Study 2: Discussion

The results of Study 2 partially confirmed our primary expectations; like Study 1 a significant positive interaction between actors' and partners' attitudes toward using pornography themselves was found when predicting sexual satisfaction but not relationship satisfaction. Unfortunately, because pornography use was not measured in this study, it was not possible to test this explanatory mechanism for the interactive effects of partners' solitary pornography use on sexual satisfaction directly.

This study also found that similarity-dissimilarity in attitudes toward pornography use measured some years after marriage remained predictive of sexual satisfaction 18 months after the attitudes were measured. Moreover, the statistical effect of similarity-dissimilarity appeared to be relatively constant across time, neither increasing in magnitude nor decreasing. We are inclined to believe that such findings reflect a degree of stability within partner similarity-dissimilarity in attitudes toward pornography use, which may be entrenched in a broader network of similar-dissimilar values. We also note that this is not a pattern of results that we would expect from a harm-focused effect-based approach. However, without further assessments of

attitudes toward pornography use at subsequent waves of data collection, broader measures of sexual value dissimilarity, or measures of actual pornography use, the best interpretation of this pattern of association remains uncertain.

STUDY 3: EROTOPHOBIA-EROTOPHILIA AND SEXUAL PREFERENCES

Although suggestive, the results of Studies 1 and 2 are far from definitive. Of particular importance, the findings from Study 1 should not be taken as strong evidence of a conceptual extension of the correlates of similarity-dissimilarity in solitary pornography use or shared pornography use. The data used in Study 1 came from the same sample employed by Kohut et al. (2018), who reported nearly identical patterns of results with respect to sexual communication and interpersonal closeness. To further substantiate these findings, we sought to replicate them by testing H1 and H2 in an independent cross-sectional sample of $N = 207$ romantic dyads that was collected for a project involving sexual ideal preferences (Balzarini et al., 2021). In this sample, we expected to find clear evidence that shared pornography use would be associated with both relationship and sexual satisfaction (H1) and that dissimilarity in solitary pornography use would be related to lower relationship and sexual satisfaction (H2).

An additional goal of this study was to strengthen the elucidation of theoretical mechanisms underlying the similarity-dissimilarity effect of solitary pornography use by further examining RQ1. Unlike Study 2, the data used for Study

3 included both measures of pornography use and relevant individual difference dimensions which allowed us to test whether or not similarity-dissimilarity in pornography use added to the prediction of sexual/relationship satisfaction once other patterns of similarity-dissimilarity were statistically controlled. If similarity-dissimilarity in solitary pornography use did not emerge under these circumstances, it would suggest either that similarity-dissimilarity in other characteristics mediate the causal impact of pornography on relationship quality, or potentially, that the associations between pornography use and relationship quality may be spurious.

Individual differences in couple members' erotophobia-erotophilia are of considerable conceptual relevance to understanding the connections between pornography use and relationship quality because erotophobia-erotophilia is reliably correlated with pornography use (Fisher et al., 1988). Moreover, previous research has shown that similarity-dissimilarity in erotophobia-erotophilia is related to sexual satisfaction (Smith et al., 1993). If similarity-dissimilarity in partners' erotophobia-erotophilia is implicated in the effects of similarity-dissimilarity in solitary pornography use, we would expect to find a positive interaction between actors' and partners' erotophobia-erotophilia when predicting relationship and sexual satisfaction. Further, if erotophobia-erotophilia is a major contributor to relationship functioning – either because it represents an ultimate cause and pornography use is a mediating process or because it is a proximal cause that either mediates or creates spurious associations between pornography use and relationship functioning – actors' and partners' solitary pornography use and the interaction between these variables should not add to the prediction of sexual/relationship satisfaction once actors' and partners' erotophobia-erotophilia, and their interaction, are statistically controlled.

As an alternative to erotophobia-erotophilia, it is also known that similarity-dissimilarity in partners' sexual preferences (e.g., “My preferred time for having sex is in the morning”) are related to sexual satisfaction (Purnine and Carey, 1999). From this perspective, the data used for the current analyses are particularly relevant as they come from a dyadic study that was designed to determine if discrepancies in partners' sexual ideals are associated with various aspects of relationship quality. To this end, members of participating couples were each asked to indicate their own sexual ideal preferences across a diverse set of 30 items, none of which specifically involved pornography use. Because differences in pornography use may reflect wider differences in personally held sexual ideal preferences within relationships, controlling for differences in personally held sexual ideals may also reduce or eliminate the associations between pornography use and relationship and sexual satisfaction.

In sum, Study 3 had two research goals. First, we wished to determine if the associations between similarity-dissimilarity in solitary pornography use, shared pornography use, and relationship and sexual satisfaction would replicate in an independent dyadic sample. Second, we wished to determine if similarity in erotophobia-erotophilia and/or sexual ideal preferences could statistically “explain” these associations

(registered materials: <https://osf.io/h8agx>; data and syntax⁵). Details of related ancillary research questions concerning curvilinear associations between pornography use and relationship quality can be found in Supplementary Data Sheet 1.

Study 3: Method

Study 3: Participants

This sample was recruited by *Qualtrics Panel LLC*. To this end, *Qualtrics* contacted panel members with the opportunity to participate in a study whose stated purpose was to better understand sexual ideals and to assess the associations between sexual ideal discrepancies and relationship functioning. To be eligible, individuals were required to be at least 18 years of age, be fluent in English, to have an active *Qualtrics Panel* account, to be involved in a romantic relationship of at least 4 months, and to have a romantic partner willingly complete the survey. These inclusion criteria were confirmed through a screening process conducted by *Qualtrics Panel LLC*, and subsequently reconfirmed by participants' responses to the demographic questionnaire.

A total of 2,050 individuals accessed the online study, and of those, 1,843 were removed because one or both partners: did not consent to participate (12.93%, $n = 265$), failed to meet the inclusion criteria (22.73%, $n = 466$), failed an attention check (25.37%, $n = 520$), did not complete the study in full (28.20%, $n = 578$), or because our quota was reached (0.20%, $n = 4$). The final sample was composed of $N = 207$ heterosexual couples ($N = 414$ individuals). Retained couple members were primarily middle-aged ($M = 45.81$), Caucasian (84.54%), monogamous (88.89%), and married (88.41%). Compared to the participants in intact couples with complete data who were not included in this study, the retained sample reported significantly higher solitary pornography use, $t(237) = 2.85$, $p = 0.005$. These two subsamples did not differ with respect to age, $t(237) = 0.87$, $p = 0.387$, race, $F(1,476) = 2.99$, $p = 0.084$, relationship orientation, $F(1,476) = 0.52$, $p = 0.473$, relationship status, $F(1,476) = 0.19$, $p = 0.667$, relationship satisfaction, $t(236) = -1.08$, $p = 0.281$, sexual satisfaction, $t(236) = -1.89$, $p = 0.070$, or shared pornography use, $t(237) = -0.09$, $p = 0.928$.

Study 3: Materials and Procedure

Eligible parties followed a link to a webpage which presented the Letter of Information and informed consent. Participants were first asked to fill out a questionnaire assessing demographic information. Then, participants were asked to build a mental picture of their ideal sexual partner and to indicate how important each of 30 traits was to their concept of an ideal sexual partner. After this exercise, participants rated the extent to which they believed their actual partner met these 30 ideals. Participants were then asked about their perceptions of their actual partners' ideals and the extent to which they believed they met their partners' ideals. Next, participants responded to a series of measures meant to examine relationship functioning correlates (e.g., relationship and sexual satisfaction, perceived likelihood of relationship dissolution) of similarity-dissimilarity in sexual ideal preferences, potential moderators of these

⁵https://osf.io/4tbxu/?view_only=44b673a4ede14d31b6be29c033eabdfc

associations (e.g., erotophobia-erotophilia, implicit theories of relationships, motivations for sex), and questions about their solitary pornography use and their shared pornography use with their partner. Once all questionnaires were complete, participants were forwarded to a page where they were provided with debriefing information and token compensation for taking part in the study. Means and standard deviations for the following measures can be found in **Table 5**.

Study 3: relationship satisfaction

Three items from the Investment Model Scale (Rusbult et al., 1998) were used to assess relationship satisfaction (e.g., “I feel satisfied with our relationship”). Participants responded with 9-point scales that ranged from “do not agree at all” (1) to “agree completely” (9). Responses to these items were mean aggregated ($\alpha = 0.95$), with higher scores indicating more relationship satisfaction.

Study 3: sexual satisfaction

As with Study 1, sexual satisfaction was measured with Lawrence and Byers’ instrument (1998; as cited in Byers, 2005). Responses were mean aggregated ($\alpha = 0.97$) with higher scores indicating more sexual satisfaction (range: 1–7).

Study 3: pornography use

Pornography use was assessed with the same 2-items used in Study 1 to obtain information about the frequency of participants’ solitary pornography use and their shared pornography use with their partner. However, in this case, definitions of pornography use were not provided to participants. Response options ranged from “Never” (1) to “More than once a day” (8). As with Study 1, non-use of pornography was common and responses were positively skewed in this sample: 39.61% of the sample reported never using pornography alone ($S = 0.94$, $p < 0.001$) while 46.62% reported never using it with a partner ($S = 1.25$, $p < 0.001$). As before, partners’ respective reports of shared pornography use were mean averaged and both the measure of solitary pornography use and shared pornography use were standardized and re-centered at the midpoint of the scale range for use in the RSA analyses described below.

Study 3: erotophobia-erotophilia

The short-form of the Sexual Opinion Survey (Fisher et al., 1988) was used to assess erotophobia-erotophilia. Participants were asked to indicate the extent they agreed or disagreed with five statements such as, “Masturbation can be an exciting experience” and “It would be emotionally upsetting to me to see someone exposing themselves publicly” ($\alpha = 0.67$). Participants responded using a 7-point Likert-like scale ranging from “strongly agree” (1) to “strongly disagree” (7). Responses were mean aggregated with reverse coding were applicable so that higher scores indicated more erotophilia, and then standardized.

Study 3: sexual ideal preferences

Participants were asked to mentally construct an ideal sexual relationship and then indicate how important each of 30 items was for understanding that relationship. Items included specific partner traits (e.g., “Ideal sexual partner is kinky”), optimal aspects of sexual encounters (e.g., “Ideal sexual encounter would

involve dirty talk”), and other characteristics of one’s ideal relationship with a sexual partner (e.g., “Go on dates with ideal sexual partner”). Participants responded to the items with 7-point scales that ranged from “very unimportant” (–3) to “very important” (3). Responses were subjected to an exploratory factor analysis using maximum-likelihood and an oblimin rotation. A parallel analysis indicated that no more than six factors should be extracted though a five factor solution was most interpretable. The five factor solution explained 40% of the variance and had reasonable fit, TLI = 0.91, RMSEA = 0.04; 90% CI [0.04, 0.05]. The resulting factors indicated discrete preferences for aggressive sex (e.g., spanking, hair-pulling, etc.), a loving partner and relationship (e.g., loving, supportive, etc.), pornographic sex (e.g., swallowing ejaculate, anal sex, etc.), specific partner demographic characteristics (e.g., ethnicity, religiosity, etc.), and holistic somatic stimulation (e.g., nipple stimulation, tickling, etc.). Factor scores were calculated for each factor using the regression method and then standardized. Weighted composite reliabilities for regression factors scores (Beauducel et al., 2016) ranged from adequate to good: aggressive sex, $R_R = 0.90$; a loving partner and relationship, $R_R = 0.88$; pornographic sex, $R_R = 0.79$; specific partner characteristics, $R_R = 0.70$; and holistic somatic stimulation, $R_R = 0.77$.

Study 3: Analytic Plan

The associations between pornography use, relationship satisfaction, and sexual satisfaction were analyzed using the same RSA APIM approach that was outlined in Study 1 using IBM SPSS Statistics 25 (IBM Corporation, 2017).

Erotophobia-erotophilia and each dimension of sexual preference were then used to explore statistical confounding of the associations between similarity-dissimilarity in pornography use and relationship and sexual satisfaction. To this end, we first constructed separate linear mixed APIMs for each of the six potential explanatory variables. In each case, relationship and sexual satisfaction were regressed on an actor effect, a partner effect, and the interaction between the actor and partner effects (e.g., relationship satisfaction was regressed on actors’ erotophobia-erotophilia, partners’ erotophobia-erotophilia, and the interaction between these effects). Models that produced significant interactions were assumed to be eligible candidates for testing statistical confounding with the interaction between actors’ and partners’ solitary pornography use. Actors’ and partners’ solitary pornography use and their interaction and shared pornography use were then added to these candidate models only. In all cases, ML estimation was used and residuals were modeled by nesting partner within couple using an unstructured residual covariance matrix.

Study 3: Results

Correlations between primary measures can be found in **Table 5**. Strong correlations existed between men and women’s reports of relationship satisfaction, $r = 0.77$, $p < 0.001$, sexual satisfaction, $r = 0.76$, $p < 0.001$, and shared pornography use, $r = 0.86$, $p < 0.001$, as well as between the within-subject reports of sexual and relationship satisfaction provided by men, $r = 0.77$, $p < 0.001$, and women, $r = 0.84$, $p < 0.001$.

TABLE 5 | Summary of the correlations, means, and standard deviations of the focal variables for Study 3 ($N = 207$ couples).

	1	2	3	4	5	6	7	8	<i>M</i>	<i>SD</i>
1. Relationship Satisfaction Male									7.61 ¹	1.84
2. Relationship Satisfaction Female	0.76**								7.28	2.06
3. Sexual Satisfaction Male	0.77**	0.69**							6.06 ¹	1.32
4. Sexual Satisfaction Female	0.63**	0.84**	0.76**						5.81	1.45
5. Solitary Porn. Use Male	-0.16*	-0.21**	-0.18*	-0.20**					2.96 ¹	1.77
6. Solitary Porn. Use Female	-0.05	-0.03	-0.06	-0.01	0.38**				2.01	1.33
7. Shared Porn. Use Male	0.08	0.08	0.20**	0.14*	0.42**	0.39**			1.99	1.11
8. Shared Porn. Use Female	-0.03	0.05	0.13	0.15*	0.37**	0.44**	0.86**		1.95	1.22
9. Mean Shared Porn. Use	0.02	0.07	0.17*	0.15*	0.41*	0.43*	0.96**	0.97**	1.97	1.13

*Signifies significant correlations $p < 0.05$; **signifies significant correlations, $p < 0.01$.

¹Men report significantly higher relationship satisfaction, $p < 0.001$, sexual satisfaction, $p < 0.001$, and pornography use, $p < 0.001$, than women. For interpretability, all *M* and *SD* are presented in the original scale metric.

The initial model predicted relationship satisfaction using actors' and partners' reports of solitary pornography use and their interaction. In subsequent steps, model fit was improved, $\chi^2(1) = 4.66$, $p = 0.031$, by adding shared pornography use as a between-dyad covariate, and gender as a within-dyad factor, $\chi^2(1) = 5.13$, $p = 0.024$. In this model, frequency of shared pornography use was significantly related to relationship satisfaction (H1a), $b = 0.30$, $p = 0.03$, and the positive interaction term between actors' and partners' solitary pornography use was significant, $b = 0.40$, $p = 0.002$ (see **Table 6** and **Figure 4A**). These results are similar to those presented in Study 1, though in this case the interaction between actors' and partners' solitary pornography use remained significant after controlling for gender. The RSA of the solitary pornography use components of this model further revealed significant curves along the lines of congruence, $a_2 = 0.40$, $p = 0.002$, and incongruence, $a_4 = -0.40$, $p = 0.002$, which indicated a similarity-dissimilarity effect (H2a). There were no significant slopes in this analysis, $a_1 = 0.41$, $p = 0.236$ and $a_3 = 0.15$, $p = 0.083$, and the lack of a significant slope for a_3 suggested that the effect of similarity-dissimilarity was similar regardless of who was using pornography alone in the relationship. Adding further interactions between gender and the other components of the model did not significantly improve model fit, $\chi^2(3) = 0.19$, $p = 0.980$.

Tests for simple slopes of actors' solitary pornography use at different values of a partners' solitary pornography use indicated regions of significance that were less than -1.15 and greater than 0.38 . These results implied that participants' own solitary

pornography use was negatively related to their relationship satisfaction if their partners' almost never used pornography but positively related to their relationship satisfaction when their partners' used pornography alone more than once or twice a week.

Sexual satisfaction was analyzed in the same way. In this case, adding the main effect for shared pornography use significantly improved fit, $\chi^2(1) = 20.76$, $p < 0.001$, as did adding gender, $\chi^2(1) = 6.30$, $p = 0.012$. As in Study 1, in this model (see **Table 6** and **Figure 4B**), the interaction between actor's and partners' solitary pornography use was significant when predicting sexual satisfaction, $b = 0.25$, $p = 0.007$, as was the frequency of shared pornography use, $b = 0.45$, $p < 0.001$. The RSA of the solitary pornography use components of this model further revealed significant curves along the lines of congruence, $a_2 = 0.25$, $p = 0.005$, and incongruence, $a_4 = -0.25$, $p = 0.005$, however, the slopes along these lines were not significant, $a_1 = 0.04$, $p = 0.880$, $a_3 = 0.10$, $p = 0.103$. As with the prediction of relationship satisfaction in this sample, the significant main effect for shared pornography use indicated that couples who reported higher frequencies of shared pornography use reported higher sexual satisfaction (H1b), and the significant curve along the line of incongruence accompanied by a null slope implied the presence of similarity-dissimilarity effect in solitary pornography use that did not depend on who was using pornography alone in the relationship (H2b). Model fit was not improved by adding interactions between gender and the other components of the model, $\chi^2(3) = 0.33$, $p = 0.954$.

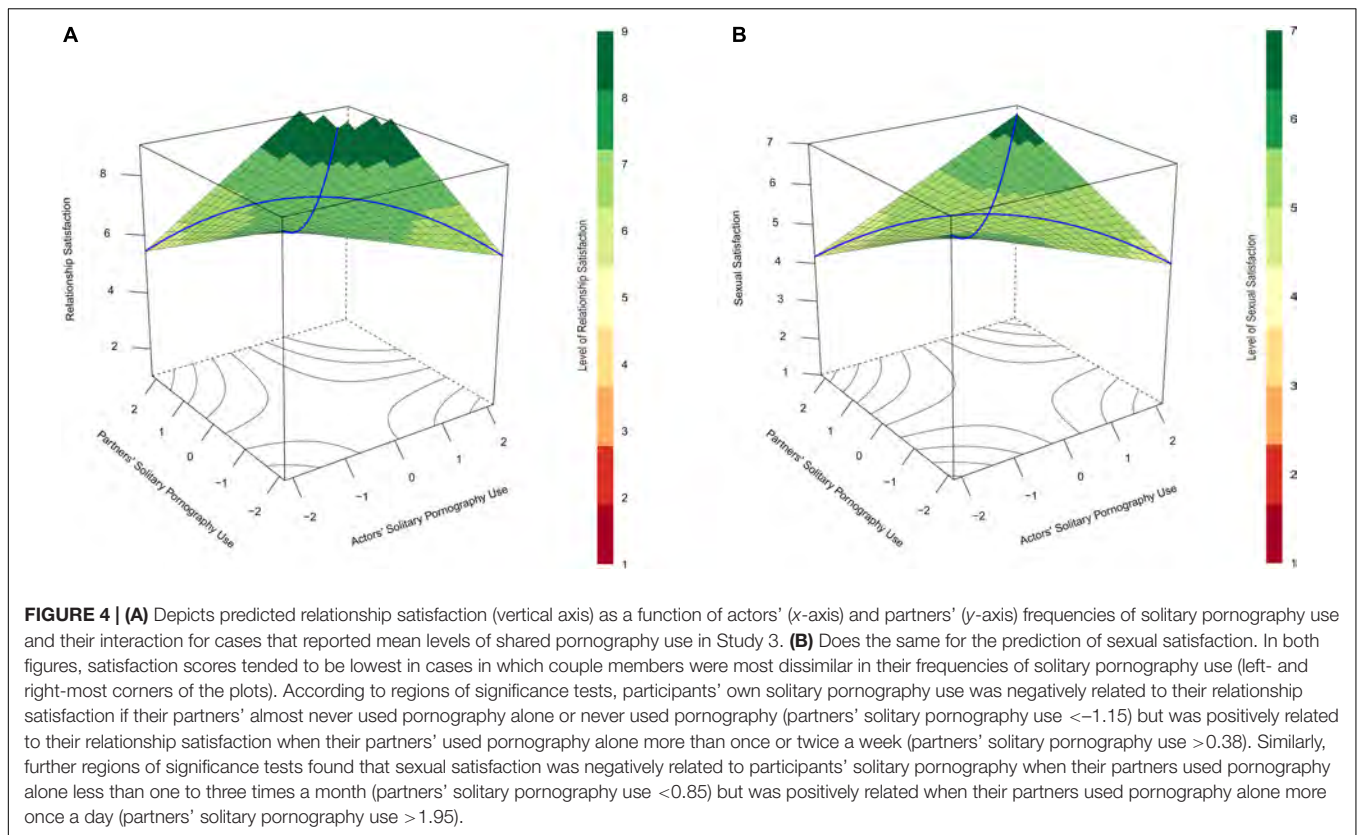
Region of significance tests for simple slopes of actors' solitary pornography use at different values of partners' solitary pornography use revealed significant slopes outside of the region bounded by -0.85 and 1.95 . These results indicated that participants' solitary pornography use was negatively related to participants' own sexual satisfaction when their partners used pornography less than 1–3 times per month but was positively related to their sexual satisfaction when their partners used pornography more than once a day.

TABLE 6 | Linear mixed models predicting relationship and sexual satisfaction for Study 3 ($N = 207$ couples).

	Relationship Satisfaction		Sexual Satisfaction	
	s^2	p	s^2	p
Fixed Effects				
Intercept	7.23	>0.001	5.54	>0.001
Actors' Solitary Porn Use	0.28	0.120	0.07	0.581
Partners' Solitary Porn Use	0.13	0.462	-0.03	0.788
Actors' by Partners' Solitary Porn Use	0.40	0.002	0.25	0.005
Shared Porn Use	0.30	0.031	0.45	>0.001
Gender	-0.12	0.024	-0.10	0.012

Study 3: Similarity-Dissimilarity in Other Individual Difference and Attitudinal Dimensions

Correlations between the study's primary measures, erotophobia-erotophilia, and each of the five sexual preference factor scores



can be found in **Table 7**. Of particular note, participants' preference for a loving partner was positively correlated with relationship satisfaction, $r = 0.22$, $p < 0.001$, and sexual satisfaction, $r = 0.22$, $p < 0.001$, and negatively correlated with participants' solitary pornography use, $r = -0.28$, $p < 0.001$, and their partners' solitary pornography use, $r = -0.10$, $p = 0.050$.

When similarity-dissimilarity models were constructed to predict relationship satisfaction using these individual difference measures, significant interactions between actor and partner effects were only found when examining erotophobia-erotophilia, $b = 0.27$, $p = 0.014$, and preference for pornographic sex, $b = 0.27$, $p = 0.019$. While both models resulted in prediction surfaces that were comparable to those found for similarity-dissimilarity in solitary pornography use, model fit was improved in both cases when the effects for solitary pornography use were added (erotophobia-erotophilia model, $\chi^2(4) = 27.30$, $p < 0.001$; preference for pornographic sex model, $\chi^2(4) = 20.97$, $p < 0.001$). Moreover, in these combined models, the interactions between actors' and partners' solitary pornography use were significant while controlling for similarity-dissimilarity in erotophobia-erotophilia, $b = 0.40$, $p = 0.002$, and preference for pornographic sex, respectively, $b = 0.37$, $p = 0.004$. On the basis of these results, it does not appear that the similarity-dissimilarity effect of actors' and partners' solitary pornography use on relationship satisfaction can be explained by similarity-dissimilarity in erotophobia-erotophilia or sexual ideal preferences (RQ1).

When the same approach was applied to sexual satisfaction, significant interactions between actor and partner effects were limited to similarity-dissimilarity models involving erotophobia-erotophilia, $b = 0.26$, $p < 0.001$, preference for pornographic sex, $b = 0.30$, $p = 0.014$, and preference for holistic somatic stimulation, $b = 0.17$, $p = 0.023$. Similar to the analysis of relationship satisfaction, the addition of the effects of solitary pornography use resulted in significant interactions between actors' and partners' solitary pornography use when erotophobia-erotophilia was controlled for, $b = 0.23$, $p = 0.010$, when preference for pornographic sex was controlled for, $b = 0.21$, $p = 0.014$, and when preference for holistic somatic stimulation was controlled for, $b = 0.21$, $p = 0.016$, and model fit was improved in all cases [erotophobia-erotophilia model, $\chi^2(4) = 35.13$, $p < 0.001$; preference for pornographic sex model, $\chi^2(4) = 34.61$, $p < 0.001$; preference for holistic somatic stimulation $\chi^2(4) = 31.70$, $p < 0.001$]. Unlike the examination of relationship satisfaction, however, the magnitude of the interaction between actors' and partners' solitary use appeared to be marginally reduced in each case. Still, the results did not clearly support the notion that any of these variables are strongly implicated as potential explanatory mechanisms that underlie the associations between similarity-dissimilarity in solitary pornography use and relationship and sexual satisfaction (RQ1).

Study 3: Discussion

The results of the primary analyses in Study 3 largely replicate those of Study 1. Shared pornography use was

TABLE 7 | Correlations between primary variables and potential “third variables” for Study 3 ($N = 207$ couples).

	Relationship Satisfaction	Sexual Satisfaction	Actors' Porn. Use	Partners' Porn. Use	Shared Porn. Use
Sexual Ideals					
Aggressive Sex	0.09	0.12*	0.26*	0.13*	0.21*
Loving Partner	0.22*	0.22*	−0.28*	−0.10*	−0.07
Pornographic Sex	0.05	0.08	0.30*	−0.03	0.21*
Partner Characteristics	0.07	0.09	−0.13*	−0.15*	−0.09
Holistic Stimulation	0.15*	0.18*	0.18*	0.04	0.28*
Erotophobia-Erotophilia	0.02	0.03	0.45*	0.13*	0.33*

* $r > 0.09$ is $p < 0.05$; $r > 0.12$ is $p < 0.01$; $r > 0.16$ is $p < 0.001$.

positively correlated with relationship and sexual satisfaction while associations between one's own solitary pornography use and relationship and sexual satisfaction were contingent on a partner's solitary pornography use. With respect to the similarity-dissimilarity effects, both indicators of relationship quality were lowest when partners were highly discrepant in their frequencies of solitary pornography use and highest when both partners either did not use pornography alone or used it at a high frequency alone. Once again, couples that were characterized by mid-frequency solitary pornography use fell somewhere between these two extremes.

Our investigation of explanatory mechanisms of this phenomenon, however, came up short. While we found similarity-dissimilarity effects for couple members' erotophobia-erotophilia, their preferences for pornographic sex, and their preferences for holistic somatic stimulation, none of these constructs accounted wholly for the similarity-dissimilarity effects of solitary pornography use. Perhaps this was because none of these variables was highly correlated with solitary pornography use (erotophobia-erotophilia: $r = 0.45$; preference for pornographic sex: $r = 0.30$; preference for holistic somatic stimulation: $r = 0.18$). Similarities and differences in preference for pornographic sex and erotophilia, while relevant to understanding differences in relationship and sexual satisfaction across couples, may simply have been too distal from pornography use behavior to account for its effects. Given erotophobia-erotophilia's conceptual similarity to attitudes toward pornography use (Fisher et al., 1988), these results somewhat undermine the view that similarity-dissimilarity in attitudes toward pornography use account for the effects of similarity-dissimilarity in solitary pornography use either.

STUDY 4: SEXUAL AND RELATIONSHIP SATISFACTION OVER TIME

The pattern of findings across these three studies suggests a narrative that is at odds with predominant views in this field. Despite meta-analytic findings linking pornography use to lower relationship and sexual satisfaction (Wright et al., 2017), the results of the current research provide evidence that pornography use is not necessarily associated with deficiencies in relationship functioning. Specifically, relationship and sexual satisfaction appear to be higher

among those who use pornography together than those that do not. Furthermore, the negative associations between solitary pornography use and relationship and sexual satisfaction appear to be mostly limited to couples that are characterized by high discordance in solitary pornography use between couple members.

In her dissertation work, Shaw (2017) independently tested similar hypotheses in a large sample of heterosexual dyads that were re-assessed at 1-month intervals for 6 months. The results reported in that research are similar to those reported in Studies 1 and 3, though differences in the analytic models preclude close comparisons. In an effort to build a cohesive examination of the associations between pornography use and relationship and sexual satisfaction, Shaw's (2017) data were used to test H1 and H2 using variations of the models developed in Studies 1 through 3.

On the basis of our previous findings and Shaw's (2017) original analyses, we expected that shared pornography use would be positively related to relationship and sexual satisfaction and that actors' and partners' solitary pornography use would interact, such that solitary pornography use would be negatively related to relationship and sexual satisfaction among couples exhibiting dissimilarity in solitary pornography use. Although Shaw (2017) reported some gender specific coefficients that suggested differences in results by gender, these differences were often small, and were not found in many of the models that were tested. Given our previous findings, we did not expect to find significant differences by gender when the data were re-analyzed. This study also afforded an opportunity to replicate the time-based analysis conducted in Study 2 with measures of pornography use rather than attitudes toward pornography use alone.

In addition, this dataset included two variables that could be used to further examine potential explanations for similarity-dissimilarity effects of solitary pornography use (RQ1). Attitudes toward a partners' pornography use and sex drive were both measured at baseline data collection. When these predictions were registered, we believed that similarity-dissimilarity in either or both dimensions might explain the similarity-dissimilarity effects, so we further scrutinized significant interactions between actors' and partners' solitary pornography use by controlling for the interaction between actors' and partners' attitudes toward a partner using

pornography, and the interaction between actors' and partners' sex drive (registered materials: <https://osf.io/w9m6p>; data and syntax⁶).

Study 4: Method

Study 4: Participants

Data for this study were drawn from a large dyadic panel of adults in sexually active relationships. Of the initial $N = 2,214$ participants who completed a baseline survey, $n = 599$ romantic partners were successfully recruited into the longitudinal panel, $n = 529$ of which were heterosexual. Detailed descriptions of the selection biases for the recruited dyads can be found in Shaw (2017). For the purposes of this study, analyses were further restricted to heterosexual dyads in which both partners provided data at one or more of the first 6 follow-up waves ($n = 277$ of 529). Couple members in the retained sample were young adults ($M = 33.07$, $SD = 11.52$), Caucasian (87.73%), non-Hispanic (95.46%), and married (50.54%), who had been in their romantic relationships for $M = 8.17$, $SD = 9.86$ years.

Compared to the participants from the $n = 252$ heterosexual dyads who were not included in this study, those who were included in this study were more likely to be white, $\chi^2(1) = 15.95$, $p < 0.001$, and were older, $t(1054) = -5.82$, $p < 0.001$, had more years of education, $t(1013) = -6.18$, $p < 0.001$, higher incomes, $t(1044) = -3.12$, $p = 0.002$, longer relationships, $t(985) = -5.19$, $p < 0.001$, higher relationship satisfaction, $t(1056) = -1.96$, $p = 0.049$, more positive attitudes toward a partner's pornography use, $t(913) = -1.97$, $p = 0.049$, and lower sex drive, $t(1054) = 2.22$, $p = 0.027$. These two groups did not differ significantly in their solitary pornography use, $t(970) = 1.78$, $p = 0.075$, shared pornography use, $t(1056) = 0.56$, $p = 0.562$, sexual satisfaction, $t(1052) = -0.14$, $p = 0.890$, or sexual dissatisfaction, $t(1049) = 0.06$, $p = 0.957$.

Study 4: Materials and Procedure

Couples who participated in the baseline survey were sent e-mail invitations to complete 11 brief follow-up surveys at 1-month intervals and a final 12th outgoing survey that was more comprehensive in nature. The data used in this study were limited to the baseline assessment through the 6th follow-up due to increasing participant attrition. The current study made use of baseline assessments of sex drive and attitudes toward pornography use in conjunction with follow-up measures of pornography use, relationship satisfaction, sexual satisfaction, and sexual dissatisfaction. Unfortunately, operational differences between baseline and follow-up assessments of sex-drive, pornography use, and sexual dissatisfaction precluded the possibility of creating analytic models that included both baseline and successive assessments of these variables as equivalent "waves" of data. Monetary rewards and raffle opportunities for goods were used to incentivize participation, and all procedures were reviewed and approved by an institutional review board before data collection began. Further details concerning the procedure and other measures can be found in <https://osf.io/w9m6p>.

io/w9m6p. Means and standard deviations for the following measures can be found in Table 8.

Study 4: relationship satisfaction

Relationship satisfaction was measured with the four item Couples Satisfaction Index (Funk and Rogge, 2007) at all six waves. Item descriptions can be found in Study 1. Responses were summed so that higher scores reflected higher levels of relationship satisfaction (Cronbach's $\alpha = 0.90 - 0.94$).

Study 4: sexual satisfaction

Sexual satisfaction and sexual dissatisfaction were measured separately using two items each from the Quality of Sex Inventory (Shaw and Rogge, 2016) at each of the six waves. Specifically, sexual satisfaction was assessed with "My sex life is fulfilling" and "I am satisfied with our sexual relationship" while sexual dissatisfaction was assessed with "Sexual activity with my partner was not fun" and "I was very disappointed with my sex life with my partner." Responses were collected on 6-point scales that ranged from 1 "Not at all TRUE" to 6 "Completely TRUE" and were mean aggregated so that higher scores reflected higher levels of sexual satisfaction and dissatisfaction, respectively. These scales demonstrated high internal consistency in the current sample (sexual satisfaction: $\alpha = 0.93 - 0.97$; sexual dissatisfaction: $\alpha = 0.79 - 0.88$).

Study 4: pornography use

At each of 6 waves following baseline assessment, participants read the stem, "IN THE LAST WEEK, how often did you and your partner view erotic material or engage in sexually charged experiences (visiting/viewing websites, chat rooms, magazines, or movies with adult content, or going to strip clubs or live shows)" and responded to following two items: "How often did you do any of these things WITHOUT your partner?" and "How often did you do any of these things WITH your partner?". Responses were collected with an 8-point scale (0 times to 13+ times). Responses were averaged across waves to create single time invariant estimates of solitary and shared pornography use for each participant in this study (rationale described in Supplementary Data Sheet 2). As with Studies 1 and 3, non-use of pornography was common and responses were positively skewed in this sample: 40.43% of the sample reported never using pornography alone ($S = 2.03$, $p < 0.001$) while 64.62% reported never using it with a partner ($S = 4.71$, $p < 0.001$). Reports of shared pornography use by each partner were moderately correlated, $r = 0.58$, $p < 0.001$, and were mean averaged to create a time invariant dyadic index of shared pornography use. All measures of pornography use were standardized and re-centered at the midpoint of the scale range for use in the RSAs described below.

Study 4: sex drive

Four items were used to assess participants' sex drives at baseline: "I find myself craving sex often"; "I tend to be horny most of the time"; "My mind often wanders to sex"; and "I can get turned on very quickly." These items were rated on 5-point response scales that ranged from 1 "Not at all TRUE" to 5 "Very TRUE" and were mean averaged so that higher scores reflected higher sex drive

⁶https://osf.io/8e9xb/?view_only=c888f7b084434598901af4bc01c48a7a

TABLE 8 | Summary of the correlations, means, and standard deviations of the focal variables for Study 4 ($N = 277$ couples).

	1	2	3	4	5	6	7	8	9	10	<i>M</i>	<i>SD</i>
1. Relationship Satisfaction Male											4.76 ¹	1.01
2. Relationship Satisfaction Female	0.58**										4.97	0.90
3. Sexual Satisfaction Male	0.63**	0.38**									3.97	1.59
4. Sexual Satisfaction Female	0.35**	0.47**	0.34**								4.19	1.50
5. Sexual Dissatisfaction Male	-0.52**	-0.41**	-0.67**	-0.20**							1.61	1.06
6. Sexual Dissatisfaction Female	-0.31**	0.43**	-0.32**	-0.62**	0.28**						1.44	0.82
7. Solitary Porn. Use Male	-0.03	-0.06	-0.19**	-0.10	0.17*	0.08					1.36 ¹	1.27
8. Solitary Porn. Use Female	-0.03	0.00	0.00	-0.11	0.10	0.14*	0.05				0.40	0.89
9. Shared Porn. Use Male	0.13	0.12	0.15*	0.14*	-0.14*	-0.09	0.12*	0.05			0.21	0.51
10. Shared Porn. Use Female	0.11	0.11	0.14*	0.20**	-0.04	-0.15	0.08	0.25**	0.58**		0.18	0.48
11. Mean Shared Porn. Use	0.14*	0.14*	0.17**	0.20**	-0.11	-0.14	0.11	0.18*	0.90**	0.88**	0.20	0.44

With respect to relationship satisfaction, sexual satisfaction, and sexual dissatisfaction, only correlations with these measures at the first assessment are presented.

*Signifies significant correlations $p < 0.05$; **signifies significant correlations, $p < 0.01$.

¹Men report significantly lower relationship satisfaction, $p < 0.001$, and higher solitary pornography use, $p < 0.001$, than women.

For interpretability, all *M* and *SD* are presented in the original scale metric.

($\alpha = 0.92$). Aggregate scores were then standardized for use in the analyses described below.

Study 4: attitudes toward a partner's pornography use

Following baseline measures of pornography use, one item assessed attitudes toward a partners' pornography use: "How upset are YOU over your partner engaging in these activities? (if your partner engages in them at all)" Responses were collected in a 6-point scale that ranged from 1 "Not at all" to 6 "Completely." This item was reverse scored and responses were standardized for use in the analyses described below.

Study 4: Analytic Plan

We departed from our pre-registered analytic plan involving time varying estimates of pornography use after executing it because we realized that weekly frequency of pornography use measures failed to identify many female pornography users (for the full rationale, see Appendix B). Despite some modifications, the resulting analytic approach followed the same general plan outlined in the pre-registered analyses. The initial linear mixed modeling approach involved the prediction of each of three time varying dependent variables (relationship satisfaction, sexual satisfaction, and sexual dissatisfaction) with time invariant actors' solitary pornography use, partners' solitary pornography use, their interaction, and shared pornography use. Following Kenny et al.'s (2006) recommendations for repeated measures APIMs, residuals were modeled by crossing partner with time nested within couple and constraining the resulting covariance matrix to a heterogeneous autoregressive structure. ML estimation was used so that nested models could be tested for changes in model fit. Subsequent models tested the addition of gender and interactions between pornography components and gender, as well as time, and interactions between pornography components and time.

When significant interactions between actors' and partners' solitary pornography use emerged, two further fixed effect models were considered to examine possible explanations for these effects. First, the basic fixed effects model with all pornography

use components but without gender or time components was re-run with the addition of fixed effects for actors' sex drive, partners' sex drive and the interaction between actors' and partners' sex drive. The second model was similar, but replaced sex drive with attitudes toward a partner's use of pornography.

Study 4: Results

Correlations between primary measures can be found in Table 8. At the first wave, a moderate correlation existed between men's and women's reports of relationships satisfaction, $r = 0.58$, $p < 0.001$, but correlations were weaker for sexual satisfaction, $r = 0.34$, $p < 0.001$ and sexual dissatisfaction, $r = 0.28$, $p < 0.001$. The correlation between partners' reports of solitary pornography use, $r = 0.05$, $p = 0.376$, was also much lower than expected.

In the first step, relationship satisfaction was predicted with actors' and partners' reports of solitary pornography use, their interaction, and their reports of shared pornography use. This model indicated a significant positive main effect for shared pornography use, $b = 0.13$, $p = 0.002$, but the interaction between actors' and partners' pornography use was not significant, $b = 0.04$, $p = 0.395$ (see Table 9 and Figure 5A). As with Study 1, such results support the view that relationship satisfaction was higher among those who shared pornography use more frequently (H1a) but not among those who were more similar in their solitary pornography use (H2a). Adding gender and further interactions between gender and the other components of the model did not significantly improve model fit, $\chi^2(5) = 2.65$, $p = 0.754$, nor did adding time components, $\chi^2(5) = 4.71$, $p = 0.452$.

Sexual satisfaction was analyzed in the same way. The initial model, which predicted sexual satisfaction using actors' and partners' reports of solitary pornography use, their interaction, and their reports of shared pornography use, revealed a significant main effect for shared pornography use, $b = 0.34$, $p < 0.001$, and a significant positive interaction between actors' and partners' solitary pornography use, $b = 0.19$, $p = 0.008$ (see Figure 5B). The RSA of this model further revealed significant curves along the lines of congruence, $a_2 = 0.19$, $p < 0.009$, and

TABLE 9 | Linear mixed models predicting relationship and sexual satisfaction for Study 4 ($N = 277$ couples).

	Relationship Satisfaction		Sexual Satisfaction		Sexual Dissatisfaction	
	<i>b</i>	<i>p</i>	<i>b</i>	<i>p</i>	<i>b</i>	<i>p</i>
Fixed Effects						
Intercept	4.75	> 0.001	3.85	> 0.001	1.78	> 0.001
Actors' Solitary Porn Use	−0.03	0.821	0.09	0.614	0.04	0.731
Partners' Solitary Porn Use	0.09	0.493	0.23	0.191	−0.24	0.042
Actors' by Partners' Solitary Porn Use	0.04	0.395	0.19	0.006	−0.14	0.003
Shared Porn Use	0.13	0.002	0.34	> 0.001	−0.17	>0.001
Gender	—	—	—	—	−0.51	0.007
Gender by Actor's Porn Use	—	—	—	—	−0.20	0.006
Time	—	—	−0.07	> 0.001	0.03	0.031

incongruence, $a_4 = -0.19$, $p < 0.009$, and a significant slope along the line of incongruence $a_3 = -0.12$, $p = 0.043$ but not along the line of congruence $a_1 = 0.30$, $p = 0.401$. The a_3 slope suggested that the dissimilarity effect in sexual satisfaction was more pronounced among the partners who use pornography alone than the partners that do not. These effects again confirmed that sexual satisfaction was higher among participants who reported more shared pornography use (H1b) and more similar solitary pornography use in this sample (H2b).

Region of significance tests indicated significant slopes for actors' solitary pornography use when partners' solitary pornography use was less than -1.40 . The slopes for actors' solitary pornography use were not significant above this point. These results suggested that participants' solitary pornography use was negatively related to sexual satisfaction if their partners' used pornography less frequently than 1.80 times a week but was otherwise unrelated.

Adding further interactions between gender and the other components of the model did not significantly improve model fit, $\chi^2(5) = 2.92$, $p = 0.712$. Adding a main effect for time significantly improved model fit, $\chi^2(1) = 15.79$, $p < 0.001$, resulting in a significant negative main effect for time, $b = 0.34$, $p < 0.001$, which indicated that sexual satisfaction generally decreased over the course of the study (see Table 9). Adding additional interactions between time and other components of the model did not improve fit further, $\chi^2(4) = 3.39$, $p = 0.495$. This negative main effect for time did not diminish the significant interaction between actors' and partners' solitary pornography use appreciably.

Analysis of sexual dissatisfaction followed the same approach, beginning with a fixed effects model that included actors' and partners' solitary pornography use, their interaction, and shared pornography use. As expected, there was a negative main effect for shared pornography use, $b = -0.17$, $p < 0.001$, and a negative interaction between actors' and partners' solitary pornography use, $b = -0.09$, $p = 0.042$ (see Figure 5C). The RSA of this model further revealed significant curves along the lines of congruence, $a_2 = -0.09$, $p = 0.043$, and incongruence, $a_4 = 0.09$, $p = 0.043$, and a significant slope along the line of incongruence $a_3 = 0.12$, $p = 0.001$, but not along the line of congruence $a_1 = -0.09$, $p = 0.673$. As with the analysis of sexual satisfaction,

this significant slope indicated that the effects of dissimilarity in solitary pornography use were particularly prominent among the pornography user rather than the non-user. In this case, participants who reported more sexual dissatisfaction tended to report lower frequencies of shared pornography use (H1b), and more dissimilar frequencies of solitary pornography use (H2b).

Region of significance tests indicated significant slopes for actors' solitary pornography use when partners' solitary pornography use was less than -1.18 and slopes above this point were not significant. These results suggested that participants' solitary pornography use was positively related to their sexual dissatisfaction if their partner indicated that they used pornography less frequently than 2.17 times a week, otherwise their pornography use was unrelated to their sexual dissatisfaction.

Adding gender and an interaction between gender and actors' solitary pornography use improved fit, $\chi^2(2) = 7.29$, $p = 0.019$. In this model, gender interacted with actors' solitary pornography use such that being male reduced the association between actors' solitary pornography use and sexual dissatisfaction, $b = -0.20$, $p = 0.006$, a rather surprising finding. Although this was not of particular interest in the current study, it appeared that in the context of this particular model, on average, men's solitary pornography use was related to lower sexual dissatisfaction while the same was not true of women. Adding further interactions with gender did not significantly improve fit, $\chi^2(3) = 1.34$, $p = 0.720$. However, fit was improved when a fixed effect for time was added, $\chi^2(1) = 4.61$, $p = 0.032$, because sexual dissatisfaction appears to have increased over time, $b = -0.03$, $p = 0.031$. Adding additional interactions between time and pornography use did not improve fit, $\chi^2(4) = 2.84$, $p = 0.585$. The significant interaction between actors' and partners' solitary pornography use remained when controlling for these additional components (see Table 9).

Testing Explanations for the Interaction When Predicting Sexual Satisfaction

To test the possible influence of similarity-dissimilarity in sex drive (RQ1), actors' baseline sex drive, partners' baseline sex drive, and the interaction between actors' and partners'

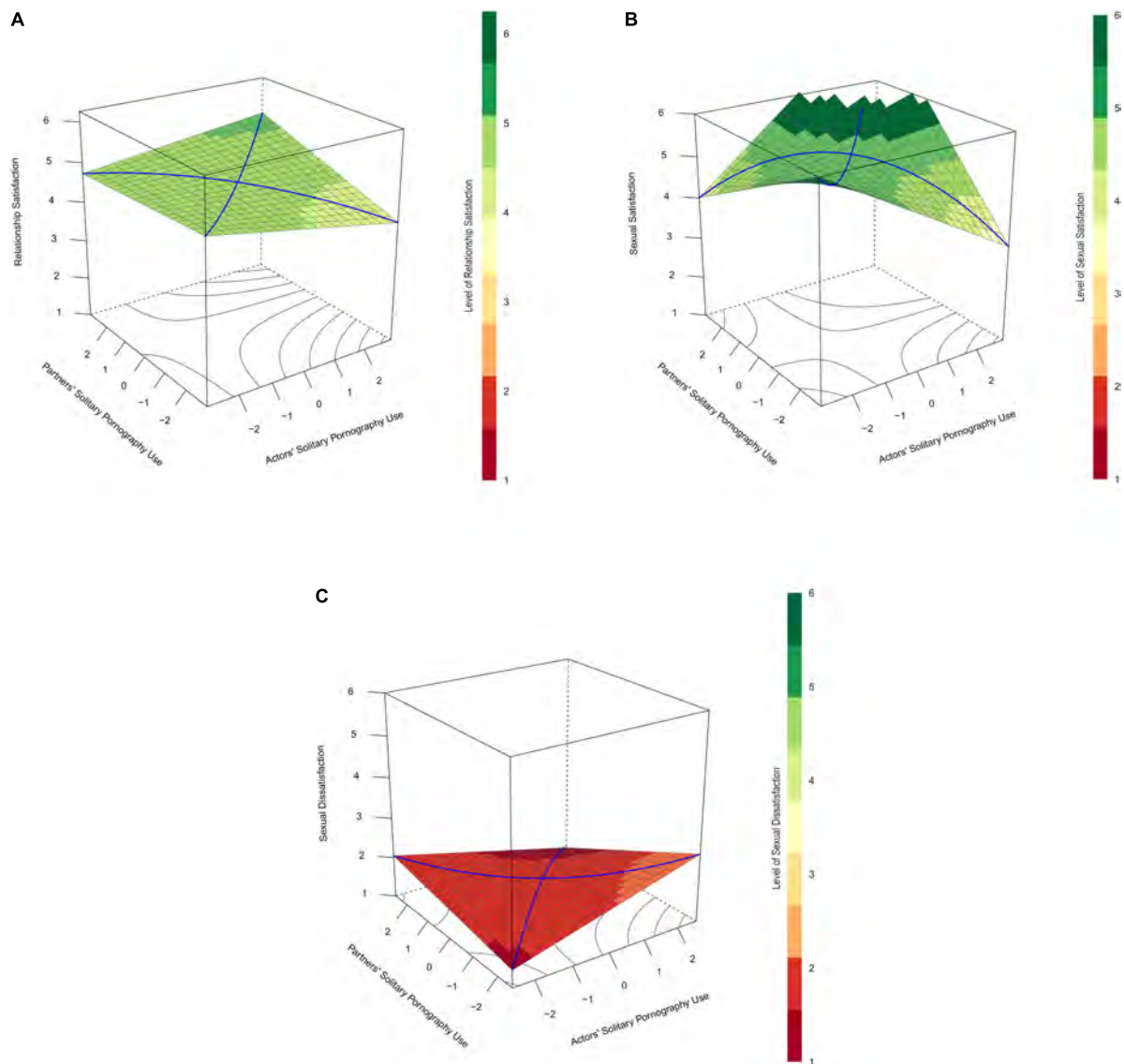


FIGURE 5 | (A) Depicts predicted relationship satisfaction (vertical axis) as a function of actors' (x-axis) and partners' (y-axis) frequencies of solitary pornography use and their interaction for cases that reported mean levels of shared pornography use in Study 4. (B,C) Do the same for the prediction of sexual satisfaction and sexual dissatisfaction, respectively. In (A), the lack of significant interaction resulted in a flatter prediction surface where partners with dissimilar frequencies of solitary pornography use were not notably lower in relationship satisfaction than partners with more similar frequencies. In (B), sexual satisfaction scores tended to be lowest in cases in which couple members were most dissimilar in their frequencies of solitary pornography use (left- and right-most corners of the plots). According to regions of significance tests, participants' own solitary pornography use was negatively related to their relationship satisfaction if their partners' used pornography alone less than 1.80 times a week but was otherwise unrelated. Conversely, in (C), sexual dissatisfaction scores tended to be highest in cases in which couple members were most dissimilar in their frequencies of solitary pornography use (left- and right-most corners of the plots). According to regions of significance tests, participants' solitary pornography use was positively related sexual dissatisfaction if their partner indicated that they used pornography less than 2.17 times a week, otherwise their pornography use was unrelated to their sexual dissatisfaction.

baseline sex drive were added to the model predicting sexual satisfaction without gender or time components. These additions significantly improved fit, $\chi^2(3) = 18.36$, $p < 0.001$, and in the resulting model the main effect for shared pornography use remained significant, $b = 0.27$, $p < 0.001$, and the interaction between actors' and partners' solitary pornography use dropped to non-significance, $b = 0.14$, $p = 0.062$ (see **Table 10**). These results suggest that partner similarity-dissimilarity in sex drive

may be linked to the association between similarity-dissimilarity in solitary pornography use and sexual satisfaction.

The influence of similarity-dissimilarity in attitudes toward a partners' use of pornography (RQ1) was examined by adding actors' and partners' baseline attitudes toward a partner's use of pornography and their interaction to the model without time. These additions significantly improved fit, $\chi^2(3) = 9.73$, $p = 0.021$, and in the resulting model, both the main effect

TABLE 10 | Testing potential confounding effect of differences in actors' and partners' attitudes toward pornography in Study 4 ($N = 233$ couples).

	Sexual Satisfaction				Sexual Dissatisfaction			
	Base Model		Sex Drive Model		Base Model		Sex Drive Model	
	<i>b</i>	<i>p</i>	<i>b</i>	<i>p</i>	<i>b</i>	<i>p</i>	<i>b</i>	<i>p</i>
Fixed Effects								
Intercept	3.68	> 0.001	3.32	> 0.001	1.77	> 0.001	1.92	> 0.001
Actors' Solitary Porn Use	0.09	0.612	−0.03	0.826	0.02	0.891	0.09	0.434
Partners' Solitary Porn Use	0.21	0.248	0.04	0.786	−0.11	0.337	−0.02	0.881
Actors' by Partners' Solitary Porn Use	0.19	0.008	0.13	0.062	−0.09	0.042	−0.05	0.262
Shared Porn Use	0.34	> 0.001	0.27	> 0.001	−0.17	> 0.001	−0.14	> 0.001
Actors' Sex Drive	—	—	0.19	> 0.001	—	—	−0.03	0.368
Partners' Sex Drive	—	—	0.25	> 0.001	—	—	−0.07	0.027
Actors' by Partners' Sex Drive	—	—	0.09	0.072	—	—	−0.12	> 0.001

for shared pornography use, $b = 0.30$, $p < 0.001$, and the interaction between actors' and partners' solitary pornography use, $b = 0.17$, $p = 0.016$, remained significant and largely unperturbed (see **Table 11**). With respect to the attitudinal components themselves, participants who had more positive attitudes toward their partners' pornography use reported higher levels of sexual satisfaction than participants with more negative attitudes, but partners' attitudes, and the interaction between actors' and partners' attitudes appeared to be unrelated.

Testing Explanations for the Interaction When Predicting Sexual Dissatisfaction

To test the influence of similarity-dissimilarity in sex drive (RQ1), actors' baseline sex drive, partners' baseline sex drive, and the interaction between actors' and partners' baseline sex drive were added to the base model predicting sexual dissatisfaction without gender or time components. These additions significantly improved fit, $\chi^2(3) = 20.29$, $p < 0.001$, and in the resulting model, the main effect for shared pornography use remained significant, $b = -0.14$, $p < 0.001$, and the interaction between actors' and partners' solitary pornography use dropped to non-significance, $b = -0.05$, $p = 0.262$ (see **Table 10**). Such results suggest that similarity-dissimilarity in sex-drive may be implicated in the association between similarity-dissimilarity in solitary pornography use and sexual dissatisfaction.

The influence of similarity-dissimilarity in attitudes toward a partner's use of pornography was examined next⁷ (RQ1), with the addition of actors' and partners' baseline attitudes toward their partner's use of pornography and the interaction to the base model without gender or time components. These additions significantly improved fit, $\chi^2(3) = 22.27$, $p = 0.021$, and in the resulting model both the main effect for shared pornography use, $b = -0.14$, $p < 0.001$, and the interaction between actors' and partners' solitary pornography use, $b = -0.10$, $p = 0.019$, were significant (see **Table 11**). Unlike the results for sexual satisfaction, this model resulted in a significant negative

interaction between actors' and partners' attitudes toward pornography, $b = -0.06$, $p = 0.003$, suggesting a similarity-dissimilarity effect on sexual dissatisfaction. Controlling for this effect, however, did not eliminate the similarity-dissimilarity effect for solitary pornography use.

Study 4: Discussion

Similar to the findings presented in Studies 1 and 3, the results of Study 4 indicated that shared pornography use was related to higher relationship and sexual satisfaction, and lower sexual dissatisfaction. As in Study 1, clear similarity-dissimilarity effects of solitary pornography use were not found when examining relationship satisfaction, though the expected interaction emerged when examining sexual satisfaction and dissatisfaction. In this case, sexual satisfaction was lowest (and sexual dissatisfaction was highest), among couples that were discordant in their solitary pornography use, particularly among the relationship partner who used pornography frequently.

The results of Study 4 are also the first to indicate overlap between the similarity-dissimilarity effect of solitary pornography use and partner similarity-dissimilarity in one of the proposed explanatory variables. Specifically, when analyzing sexual satisfaction and dissatisfaction, the interaction between partners' sex drives but not the interaction between their attitudes toward their partner's use of pornography, was partially confounded with interaction between actors' and partners' solitary pornography use, reducing this effect to non-significance. These findings are consistent with the possibility that the concordance-discordance effects of solitary pornography use may be an extension of, or contribute to, partner similarity-dissimilarity in sex drive.

GENERAL DISCUSSION

Building on previous research indicating positive correlations between pornography use and relationship functioning (Kohut et al., 2017b, 2018), the current work sought to determine if associations between pornography use and relationship and sexual satisfaction may vary as a function of different dyadic

⁷Note, there was a reduction in sample size from $n = 277$ couples to $n = 233$ in this analysis due to missing data on the attitudinal items. For comparison purposes, the base sexual satisfaction and sexual dissatisfaction models were re-run with the reduced sample and the results were described in **Table 11**.

TABLE 11 | Testing potential confounding effect of differences in actors' and partners' attitudes toward pornography in Study 4 ($N = 233$ couples).

	Sexual Satisfaction				Sexual Dissatisfaction			
	Base Model		Sex Drive Model		Base Model		Sex Drive Model	
	<i>b</i>	<i>p</i>	<i>b</i>	<i>p</i>	<i>b</i>	<i>p</i>	<i>b</i>	<i>p</i>
Fixed Effects								
Intercept	3.37	> 0.001	3.65	> 0.001	1.78	> 0.001	1.66	> 0.001
Actors' Solitary Porn Use	0.03	0.884	0.06	0.748	0.04	0.732	−0.01	0.916
Partners' Solitary Porn Use	0.15	0.401	0.19	0.285	−0.10	0.375	−0.16	0.152
Actors' by Partners' Solitary Porn Use	0.16	0.028	0.17	0.016	−0.08	0.066	−0.10	0.019
Shared Porn Use	0.32	> 0.001	0.30	> 0.001	−0.16	> 0.001	−0.14	> 0.001
Actors' Attit. Toward Porn Use	—	—	0.17	0.004	—	—	−0.16	> 0.001
Partners' Attit. Toward Porn Use	—	—	0.09	0.127	—	—	−0.08	0.035
Actors' by Partners' Attit. Toward Porn Use	—	—	0.05	0.123	—	—	−0.06	0.003

patterns of pornography use within adult relationships. Across three studies, we found consistent evidence that partners who watch pornography together report higher relationship and sexual satisfaction than partners who do not, and notably, this association was not moderated by gender. Independent of this association, we also found evidence of a similarity-dissimilarity effect, such that the solitary pornography use of one partner was negatively associated with their own relationship and sexual satisfaction, but only in cases where their romantic partners used little or no pornography alone⁸. Further, satisfaction measures tended to be highest among couples in which both partners either used pornography at a high frequency or did not use pornography at all. In probing potential mechanisms for the similarity-dissimilarity effect, we found that similarity-dissimilarity in sex drive, but not attitudes toward pornography, erotophobia-erotophilia, or sexual preferences may be implicated.

The most robust finding in the current analysis was that the frequency of shared pornography use was positively associated with both relationship and sexual satisfaction. These findings corroborate previous reports of similar associations in research that failed to control for similarity-dissimilarity in partners' solitary pornography use (Bridges and Morokoff, 2011; Maddox et al., 2011; Willoughby and Leonhardt, 2020), and extend Kohut et al.'s (2018) findings that shared pornography use is associated with more open sexual communication and higher interpersonal closeness. Positive associations between shared pornography use and relationship functioning are difficult to explain with harm-focused exposure-based paradigms that draw heavily from objectification, social comparison, and script theories. Such findings, however, are quite consistent with descriptions of shared pornography use as a novel and exciting couples' activity (Kohut et al., 2017b), as well as more general theories and evidence

that link the experience of shared novel and exciting activities with relationship functioning (Aron et al., 1992, 2000; Reissman et al., 1993). Further experimental research in this vein should consider whether the introduction of (or increase in) shared pornography use can improve relationship and sexual satisfaction within couples to determine if causal claims are warranted.

While the results were less robust, it is more intriguing that similarity-dissimilarity in solitary pornography use was associated with sexual satisfaction and, to a lesser extent, relationship satisfaction. Across Studies 1, 3, and 4, we found consistent evidence indicating that the well-established negative association between pornography and sexual satisfaction was limited to cases where partners were very dissimilar in their solitary pornography use. We also found evidence that solitary pornography use was positively related to sexual and relationship satisfaction among couples in which both members frequently used pornography alone, but such effects were limited to Study 3. When considering these findings in conjunction with past research (Kohut et al., 2018), we are inclined to believe that the positive associations between solitary pornography use and relationship quality reported in Study 3 were a result of chance variation and will be unlikely to replicate in future research. Moreover, it is evident to us that dissimilarity in solitary pornography use is much more common than similarity in moderate to frequent solitary pornography use (Kohut et al., 2017a), at least with respect to the heterosexual couples that have been studied. Consequently, we are left to conclude that while solitary pornography use may typically be associated with poor relationship functioning within most heterosexual romantic couples (Wright et al., 2017), there exist at least some cases where it is not. With respect to Holbert and Park's (2020) classification of interaction types, the interaction between heterosexual couple members' solitary pornography use would best be described as a form of contingent moderation with a divergent negative pattern.

Such findings are nevertheless important for a number of reasons. First, if one takes the position that pornography causes relationships to deteriorate then these findings indicate important boundary conditions that limit pornography's harmful effects to relationships with particular patterns of dissimilar

⁸A reviewer expressed concern over the skewed nature of the independent and dependent variables, so we conducted additional unplanned analyses. For this purpose, models containing main effects and the interaction for actors' and partners' solitary pornography use and the main effect for shared use were used to predict relationship and sexual satisfaction in Studies 1, 3, and 4. These models were tested with a generalized linear mixed model approach to skewed data involving a gamma distribution and log-link function. The results of these analyses also support the inferences we make here.

pornography use. Second, these results accord nicely with well-established findings that similarity-dissimilarity in attitudes, personality, and sexual preferences are related to enhanced attraction and relationship functioning (Smith et al., 1993; Purnine and Carey, 1999; Montoya and Horton, 2013), which implies that mechanisms that are not premised on the impact of exposure to sexual content may be responsible for at least some of the purported “harms” of pornography. Finally, the lack of evidence indicating that the similarity-dissimilarity effects were further moderated by gender reinforces the possibility that previously reported gender differences in the associations between pornography use and relationship functioning (Wright et al., 2017) actually represent similarity-dissimilarity effects, rather than gender-specific responses to sexual media. While intriguing, this last speculation can only be tested conclusively with large dyadic samples of male and female same-sex relationships. Nevertheless, the current results call into question the utility of further theorizing about male- and female-specific relationship “consequences” of exposure to sexual media until such research can be conducted.

Our efforts to probe potential mechanisms for the associations between similarity-dissimilarity in solitary pornography use and relationship and sexual satisfaction corroborated previous reports that similarity-dissimilarity in attitudes (Montoya and Horton, 2013), erotophobia-erotophilia (Smith et al., 1993), sexual preferences (Purnine and Carey, 1999), and sex drive (Davies et al., 1999; Mark, 2015) are related to relationship functioning. Of particular relevance to the current analysis, similarity-dissimilarity in sex drive, but not attitudes toward one's own pornography use, attitudes toward a partner's pornography use, erotophobia-erotophilia, or sexual preferences, statistically accounted for similarity-dissimilarity effects of solitary pornography use. Specifically, in Study 4, once couple differences in similarity-dissimilarity in sex drive were controlled for, patterns of solitary pornography use within couples were unrelated to their sexual satisfaction. In this case, neither similarity-dissimilarity in pornography use nor sex-drive “dominated” the statistical model as such associations effectively canceled each other out. Independent of the issue of similarity-dissimilarity, both partners' levels of sex drive in this model, but not their levels of solitary pornography use, were positively associated with sexual satisfaction. This suggests the presence of connections between sex-drive and sexual satisfaction, that are independent of solitary pornography use. It is also notable that controlling for similarity-dissimilarity in sex-drive did not interfere with the association between shared pornography use and sexual satisfaction. We believe that this latter finding reinforces the notion that the relationship correlates of shared pornography use and similarity-dissimilarity in solitary pornography use operate through different causal pathways.

The statistical overlap between similarity-dissimilarity in solitary pornography use and sex drive may be especially notable because similarity-dissimilarity in solitary pornography use was more reliably connected to sexual rather than relationship satisfaction, despite the high correlations between these two constructs. In this connection it is also worth noting that past research has indicated that pornography use has a modestly

stronger association with sexual satisfaction than relationship satisfaction (Wright et al., 2017). While very speculative, such findings coupled with our own incline us to believe that at least some of the association between pornography use and relationship satisfaction may be a downstream consequence of a more proximal relationship between pornography use and sexual satisfaction, rather than vice versa. If that is the case then ameliorating sexual dissatisfaction among couples who are dissimilar in solitary pornography use by directly addressing their sexual concerns related to pornography or by tackling factors like dissimilarity in sex drive might have further salutary effects on other aspects of their relationship quality (e.g., relationship satisfaction, interpersonal closeness, commitment, etc.).

The exact nature of the relationship between solitary pornography use and sexual satisfaction remains an open question. The ACE perspective, with its emphasis on antecedent conditions and potentially spurious associations, would suggest that partner discrepancies in sex drive – which are common in heterosexual relationships (Ellison, 2002) – may precipitate and maintain dissimilarities in solitary pornography use, and potentially independent from that, fuel sexual dissatisfaction in relationships. In other words, the similarity-dissimilarity effects of solitary pornography use may have little or no impact on sexual satisfaction and may simply represent a “marker” of the causal relationship between dissimilarity in sex-drive and sexual satisfaction. However, other views would stress the possibility that our findings represent evidence that sex drive mediates the relationship between pornography use and sexual satisfaction (e.g., Wright, 2021b). That is, solitary pornography use may fundamentally increase users' sex drives, creating imbalances in desire in the relationship, which ultimately lead to decreased sexual satisfaction for both partners. The results of Study 4 are equally consistent with both possibilities, though we would caution somewhat against the latter view. Pornography clearly induces sexual arousal in many people, but compelling data concerning pornography-induced long-term changes in people's general levels of sexual desire are scarce. The only relevant data that we are aware of indicates that perceived increases in sex drive stemming from pornography use are not particularly common and are about equally balanced by reports that pornography use decreases sexual interests (Groß et al., 2011; Kohut et al., 2017b). Regardless, assuming our pattern of findings with respect to sex-drive are robust and replicate, further work seeking to understand the role of sex drive in the associations between solitary pornography use and sexual satisfaction will need to consider experimental designs that attempt to manipulate both sex drive and solitary pornography use independently and follow couples over time.

Limitations

As is typically the case, the implications of this work are constrained by several important limitations. First, while we have speculated about several potential causal paths that could explain the associations between pornography use and relationship quality, these possibilities cannot be adequately tested with the current studies. We would also like to note that while our causal speculations are premised in part on

research involving the experimental manipulation of perceived similarity and the introduction of shared novel activities among couples, we are quite open to the possibility that we are wrong, and other causal arrangements of the relevant constructs provide better explanations. Second, although one of these studies employed a quota sampling approach to approximately match the distribution of age and political affiliation of married American women, the remaining studies relied on convenience samples of Americans, limiting the generalizability of the current findings. Third, none of the current studies was expressly designed to examine the hypotheses of interest. Had they been, design elements, particularly the inclusion and operationalization of specific measures, would have been more consistent across studies. Relatedly, the particular operationalizations of pornography use employed in these studies may be suspect. The measure employed in Study 4 was conceptually broader than the measures used in Study's 1 and 3 as it included "sexually charged" situations like visiting a strip-club and sex chatting, which are explicitly excluded in the other studies. While this is a poor defense, there currently exists no thoroughly validated measure of pornography use, nor any consensus on the best conceptual and operational definitions of this construct (Short et al., 2012; Kohut, 2014; Kohut et al., 2020). Given both the single-item assessments of pornography use and their different operationalizations across studies, it is at least promising that similar patterns of results emerged across our studies. Finally, while we made efforts to register all analytic plans before conducting the analyses, only Study 3 pre-registered these analyses before the data had been examined in any respect. In all other occasions, we had indications that similarity-dissimilarity effects for solitary pornography use emerged when different, yet closely related variables or models were tested. As a consequence, we would recommend that readers interpret the results of Studies 1, 2, and 4 as corroborative exploratory evidence for a pattern of results we confirmed in Study 3.

Conclusion

In recent years, many communities, particularly in North America, have been entertaining notions that pornography constitutes a "public health crisis" (Nelson and Rothman, 2020) in part because of its purported effects on romantic relationships. This contemporary moral panic (Barnett, 2020) is driven by the conjoint efforts of radical feminist scholars and activists (Dines, 2016) and conservative religious organizations (Hamblin, 2016). Such individuals rely heavily on research that offers exposure-based explanations of study findings to justify their assertions of harm (see expert testimony provided to the Canadian Parliamentary Committee on Health, Mulley, 2017). It should be clear from our review of the literature, and the nature of the results across our studies, that an exposure-based explanation of the association between pornography use and poor relationship quality is only one of various potential mechanisms that may be at play. The current findings highlight how our collective understanding of the impact of pornography on relationships is still developing. These issues are very complex, and it seems unlikely to us that useful explanations will eventually boil down to popular epithets like "Porn Kills Love!". It is our hope that

this research will help our field move beyond simple "monkey see, monkey screw" explanations of pornography's impact by incorporating more thorough considerations of the context of pornography use within relationships and the antecedents of such use (Campbell and Kohut, 2017; Leonhardt et al., 2019; Willoughby et al., 2020), as well as the panoply of known correlates and confounding variables (Baer et al., 2015; Perry, 2019; Vaillancourt-Morel et al., 2019; Fisher and Kohut, 2020; Kohut et al., 2020).

DATA AVAILABILITY STATEMENT

Publicly available datasets were analyzed in this study. This data can be found here: Open Science Framework. Study 1: https://osf.io/unf74/?view_only=fcbe67be7a0142d591a9bb87dcc994b0; Study 2: https://osf.io/652jg/?view_only=086e2336279f4f70bf6477e3f20503c8; Study 3: https://osf.io/4tbxu/?view_only=44b673a4ede14d31b6be29c033eabdf; Study 4: https://osf.io/8e9xb/?view_only=c888f7b084434598901af4bc01c48a7a.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Western University, University of Rochester, University of Florida. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

TK registered all studies, conducted all primary analyses across all four studies, and took lead on composing this manuscript. All authors provided feedback on the manuscript at various stages of development. TK, WF, and LC share responsibility for designing Study 1. JM and VR share responsibility for designing Study 2. KD, RB, and TK share responsibility for designing Study 3. AS under the supervision of RDR designed Study 4.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2021.661347/full#supplementary-material>

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Sexual Interaction in Digital Contexts and Its Implications for Sexual Health: A Conceptual Analysis

Nicola Döring^{1*}, Nicole Krämer^{2*}, Veronika Mikhailova¹, Matthias Brand³, Tillmann H. C. Krüger⁴ and Gerhard Vowe⁵

¹ Media Psychology and Media Design, Institute of Media and Communication Science, Department of Economic Sciences and Media, Technische Universität Ilmenau, Ilmenau, Germany, ² Social Psychology: Media and Communication, Department of Computer Science and Applied Cognitive Science, Faculty of Engineering, University of Duisburg-Essen, Duisburg, Germany, ³ General Psychology: Cognition and Center for Behavioral Addiction Research (CeBAR), Department of Computer Science and Applied Cognitive Science, Faculty of Engineering, University of Duisburg-Essen, Duisburg, Germany, ⁴ Department of Psychiatry, Social Psychiatry and Psychotherapy, Section of Clinical Psychology and Sexual Medicine, Hannover Medical School, Hannover, Germany, ⁵ Communication and Media Studies, Center for Advanced Internet Studies (CAIS), Bochum, Germany

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*Correspondence:

Nicola Döring
nicola.doering@tu-ilmenau.de
Nicole Krämer
nicole.kraemer@uni-due.de

[†]These authors share first authorship

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Based on its prevalence, there is an urgent need to better understand the mechanisms, opportunities and risks of *sexual interaction in digital contexts* (SIDC) that are related with sexual arousal. While there is a growing body of literature on SIDC, there is also a lack of conceptual clarity and classification. Therefore, based on a conceptual analysis, we propose to distinguish between sexual interaction (1) *through*, (2) *via*, and (3) *with* digital technologies. (1) Sexual interactions *through* digital technologies are face-to-face sexual interactions that (a) have been started digitally (e.g., people initiating face-to-face sexual encounters through adult dating apps) or (b) are accompanied by digital technology (e.g., couples augmenting their face-to-face sexual encounters through filming themselves during the act and publishing the amateur pornography online). (2) Sexual interactions *via* digital technology are technology-mediated interpersonal sexual interactions (e.g., *via* text chat: cybersex; *via* smartphone: sexting; *via* webcam: webcam sex/camming). (3) Sexual interactions *with* digital technology occur when the technology itself has the role of an interaction partner (e.g., sexual interaction with a sex robot or with a media persona in pornography). The three types of SIDC and their respective subtypes are explained and backed up with empirical studies that are grouped according to two major mediators: consent and commerce. Regarding the causes and consequences of the three types of SIDC we suggest a classification that entails biological, psychological, social, economic, and technological factors. Regarding implications of SIDC we suggest to focus on both opportunities and risks for sexual health. The proposed conceptual framework of SIDC is meant to inform future research.

Keywords: internet sexuality, cybersex, online sexual activities (OSA), sexting, pornography, sex robots, sexual consent, commercial sex

INTRODUCTION

A significant amount of digital media use is sexuality-related and involves, for example, online pornography, sex dating apps, webcam sex, or the use of remote-controlled sex toys. Studies show that 68% of digital media users have been involved in some sort of sexual interaction in digital contexts (Döring and Mohseni, 2018). There is a growing body of literature on sexuality-related Internet and smartphone use and its effects, particularly its public health and sexual health impacts (e.g., sexual addiction and aggression, but also sexual pleasure, intimacy, and well-being). The literature database PubMed alone documents 5127 publications for the search term combination “online” and “sexual” in the paper title or abstract (as of August 2021). However, there is still a lack of conceptual clarity and classification of different types of sexuality-related activities that involve digital technologies. Hence, the aim of this conceptual analysis article is to develop a conceptual framework that covers and structures different types of sexual interaction in digital contexts and helps to disentangle opportunities and risks for sexual health.

DEFINITION OF SEXUAL INTERACTION IN DIGITAL CONTEXTS

The literature offers several umbrella terms to address sexuality-related digital media use such as “Internet sexuality” or “online sexual activities” (see **Table 1**). One problem with some of these concepts is, that they focus on the Internet as the key technology. As the digital media landscape is ever changing and more people are involved in sexuality-related activities with their smartphones (Anzani et al., 2018), there is a need to complement the old umbrella terms “Internet sexuality” and “online sexual activities” with new terms such as “smartphone sexuality” and “mobile sexual activities”, respectively. As possibly more people will be involved in sexuality-related activities with social and sexual robots in the future (Döring et al., 2020), one would need an additional term such as “robot sexuality” or “robot-enabled sexual activities” to address this emerging field. Avoiding a surplus of technology-specific terms, we suggest to refer to “digital contexts” of sexuality-related activities instead, to be as technology-inclusive as possible.

The umbrella term “digisexuality” (see **Table 1**) has already been introduced and attempts to overcome a too narrow technology focus as it includes a variety of digital technologies (McArthur and Twist, 2017). However, this umbrella term covers both sexuality-related activities that are related to sexual arousal (e.g., using online pornography, exchanging sexual messages with a steady partner or with a stranger) but also sexuality-related activities that are not related to sexual arousal (e.g., searching for sexual health information, campaigning for sexual rights with an online activist group). Both the causes and the consequences of arousal-oriented and non-arousal-oriented activities differ substantially (e.g., people might develop an addictive use of

arousal-oriented but not of non-arousal-oriented applications; Griffiths, 2012). Hence, we suggest not to mix arousal and non-arousal activities.

Looking for umbrella terms that specifically focus on arousal-related sexual activities in digital contexts, we identified the terms “cyberintimacy”, “cybersex”, “sexting”, and “technology-mediated sexual interaction”. However, at a closer look, they were either not sufficiently arousal-oriented (e.g., “cyberintimacy”) or not sufficiently technology-inclusive (e.g., “cybersex”, “sexting”). That leaves “technology-mediated sexual interaction” as the seemingly best term (see **Table 1**).

The problem with the concept “technology-mediated sexual interaction” (TMSI), though, is its focus on one type of sexual interaction only, namely the interpersonal interaction that is mediated by technology (e.g., a couple living in a long-distance relationship experiencing sexual intimacy with each other *via* an online videoconference system; Courtice and Shaughnessy, 2017). When people deal with digital technologies in an arousal-oriented sexual manner, two further types of interaction are relevant: The technology can not only mediate the interpersonal interaction, it can also enable and shape a sexual face-to-face interaction (e.g., an online dating app enables offline sexual encounters among people who would not have met without the app; Timmermans and Courtois, 2018). Furthermore, there is considerable sexual interaction between the user and the technology itself in the role of an interaction partner, particularly with AI (artificial intelligence)-enhanced technologies such as software sexbots and hardware sex robots (e.g., people engaging in sexual interactions with a sex robot; Szczuka and Krämer, 2017b). These two additional and relevant types of interaction are not covered by the TMSI concept.

Hence, we propose the concept *Sexual Interaction in Digital Contexts* (SIDC) as a new umbrella term that is technology-inclusive, arousal-oriented and covers three types of sexual interactions (see **Table 1**). We define SIDC as interaction associated with sexual arousal that involves the use of digital technology. According to the *Media Equation Approach* and the *Computers Are Social Actors* (CASA) *Approach*, it is theoretically and empirically well established that people experience and treat media content and digital technologies like social actors (Reeves and Nass, 1996; Krämer, 2008), thus the term “interaction” is applicable to sexual interactions between people, between people and digital media content (e.g., between a person and a media persona such as a porn actor on the screen), and between people and digital artifacts in both virtual and material form (e.g., between a person and a software sexbot or a hardware sex robot). The idea that people can in fact be involved in meaningful social and sexual interactions with media personas or with anthropomorphic artifacts is also a core element of the theory of *Para-Social Interactions* (PSI) and *Para-Social Relationships* (PSR; Horton and Wohl, 1956; Dibble et al., 2016).

Sexual interaction in digital contexts covers arousal-oriented interactions that are either *solitary-arousal* activities (e.g., digital pornography use during masturbation) or *partnered-arousal* activities (e.g., digital pornography use during sexual intercourse; Shaughnessy et al., 2017). The term SIDC does not include

TABLE 1 | Umbrella terms for sexuality-related digital technology use and their conceptual breadth.

Term	Definition	Face-to-face interaction	Technology-mediated interaction	Human-technology interaction	Technology inclusiveness	Arousal focus
Internet sexuality	Sexuality-related content and activities on the Internet (Döring, 2009).	+	+	+	–	–
Online sexual activities (OSA)	The use of the Internet for any type of activity that involves human sexuality (Cooper et al., 2001).	+	+	+	–	–
Dissexuality	Sexual experiences that are enabled or accompanied by digital technology (McArthur and Twist, 2017).	+	+	+	+	–
Cyberintimacy	Technology-mediated communication between existing and potential sexual partners (Kwok and Wescott, 2020).	–	+	–	+	–
Cybersex	A subcategory of OSA, a real-time online sexual interaction between two or more people (Daneback et al., 2005).	–	+	–	–	+
Sexting	The use of mobile devices or computers to send or receive sexually explicit messages, photographs, or images (Klettke et al., 2014).	–	+	–	–	+
Technology mediated sexual interaction (TMSI)	Interpersonal interaction with the use of digital technology that includes self-created sexually explicit content (Courtice and Shaughnessy, 2017).	–	+	–	+	+
Sexual interaction in digital contexts (SIDC)	Interaction associated with sexual arousal that involves the use of digital media content or a digital artifact, or takes place in an online or digital environment.	+	+	+	+	+

Aspects that are covered within each umbrella term are marked with “+”. Respectively, aspects that are not addressed within selected umbrella term are marked with “–”.

sexuality-related non-arousal activities in digital environments such as sexuality-related online information search, sexual health communication, or political online activism by and for sexual minorities.

CONCEPTUAL ANALYSIS OF SEXUAL INTERACTION IN DIGITAL CONTEXTS

This conceptual analysis article explores the concept of SIDC. A “concept” is understood as an abstraction of a phenomenon that is defined by its components and their interrelations (Jabareen, 2009). To identify and structure the main components of SIDC, we underwent an analytical process adopted from related process models suggested in the literature on conceptual analysis (Bröder et al., 2019 drawing on Jabareen, 2009 and Rodgers, 2000) that entailed six main steps:

1. Searching for relevant theoretical and empirical English-language contributions on the target concept of SIDC (sexual interaction in digital contexts).
2. Reading and categorizing the selected publications.
3. Identifying and naming the main dimensions and components of the target concept based on the literature.
4. Deconstructing the dimension and component attributes, (re)grouping and integrating the dimensions and components into one conceptual model through several rounds of brainstorming and discussion among authors.
5. Validating and revising the conceptual model through critical discussions within the academic setting.
6. Identifying hypotheses and implications for future research and development regarding the target concept based on the conceptual model.

Three Types of Sexual Interaction in Digital Contexts

At the core of the resulting conceptual framework of SIDC is the differentiation of the three already mentioned types of interaction: sexual interaction *through*, *via* and *with* digital technology (see Table 2). Each of the three types has several subtypes that will be elaborated below.

Five Types of Causes and Consequences of Sexual Interaction in Digital Contexts

Further core components of the SIDC model are the causes and consequences of the different types of sexual interactions through, via, and with technology. The conceptual analysis led to a five-component model of causes and consequences that cover biological, psychological, social, economic and technological factors (see Table 3). This conceptualization is based on the *Bio-Psycho-Social Model of Health* (Engel, 1977; Lindau et al., 2003) and the *Bio-Psycho-Social-Model of Sexuality* (Shaer et al., 2017; Leavitt et al., 2021). The bio-psycho-social model encourages to look at health and sexuality not as something purely biomedical or physical, but to acknowledge the multiple biological, psychological and social dimensions involved. To the well-established bio-psycho-social model of health and of sexuality with thousands of publications we added economic and technological factors as both are particularly important in sexual interaction in digital contexts: Access to some digital contexts (e.g., digital dating services such as Tinder or Grindr) requires economic resources, while active-productive participation in some digital contexts (e.g., adult content platforms such as Pornhub or MyDirtyHobby) provides economic resources. This conceptualization of five types of causes and consequences of SIDC integrates a large variety of variables discussed in the

TABLE 2 | Classification and illustration of the three main types of SIDC: through, via, with.

Type of SIDC	Definition	Example activities
Sexual interaction through digital technologies	Interpersonal sexual interactions in face-to-face contexts that have been started digitally or are accompanied by digital technology.	People initiating their face-to-face sexual interactions <i>through</i> adult dating apps. People shaping their face-to-face sexual interactions <i>through</i> live filming and streaming the act on the Internet.
Sexual interaction via digital technologies	Interpersonal sexual interactions that take place in computer-mediated contexts or within an interactive immersive virtual reality system.	People experiencing a computer-mediated interpersonal sexual interaction <i>via</i> sexually explicit text-based, photo-based, audio-based or video-based communication with each other. People experiencing a computer-mediated interpersonal sexual interaction <i>via</i> an immersive virtual reality system.
Sexual interaction with digital technologies	Sexual interactions between the person and the technological artifact in the role of an interaction partner.	People interacting <i>with</i> 2D and 3D Internet pornography and their respective sexual media personas. People interaction <i>with</i> physical technological artifacts such as AI-enhanced sex chatbots, sex dolls, or sex robots.

TABLE 3 | Classification and illustration of the five types of causes and consequences of SIDC.

Causes of SIDC	Example causes	Consequences of SIDC	Example consequences
Biological causes	High level of testosterone and related increased sexual desire push user to sexuality-related technology use (e.g., exploration of sex dating apps).	Biological consequences	Use of sex dating apps enables face-to-face encounters with multiple sexual partners inaccessible before, leading to increased risk of STI (sexually transmitted infections).
Psychological causes	High level of anxiety due to relationship trauma makes user turn to a seemingly safer artificial sex partner (e.g., sex robot).	Psychological consequences	Use of a sex robot provides safe and satisfying experiences leading to stress reduction, sexual satisfaction, increased emotional stability.
Social causes	A sexual partner urges the user to sexual interaction in digital contexts (e.g., engage in unwanted sexting with them).	Social consequences	Experiences of unwanted and non-consensual sexual interactions in digital contexts cause, among other things, social withdrawal and relationship problems.
Economic causes	Lack of money pushes user to commercial sexual activities in digital contexts (e.g., commercial camsex).	Economic consequences	Providing services on a commercial camsex platform secures a living.
Technological causes	Technological affordances such as easy access and perceived anonymity pull the user to becoming a member of an online platform (e.g., online pornography platform).	Technological consequences	Use of an online pornography platform motivates user to try out additional technologies (e.g., better headphones, remote controlled sex toys linked to 3D pornography).

literature in a structured way (see **Table 3**). For each type of sexual interaction in digital contexts (through, via, with) multiple biological, psychological, social, economic and technological causes and consequences are expected.

In public and academic discourses on SIDC negative general health outcomes (e.g., depression) and negative sexual health outcomes (e.g., addictive sexual behaviors, sexual aggression, sexual victimization, HIV/STI transmission) are a major concern (Döring, 2009). Often it has been assumed, that sexual expression in digital contexts is unnatural, risky and harmful per se (Rimm, 1994; Bull and McFarlane, 2000; Dwyer, 2005; Diliberto and Matthey, 2009). However, it has also been argued, that digital contexts offer new opportunities for helpful and beneficial sexual exploration (Dir and Cyders, 2015). Particularly the *Positive Sexuality Approach* (Williams et al., 2015) and the *Positive Technology Approach* (Riva et al., 2012), both rooted in the *Positive Psychology Approach* (Seligman and Csikszentmihalyi, 2014), are applicable to SIDC and stress the multiple opportunities for sexual and overall well-being. From the perspective of the digital technology users themselves, but also external observers such as researchers and clinical experts, some SIDC consequences are clearly evaluated as negative health outcomes (e.g., increased sexual frustration, insecurity, anxiety,

trauma), while others as positive outcomes (e.g., improved sexual well-being, intimacy, confidence, pleasure).

Empirical research shows that people from the general population involved in SIDC tend to report both negative and positive outcomes, with positive outcomes often predominating (Shaughnessy et al., 2014; Döring and Mohseni, 2018; Courtice et al., 2021). However, type and intensity of reported individual consequences and overall outcomes vary greatly depending on the selection of outcome measures, the characteristics of the digital technology users (e.g., age, gender), and the type of sexual interaction involved (e.g., Lefkowitz and Vasilenko, 2014; O'Sullivan, 2014).

Two Mediators of Sexual Interaction in Digital Contexts

Our conceptual analysis led to the identification of two main mediators: consent and commerce.

Consent: (Non)consensual Sexual Interaction in Digital Contexts

The literature has recognized many forms of non-consensual sexual interactions in digital contexts based on peer pressure, extortion, deception, threat etc. (Henry and Powell, 2018). The

causes, characteristics and consequences of non-consensual sexual interactions differ significantly from consensual interactions. For example, consensual sexting is linked with positive consequences (e.g., pleasure, trust, confidence), while non-consensual sexting is linked with negative consequences (e.g., fear, anger, depression, self-harm; Wachs et al., 2021). Hence, consent is integrated as a mediator or intervening variable in our SIDC model.

The digital media user can be in the role of both the victim of non-consensual activities of others (e.g., being urged to participate in unwanted sexting) or the perpetrator (e.g., urging somebody else to participate in unwanted sexting; van Ouytsel et al., 2021). The literature describes consensual as well as non-consensual sexual interactions through, via, and with technology (e.g., Zytka et al., 2021). Examples of non-consensual interactions are sexual harassment or rape in face-to-face interactions enabled through sex dating apps (e.g., as revealed in the ABC News documentary “Tinder: Investigation reveals the dark side of the dating app”; ABC News In-depth, 2020), unwanted initiation of sexual interactions via technology (e.g., webcam exhibitionism in front of children or non-consenting adults; Jones, 2010), and violent interactions with technological artifacts (e.g., so-called “rape” of a sex robot; Danaher, 2017).

Commerce: (Non)commercial Sexual Interaction in Digital Contexts

Commerce is the second mediator integrated in the model. By definition, commercial sexual interactions involve the exchange of money or its equivalent, while non-commercial sexual interactions do not (Harcourt and Donovan, 2005). The relevance of commercial sex in digital contexts is based on both a growing supply and a growing demand in this field (Bernstein, 2007; Cunningham and Kendall, 2011; Minichiello et al., 2013; Sanders et al., 2018): People formerly not involved in commercial sex have now started both providing and buying commercial sexual services in digital contexts because digital contexts seem to be safer and more discreet than offline contexts. The literature addresses both non-commercial sex and commercial sex in digital contexts, each characterized by different causes, characteristics and consequences (Hakim, 2015; Jones, 2015).

The digital technology user can be in the role of both the commercial service provider (e.g., providing a live sex show via webcam for paying subscribers; Bleakley, 2014) or the client (e.g., paying to watch a live sex show via webcam; Weiss, 2018). While some authors describe low-threshold commercial webcam sex as a problem because it expands the commercial sex market and fosters a general commodification of sex, other authors point to the advantages of mediated commercial sex free from any risk of STI transmission or physical violence. Further examples of commercial SIDC are the use of digital technologies by sex workers to search for new offline clients (e.g., advertising own services in specialized apps or on personal websites; Pajnik, 2015) and digital artifacts being involved in sex work (e.g., “sex robot brothels” where one can rent a sex robot; Döring et al., 2020). Some authors expect positive social consequences of sex robots when they substitute commercial sex workers while they expect negative consequences of sex robots when they substitute

non-commercial sexual partners (e.g., Yeoman and Mars, 2012; Woodward, 2020).

Causal Interrelations Between Elements of the Sexual Interaction in Digital Contexts Model

The interrelations between the different dimensions and components are another core element of any conceptual model (Jabareen, 2009; Bröder et al., 2019). As SIDC addresses arousal-oriented sexual media and technology use behavior, we appropriated the most inclusive media use and effects theory available in the literature, the *Differential Susceptibility to Media Effects Model* (DSMM; Valkenburg and Peter, 2013), that has already been successfully applied to sexuality-related digital media use (Peter and Valkenburg, 2016).

The model rejects media deterministic assumptions that simply explain media effects with media characteristics. Instead, it emphasizes the importance of individual predispositions for media use. These predispositions not only influence as predictor variables which digital media technologies are used in what ways; they also influence as moderator variables which immediate reactions to media use arise, which are precursors of media effects. Finally, the DSMM conceptualizes media effects as transactional factors that in turn influence predispositions, media use and the reactions experienced after media use. These repercussions of the media effects on future media use and media experiences are covered in **Figure 1**. There are also interdependencies between the causes (e.g., biological factors such as sexual hormone status can interact with psychological factors such as sexual motivation) and between the consequences (e.g., a social consequence such as a relationship breakup due to cyberinfidelity is often linked with psychological and economic consequences as well). Those interdependencies are not depicted in **Figure 1**, though, for the sake of clarity of the visualization.

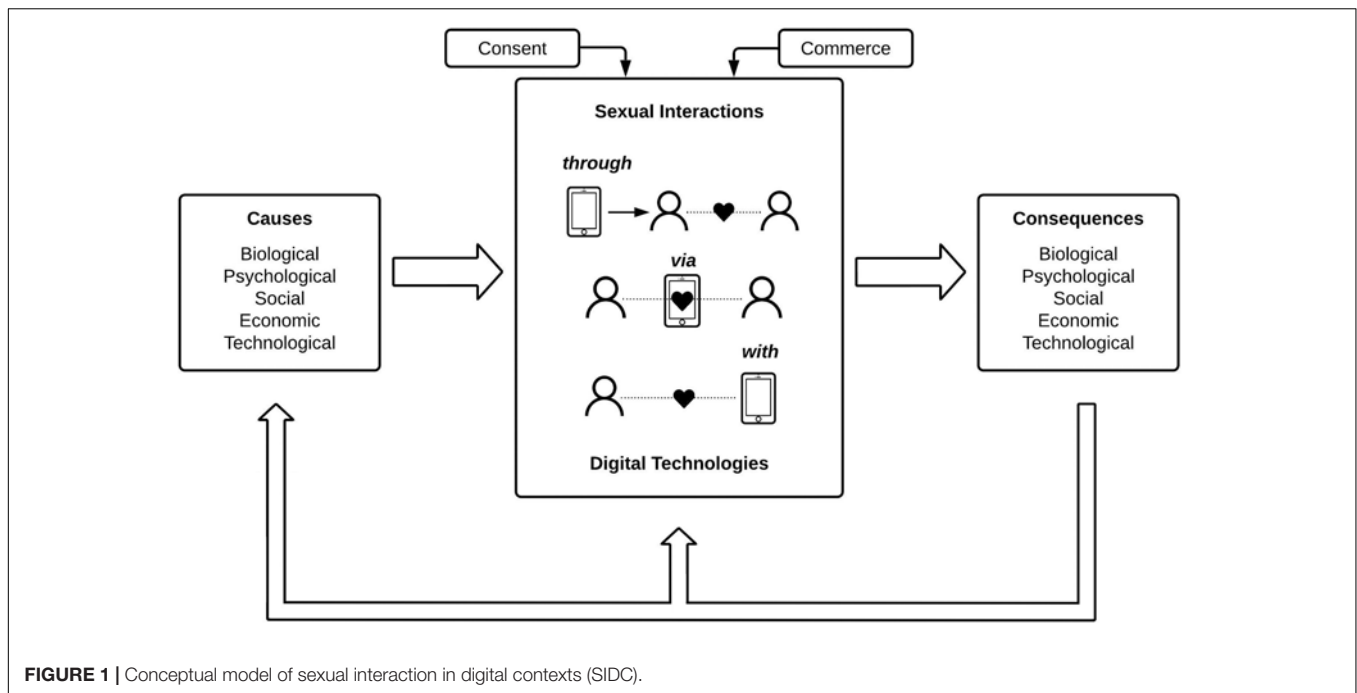
The Sexual Interaction in Digital Contexts Model

The final SIDC model including the three types of sexual interaction through, via, and with digital technology, the five types of causes and consequences, the two mediators consent and commerce and the main causal interrelations of the components is visualized in **Figure 1**.

The model will be elaborated further in the following sections that address each type of sexual interaction (through, via and with digital technology) separately with its respective subtypes.

SEXUAL INTERACTION THROUGH DIGITAL TECHNOLOGIES

Sexual interaction *through* digital technologies is a SIDC type that focuses on the face-to-face sexual encounter and how it is enabled or shaped through digital technology use.



Three Subtypes

For sexual interaction *through* digital technologies three subtypes can be identified (see Table 4).

Using Digital Media to Search for Face-to-Face Sexual Interactions

The first subtype addresses people initiating face-to-face sexual interactions *through* social media platforms and digital dating services (see Table 4). According to the main mediators consent and commerce, the literature describes this subtype very differently: consensual non-commercial initiation of offline sexual encounters in digital contexts is often characterized as an interesting (albeit somewhat risky) opportunity to improve one's social and sexual life (Sevcikova and Daneback, 2011; Hobbs et al., 2017; Timmermans and Courtois, 2018; Wu and Ward, 2018; Jung et al., 2019). Attempts of non-consensual initiation of offline sexual encounters in digital contexts are described, however, as unethical and illegal grooming of children or harassment of adults (Malesky, 2007; Thompson, 2018; Greene-Colozzi et al., 2020). When it comes to commercial sex, the literature acknowledges opportunities of reaching clients on social media or dating platform for self-determined sex workers of different genders and sexual identities (Brennan, 2017; Kingston and Smith, 2020; Mergenthaler and Yasserli, 2021; Morris, 2021). At the same time, digital technologies are also characterized as dangerous because young women in particular can be lured and pressured by older men into the digital paysex market without them being able to fully consent, sex trafficking takes place online and prostitutes are contacted online by offenders (Beckham and Prohaska, 2012; Jonsson et al., 2014; O'Brien and Li, 2020; see Table 4).

Using Digital Media Content During Face-to-Face Sexual Interactions

The second subtype focuses on people shaping their face-to-face sexual encounters *through* joint use of sexually explicit digital media content (see Table 4). Watching digital pornography together directly before and/or during sexual activities can shape the face-to-face sexual encounter in such a way that the content triggers couples to speak more openly about their sexual needs, inspires them to try out new sexual practices or enhances and prolongs their arousal (Sun et al., 2016; Kohut et al., 2018; Johnson et al., 2019; Willoughby and Leonhardt, 2020). This consensual use pattern needs to be differentiated from non-consensual use where the victim is forced to participate in joint pornography watching. For example, offenders against children sometimes force their victims to watch pornography together with them (Langevin and Curnoe, 2004). While consensual and non-consensual use of pornography may play a role in commercial sexual encounters as well, we could not find research on these issues (see Table 4).

Producing Digital Media Content During Face-to-Face Sexual Interactions

The third subtype addresses people shaping their face-to-face sexual encounters *through* joint recording, streaming or otherwise digitally documenting their sexual endeavors (see Table 4). This activity is often referred to as the production of amateur pornography (Ruberg, 2016). Some individuals and couples digitally document and share their sexual activities just out of curiosity and fun (Schwarz, 2010), while others do it with commercial interest in a more or less professionalized form (Hofer, 2014), still trying to express authenticity (Stardust, 2019). Users involved in either non-commercial or commercial digital

TABLE 4 | Sexual interactions THROUGH digital technologies: subtypes.

Subtype	Activity	Consent	Commerce	Example studies
(1) Face-to-face sexual interactions enabled through digital technology	People initiating their face-to-face sexual encounters <i>through</i> digital dating services.	+	–	Jung et al. (2019) Sevcikova and Daneback (2011) Timmermans and Courtois (2018) Wu and Ward (2018)
		–	–	Greene-Colozzi et al. (2020) Malesky (2007) Schulz et al. (2016) Thompson (2018)
		+	+	Brennan (2017) Kingston and Smith (2020) Mergenthaler and Yasseri (2021) Morris (2021)
		–	+	Beckham and Prohaska (2012) Jonsson et al. (2014) O'Brien and Li (2020)
(2) Face-to-face sexual interactions accompanied by passive-receptive use of digital technology	People shaping their face-to-face sexual encounters <i>through</i> joint pornography use.	+	–	Kohut et al. (2018) Willoughby and Leonhardt (2020)
		–	–	Langevin and Curnoe (2004)
		+	+	/
(3) Face-to-face sexual interactions accompanied by active-productive use of digital technology	People shaping their face-to-face sexual encounters <i>through</i> live filming and streaming the act.	–	+	/
		+	–	Ruberg (2016) Schwarz (2010)
		–	–	Eaton et al. (2020)
		+	+	Hofer (2014) Stardust (2019)
		–	+	Boyle (2011)

Consent: “+” – consensual sexual interactions, “–” – non-consensual sexual interactions. Commerce: “+” – commercial sexual interactions, “–” – non-commercial sexual interactions.

recording and sharing of their sexual interactions are vulnerable for consent violations in the form of wide circulation of the material against their will (so-called “revenge porn”; Eaton et al., 2020) or consent violations in the form of pressured or unwanted activities in front of the camera (Boyle, 2011).

Causes and Consequences

What causes people to get involved in sexual interaction *through* digital technology, i.e., to search online for offline sexual partners and to consume or produce pornography during face-to-face sexual encounters? Research points to bio-psycho-social push factors meaning that particularly younger, non-heterosexual, male individuals with certain personality characteristics (e.g., sensation seeking) are more likely to get involved (Aretz et al., 2017; Wu and Ward, 2018; Bonilla-Zorita et al., 2020). Also, economic and technological pull factors that enable the respective behaviors need to be taken into consideration (e.g., convenient location-based search for potential partners through dating apps or easy access to smartphone camera and streaming apps during sexual encounters; Choi et al., 2017).

Regarding consequences of sexual interaction *through* digital technology, previous research has shown both negative and positive outcomes on general and sexual health. Involvement

in sexual interaction through digital technologies could reduce sexual isolation, improve sexual satisfaction and provide validation of one's own sexual identity (Hobbs et al., 2017), however, at the same time it is related to risks of sexual harassment or infidelity, addiction-like usage patterns and increased consumer mentality toward sexual partners (Couch et al., 2012; Choi et al., 2017). Consent turned out to be a key mediator as non-consensual interactions were linked to negative (Eaton et al., 2020) and consensual interactions to positive outcomes (Lemke and Merz, 2018). Consent is relevant in that regard not only for non-commercial, but also for commercial interactions: While the possibility to advertise own sexual services online has been economically beneficial for many sex workers (Mergenthaler and Yasseri, 2021), both private and commercial users are exposed to the risks of their intimate data being misused (Beckham and Prohaska, 2012; Greene-Colozzi et al., 2020).

SEXUAL INTERACTION VIA DIGITAL TECHNOLOGIES

Sexual interaction *via* digital technologies is a SIDC type that focuses on technology-mediated interpersonal sexual encounters.

Three Subtypes

Three subtypes can be differentiated for sexual interaction *via* digital technology (see **Table 5**).

Technology-Mediated Sexual Interactions *via* Digital Media Communication

The first subtype addresses people experiencing technology-mediated sexual interactions *via* digital media communication (see **Table 5**). The technologically mediated sexual interaction can be based on digital text communication (often called “cybersex”; Carvalheira and Gomes, 2003), digital audio communication (often called “telephone sex”; Selmi, 2014), digital image communication (often called “sexting”; Döring, 2014) and/or digital video communication (often called “webcam sex” or “camming”; Henry and Farvid, 2017). According to the main mediators consent and commerce, the literature characterizes consensual non-commercial technology-mediated sexual encounters as creative and convenient forms of sexual intimacy for both singles and people in committed relationships

(Beyens and Eggermont, 2014). At the same time, technology-mediated sexual interactions are described as risky, particularly because of boundary violations and non-consensual behaviors such as dissemination or publication of privately shared intimate messages against the will of the participant (e.g., so-called “revenge porn” or “image-based abuse”), non-consensual moves during the interaction (e.g., unsolicited sending of sexually explicit images such as “dick pics”) and technology-mediated sexual abuse of children (e.g., adults manipulating children into sending semi-nude pictures; Henry et al., 2018; Mandau, 2020; Mckinlay and Lavis, 2020; Naezer and van Oosterhout, 2021). In the context of commercial sex, the literature generally portrays technology-mediated sex work as a safer form of sexual labor that allows services providers even to become entrepreneurs (Podlas, 2000; Bleakley, 2014; Selmi, 2014; Jones, 2016; Weiss, 2018). At the same time, digital commercial sex services in the form of technology-mediated live interactions are associated with specific risks such as harassment or child prostitution (Jones, 2016; Açar, 2017; see **Table 5**).

TABLE 5 | Sexual interactions VIA digital technologies: subtypes.

Subtype	Activity	Consent	Commerce	Example studies
(1) Technology-mediated sexual interactions <i>via</i> digital media communication	Digital technologies are used to create a mediated text-, audio-, image-, photo- or video-based sexual interaction.	+	–	Beyens and Eggermont (2014) Carvalheira and Gomes (2003) Gregory (2018) Mileham (2007)
		–	–	Henry et al. (2018) Mandau (2020) Mckinlay and Lavis (2020) Naezer and van Oosterhout (2021)
		+	+	Bleakley (2014) Jones (2016) Selmi (2014) Weiss (2018)
		–	+	Açar (2017) Jones (2016)
(2) Technology-mediated sexual interactions <i>via</i> immersive virtual environments	Digital technologies are used to create a mediated avatar-based sexual interaction in virtual worlds.	+	–	Craft (2012) Gilbert et al. (2011) Mello et al. (2021) Wardle (2018)
		–	–	Behm-Morawitz and Schipper (2016) Reeves (2018) Strikwerda (2015)
		+	+	Lynch (2010) Martin (2014) Procter (2015) Smith (2009)
		–	+	/
(3) Technology-mediated sexual interactions <i>via</i> remote-controlled sex toys	Digital technologies are used to create a mediated sex toy-facilitated sexual interaction.	+	–	Flore and Pienaar (2020) Gomes and Wu (2018) Liberati (2017)
		–	–	Sparrow and Karas (2020) Sundén (2020) Wynn et al. (2017)
		+	+	Martins (2019)
		–	+	/

Consent: “+” – consensual sexual interactions, “–” – non-consensual sexual interactions. Commerce: “+” – commercial sexual interactions, “–” – non-commercial sexual interactions.

Technology-Mediated Sexual Interactions *via* Immersive Virtual Environments

The second subtype concerns people experiencing technology-mediated sexual interactions *via* immersive virtual environments (see **Table 5**). A typical example of an immersive virtual environment is a virtual world such as Second Life. Virtual worlds are computer-simulated representations of fictional worlds, where users synchronously interact with each other via virtual representations of themselves called “avatars” (Bell, 2008). Among these interpersonal interactions are also sexual interactions often labeled as “avatar sex” (Wardle, 2018). People involved in avatar sex with each other can have very diverse relationship backgrounds ranging from being strangers to each other to being in a committed relationship (Craft, 2012). Avatar sex is described as somewhat more disinhibited, diverse and adventurous than participants’ real-life sex (Smith, 2009; Gilbert et al., 2011). Interestingly, experiments have shown that virtual touch of the avatar body one is wearing is related to erotic experiences (Mello et al., 2021).

Non-consensual practices, such as virtual rape or sexual interactions with avatars that look like children, are also known and have been met with vivid discussions in the research community regarding their ethical and legal implications (Strikwerda, 2015; Reeves, 2018). New emerging technologies, such as augmented reality (AR), become more and more widespread. While they are already starting to receive recognition in the context of sexual health education (Baran et al., 2020), the potential of AR systems for sexual interaction is still widely unknown (Lombard and Jones, 2013). Evidence about consensual commercial sex in immersive virtual environments focuses on Second Life and points to the fact that some people enjoy playing an avatar escort for both money and sexual satisfaction (Smith, 2009; Lynch, 2010; Martin, 2014; Procter, 2015).

Technology-Mediated Sexual Interactions *via* Remote-Controlled Sex Toys

The third subtype focuses on people experiencing technology-mediated sexual interactions *via* remote-controlled sex toys (see **Table 5**). Such smart sex toys that are controlled by a smartphone app via Bluetooth or Internet have become popular in recent years. Sex toy-facilitated sexual interaction over distance, which has been discussed for decades under the label “teledildonics” (Rheingold, 1990), is now available to end users (Flore and Pienaar, 2020). Integrating haptic interfaces in technology mediated sexual interactions provides additional sensual and erotic experiences (Liberati, 2017) and particularly supports people who lack physical touch such as couples in long-distance relationships or people with disabilities (Gomes and Wu, 2018). However, the design of haptic interfaces and the idea of “teledildonics” might also limit sexual expression by pushing a phallogentric or penetration-focused sexual script (Flore and Pienaar, 2020). Non-consensual uses of remote-controlled sex toys have already been identified such as sex toy producers illegally recording their customers’ sexual interactions via the toys (Sundén, 2020) or people deceiving their sex partners about their true identity to initiate sexual interactions via remote-controlled sex toys without their counterpart’s informed consent

which turns the interaction to rape (Sparrow and Karas, 2020). Both privacy breaches and sexual assault are discussed as serious threats of smart sex toys (Wynn et al., 2017). Remote-controlled sex toys are also integrated in commercial sex, for example in commercial webcam live sex shows where the client pays to control the sex toys handled by the sex worker (Martins, 2019). The risks of consent violations described for non-commercial sexual interactions are applicable to commercial sex.

Causes and Consequences

What causes people to get involved in sexual interaction *via* digital technology, i.e., to sexually interact with other people via digital media communication, remote-controlled sex toys or in immersive virtual environments? In regards to bio-psycho-social push factors, research indicates that younger, non-heterosexual, male individuals with specific personality characteristics (e.g., neuroticism, low levels of agreeableness) are more likely to get involved (Delevi and Weisskirch, 2013; Gordon-Messer et al., 2013; Courtice and Shaughnessy, 2017). Among economic and technological pull factors the emergence of affordable smart devices with aesthetically attractive design and the rapid growth of the Internet of Things (IoT) need to be considered (Flore and Pienaar, 2020).

Concerning consequences of sexual interaction *via* digital technology, previous research has reported both positive (e.g., opportunities for sexual self-exploration, pleasure, and sexual identity validation; Döring, 2014) and negative (e.g., increased involvement in sexual risk behaviors by adolescents; van Ouytsel et al., 2015) effects for general and sexual health of participants. Nonsent plays a crucial role and is closely connected to technological factors, as non-consensual sexual interactions are often linked with data misuse and loss of control over one’s own sexual content resulting in humiliation, cyberbullying or harassment (Kopecký, 2015; McKinlay and Lavis, 2020). In terms of the second mediator commerce, the literature suggests that providing technology-mediated live sexual services in a digital space creates a safer work environment compared to traditional offline settings and thus enhances the opportunity not only for the client, but also for the sex worker to experience sexual pleasure and satisfaction (Jones, 2016).

SEXUAL INTERACTION WITH DIGITAL TECHNOLOGIES

Sexual interaction *with* digital technologies is a SIDC type that focuses on sexual interactions where a digital artifact plays the role of the sex partner.

Four Subtypes

With regard to sexual interaction *with* digital technologies four subtypes can be identified (see **Table 6**).

Sexual Interaction *With* Media Personas in Traditional Digital Pornography

The first subtype addresses people engaging in sexual interaction *with* media personas represented in traditional digital

TABLE 6 | Sexual interactions WITH digital technologies: subtypes.

Subtype	Activity	Consent	Commerce	Example studies
(1) Sexual interaction <i>with</i> media personas in traditional digital pornography	Digital technologies are used to enable sexual interaction between a person and media personas represented in text-, audio-, image- or video-based 2-dimensional pornographic content.	+	–	Ashton et al. (2019)
				Baudinette (2017)
				Döring (2021)
				Floegel (2020)
				Glascoock and LaRose (1993)
				Gorissen (2020)
				Hester et al. (2015)
				Saunders (2019)
				Vaillancourt-Morel et al. (2017)
				Vučurović (2016)
		–	–	Zhang (2016)
				Eggestein and Knapp (2014)
				Harris (2019)
				Henshaw et al. (2017)
				Kikerpill (2020)
				McLelland (2010)
				Xu and Yang (2013)
(2) Sexual interaction <i>with</i> media personas in virtual reality pornography	Digital technologies are used to enable sexual interaction between a person and media personas represented in virtual reality pornography.	+	+	See section “Producing Digital Media Content during Face-to-Face Sexual Interactions”
				See section “Producing Digital Media Content during Face-to-Face Sexual Interactions”
				See section “Producing Digital Media Content during Face-to-Face Sexual Interactions”
				See section “Producing Digital Media Content during Face-to-Face Sexual Interactions”
				See section “Producing Digital Media Content during Face-to-Face Sexual Interactions”
		–	–	See section “Producing Digital Media Content during Face-to-Face Sexual Interactions”
				See section “Producing Digital Media Content during Face-to-Face Sexual Interactions”
				See section “Producing Digital Media Content during Face-to-Face Sexual Interactions”
				See section “Producing Digital Media Content during Face-to-Face Sexual Interactions”
				See section “Producing Digital Media Content during Face-to-Face Sexual Interactions”
(3) Sexual interaction <i>with</i> software sexbots	Digital technologies are used to enable sexual interaction between a person and software sexbots.	+	–	Ashton et al. (2019)
				Baudinette (2017)
				Döring (2021)
				Floegel (2020)
				Glascoock and LaRose (1993)
				Gorissen (2020)
				Hester et al. (2015)
				Saunders (2019)
				Vaillancourt-Morel et al. (2017)
				Vučurović (2016)
(4) Sexual interaction <i>with</i> hardware sex robots	Digital technologies are used to enable sexual interaction between a person and a physical AI-enabled sex robot.	+	–	Zhang (2016)
				Eggestein and Knapp (2014)
				Harris (2019)
				Henshaw et al. (2017)
				Kikerpill (2020)
				McLelland (2010)
				Xu and Yang (2013)
		–	–	See section “Producing Digital Media Content during Face-to-Face Sexual Interactions”
				See section “Producing Digital Media Content during Face-to-Face Sexual Interactions”
				See section “Producing Digital Media Content during Face-to-Face Sexual Interactions”

Consent: “+” – consensual sexual interactions, “–” – non-consensual sexual interactions. Commerce: “+” – commercial sexual interactions, “–” – non-commercial sexual interactions.

pornography (see Table 6). Traditional digital pornography comes in a variety of media forms. The literature differentiates between text-based (e.g., erotic fan fiction; Floegel, 2020; Döring, 2021), audio-based (e.g., adult phone line recordings;

Glascoock and LaRose, 1993), image-based and computer-generated (e.g., erotic manga and anime; Vučurović, 2016; Baudinette, 2017; erotic gifs; Hester et al., 2015; GGI porn; Saunders, 2019) and/or video-based digital pornographic

content (e.g., cyberporn; Ashton et al., 2019). Research on traditional digital pornography mostly focuses on video-based or 2-dimensional (2D) audiovisual digital pornography. All these traditional forms of pornography allow the user to engage in parasocial interactions and relationships with the media personas (e.g., with the porn performers in video-based porn). Contemporary porn performers foster the parasocial interactions and relationships with their viewers and fans by presenting themselves not only in pornographic videos but also on social media platforms such as Twitter to appear more approachable and real (Gorissen, 2020).

Current studies show that people of different genders and sexual orientations voluntarily use traditional digital pornography that they can access discreetly and often cost-free on digital platforms (Vaillancourt-Morel et al., 2017). Issues of consent come up when adults and minors experience unwanted exposure to digital pornography (e.g., confrontation with pornographic pop-up adverts on the Internet or with forwarded porn images on social media) and when people are using sexually explicit content that depicts real life child sexual abuse (e.g., so-called “child pornography”; Eggstein and Knapp, 2014; Henshaw et al., 2017). Widely debated in the context of consent are also fictional pornographic descriptions or depictions of rape scenes, incest or sex with minors (McLelland, 2010). Furthermore, current technology allows to produce fake pornographic images and videos from everyone (so-called “deep fake”) against their will which poses a threat to their reputation (Harris, 2019; Kikerpill, 2020).

Most research on pornography has focused on its users. Research on professional porn performers and their involvement in commercial porn production is scarce. From the perspective of the porn actor participation in commercial porn production means that their face-to-face sexual interactions are recorded. Hence this activity would fall in the first type of SIDC: sexual interaction *through* digital technology (subtype: Producing digital media content during face-to-face sexual interactions; see section “Producing Digital Media Content during Face-to-Face Sexual Interactions”).

Sexual Interaction With Media Personas in Virtual Reality Pornography

The second subtype deals with 3-dimensional (3D) audiovisual digital pornography (see Table 6). It is commonly labeled in the literature as “VR porn” (Wood et al., 2017). Virtual reality (VR) pornography has been called a game-changer for the whole porn industry due to the vivid experiences it provides (Elsej et al., 2019). VR pornography is used not in front of a display but with a VR headset that allows to immerse in the VR world. By turning the head, the user can look around in the virtual scene. Some VR porn videos are filmed from the perspective of an external observer (voyeuristic perspective), others form the point of view (POV) of the user so that the illusion is created that the user has sex with the porn actor. Experimental studies have demonstrated that immersive VR porn provides a more intense and exciting experience than the use of traditional digital pornography on a desktop screen, particularly when the scene is filmed from the POV of the user (Elsej et al., 2019; Simon and Greitemeyer, 2019;

Dekker et al., 2021). Particularly, the parasocial interaction seems to be stronger: In the VR condition male users felt more desired, more flirted with and more looked in the eyes by the porn performer (Dekker et al., 2021).

So far, the research has focused on voluntary use. Issues of consent and commerce have not yet been investigated in the context of 3D or virtual reality pornography.

Sexual Interaction With Software Sexbots

The third subtype focuses on sexual interactions with software sexbots (e.g., AI-enabled chatbots; Banks and van Ouytsel, 2020; AI-enabled holograms; Liu, 2021). Those software artifacts are not tangible but invite the user to engage in social, romantic and sexual interactions and relationships. The 2013 science fiction US-movie “Her” has illustrated how a man can fall in love with an intelligent chatbot that is only present via its voice. However, available sex chatbots are mostly not yet audio-based but purely text-based¹.

Issues of consent arise when sexbots appear childlike or when users engage in aggressive and abusive interactions with virtual assistants (Laorden et al., 2015; Curry and Rieser, 2018). So far, the use of software sexbots in commercial sex has not been explored.

Sexual Interaction With Hardware Sex Robots

The fourth subtype addresses sexual interactions with hardware sex robots (see Table 6). Hardware sex robots differ from software sexbots in terms of their materiality. They are often described as AI-enhanced sex dolls (Döring et al., 2020; González-González et al., 2020). Hardware sex robots stand out from all other technologies discussed in this paper so far because of their high price of several thousand US Dollars. Even though the first sex robot models are on the market², the community of pioneer users of sex robots seems to be fairly small and not very visible in the public (Döring et al., 2020).

That is why empirical research on sex robots so far often draws on sex dolls and sex doll owners as a proxy as this user group is larger and also more publicly visible and accessible via their sex doll owner online communities (Döring and Pöschl, 2018). Research on sex doll owners has revealed a diversity of use patterns that include sexual interaction (e.g., sexual intercourse with the doll) but also social interaction (e.g., dining and watching TV with the doll) as well as physical care work (e.g., washing, powdering, and dressing the doll). Another research strand explores attitudes toward sex robots, intentions to use and to buy a sex robot with the help of surveys and vignette experiments where the robot is described to the participants or pictures of the robot are shown (Szczuka and Krämer, 2017a,b; Appel et al., 2019; Nordmo et al., 2020; Oleksy and Wnuk, 2021). Even though first theoretical models of the psychological mechanisms of sex robot use have been presented (Szczuka et al., 2019), so far, no empirical data are available on sexual and

¹e.g., collection of adult sex bots, <https://www.personalityforge.com/adult-chatbots.php>

²e.g., the AI driven robotic doll “Harmony-X” from the US company Real Doll: <https://www.realdoll.com/product/harmony-x/>

social interactions with actual sex robots or about long-term sex robot users.

The emerging technology of sex robots has elicited a lot of ethical and legal concerns around issues of consent. Main objections are that male users assault and rape female sex robots as well as child-like robots and hence normalize and train sexually abusive and violent behaviors (Richardson, 2016; Danaher, 2017; Frank and Nyholm, 2017). Child-like sex dolls and sex robots are considered particularly dangerous, and their production and possession is already criminalized in some countries (Maras and Shapiro, 2017; Brown and Shelling, 2019). The idea that female or child-like sex dolls and sex robots could successfully be used in the therapy of sex offenders is met with skepticism by ethicists, therapists, and sex offenders (Zara et al., 2021).

Commercial use of sex robots is already being observed in the sense that selected brothels world-wide offer users the option to rent a sex doll/robot or to book a sex worker together with a sex doll/robot (Döring et al., 2020). Some authors speculate that the use of sex robots in commercial sex could be beneficial. When sex robots substitute female prostitutes (e.g., in the red light district of Amsterdam) related risks of sexual violence, sex trafficking and STI transmission become obsolete (Yeoman and Mars, 2012). Other authors, however, argue that using a female sex robots as prostitutes and sex slaves is already an act of symbolic violence against all women and will foster more sexual violence against women and children (Richardson, 2016).

Causes and Consequences

What causes people to get involved in sexual interaction *with* digital technology, i.e., to sexually interact with traditional or virtual reality pornography, with software sexbots or hardware sex robots? Taking into account bio-psycho-social push factors, research showed that men are more likely than women to interact with digital pornography and to engage in sexual interactions with sex robots (Döring et al., 2020). Such traits as sensation seeking, high sexual motivation, lower self-esteem and an overall positive attitude toward new technologies were also associated with the more eager engagement in sexual interaction with digital technologies (Laier and Brand, 2014; Stark et al., 2018; Szczuka and Krämer, 2019). Socio-cultural factors in terms of positive attitudes toward intimate interactions with technology play an important role (Aoki and Kimura, 2021). In terms of economic and technological pull factors, the wide spread of sexually explicit content on the web (Cooper et al., 2004) and the attractive human-like design, functionality and wide media representation of sex robots (Döring and Poeschl, 2019) are important motivations for their use.

Regarding consequences of sexual interaction with digital technology, previous research has pointed both to risks and opportunities for general and sexual health. It appears that some characteristics of the technology are ambivalent and might create positive and negative effects. For example, sexual interaction with novel digital technologies such as seemingly interactive media persona in immersive virtual pornography or tangible intelligent sex robots can enhance sexual arousal and satisfaction (Dekker et al., 2021) while, at the same time, this technology can increase risks of overuse and addiction (Laier and Brand, 2017;

Brand et al., 2019, 2020). Customization of digital technologies can also be ambivalent. On the one hand, catering to the user's sexual preferences in terms of a sex robot appearance, personality and behaviors might enhance their well-being and arousal, while on the other hand, customized pornography and sex robots might feed into objectification, exaggerated beauty standards and unrealistic expectations that, ultimately, endanger sexual satisfaction (Döring et al., 2020). Interaction with technological artifacts frees users from social rules of interpersonal interactions, which can improve well-being and satisfaction. At the same time, sexual interactions with human-like (mostly woman-like) artifacts violating usual social norms of sexual consent, are assumed to be linked with very negative psychological and social outcomes (Richardson, 2016). Furthermore, the design potentials of innovative digital technologies promise to fulfill sexual fantasies and, hence, foster well-being, while they also bring about risks of privacy violations (Kikerpill, 2020; Ratner, 2021).

DISCUSSION

The present paper introduces a new conceptual model of SIDC that is arousal-oriented and technology-inclusive. Considering that digital technologies can not only mediate interpersonal sexual interactions, but also act as an equal partner in it, the model differentiates between sexual interaction *through*, *via* and *with* digital technologies, depending on the role the technology plays in the interaction. Consent and commerce are identified as relevant mediators. Both causes and consequences of SIDC are described as multidimensional including bio-psycho-social as well as economic and technological factors.

Reflections on the Model and the State of Research

The core and most innovative aspect of our model is the distinction between the three types of sexual interactions: Those that occur *through* digital media, *via* digital media and *with* digital media. By introducing this systematization, we highlight that sexual interaction in the context of digital media is diverse and that digital media can take very different roles in sexual interactions. As the overview of current research indicates, first evidence that these different roles lead to different effects can be identified. Still, future research needs to scrutinize more systematically which interaction type entails which risks and benefits. So far, the summary of recent results clearly indicates that sexual interaction in digital contexts is not only related to risks but can also be accompanied by beneficial outcomes – contradicting early assumptions and publicly discussed fears (Döring, 2009). Future research, however, will need to more systematically assess the magnitude of risks and benefits and the specific boundary conditions which lead to each.

In this line, another important addition to current research and theorizing is that we plead to not only include bio-psycho-social causes and consequences as has been argued before (Shaer et al., 2017; Leavitt et al., 2021) but to also consider economic and, specifically, technological causes and consequences. A further

addition to current theorizing is the inclusion of the mediators consent and commerce. Here, the overview about first research that either focusses on (non)consensual and/or (non)commercial sexual interactions or even directly addresses their differences indicates that these mediators indeed affect the relationship between the digitalized sexual interaction and the consequences. Future research needs to scrutinize the boundary conditions. Therefore, altogether this contribution is meant to support future research by identifying variables that have so far been overlooked and that have not been sufficiently systematized. Still, the strength of the paper lies in its summary of relevant phenomena, variables and empirical findings. The model we present, however, is not yet a theoretical model. Future research and theorizing must clarify how the variables and conditions which we identified interact and what exact mechanisms lead to risks or benefits.

Limitations

Despite its universal approach, the presented conceptual analysis of sexual interaction in digital contexts has its limitations. The analysis has been conducted by an interdisciplinary research team with experts from psychology, medicine, and communication science. It was validated by discussions with further colleagues from these three fields and related social sciences (e.g., sociology). While all experts involved are familiar with relevant research in engineering (e.g., smartphone apps, virtual reality systems, robotics), genuine engineers or computer scientists did not participate. The conceptual analysis methodology involved searching for and analyzing a large body of interdisciplinary literature that is presented both in text and tables. However, it has not been the goal of this paper to provide a systematic literature review. As our literature search was limited to English-language academic sources and our research group is based in Germany, we need to admit that our perspective might have a bias toward the Western world and the Global North.

There is broad consensus that SIDC can have negative (e.g., sexual addiction, sexual violence, relationship breakup) as well as positive (e.g., sexual self-validation, sexual satisfaction, relationship building) consequences. Also, it is obvious that SIDC consequences on different dimensions influence each other: For example, using digital media to search for face-to-face sexual interactions can lead to infidelity among partnered and married participants. Infidelity as a social consequence of online dating can bring about relationship crisis and breakup, emotional stress and increased cortisol level as psychological and biological consequences, and even economic consequences such as loss of property and assets. All of this is covered by our SIDC model. However, we did not explicitly differentiate short-, medium-, and long-term consequences. In the case of a SIDC-induced relationship breakup or divorce, short- and medium-term consequences can be experienced as very negative, while long-term evaluations can be positive, for example in light of a happy and sexually fulfilling new relationship. This example illustrates that classifying SIDC consequences as positive or negative, as opportunities or challenges for sexual and overall health is often not straightforward. People involved in SIDC, external observers, and clinical experts alike can be ambivalent or unsure about the valence of consequences and might change their

evaluation over time. The value-laden and even philosophical issue of evaluating complex SIDC consequences from a lifespan-perspective is beyond the scope of this analysis.

Conclusion and Outlook

The aim of the present paper was to identify relevant variables that so far have been overlooked or under-researched. By differentiating the three types of sexual interaction *through*, *via* and *with* technology and discussing them together with bio-psycho-social-economic-technological causes and consequences and with mediators such as consent and commerce, we lay the ground for future studies in this broad and emerging field.

It would, for instance, be helpful to design comparative studies, that contrast different (sub)types of SIDC, e.g., interactions with media personas in traditional 2D versus 3D digital pornography or interactions with software versus hardware sexbots. Those comparisons can be helpful to better understand experiences of social presence and para-sociality during sexual interactions with technology and their links to sexual arousal and satisfaction. Based on the current state of research it is expected, for example, that interaction with media personas in 3D porn are experienced as more intense in comparison to interactions with media personas in 2D porn. Furthermore, interaction with a hardware sexbot should provide more intense experiences than interactions with a software sexbot.

Also, acknowledging consent and commerce as meaningful mediators of SIDC, leads to questions of precise measurement: Using instruments that clearly distinguish between consensual and non-consensual as well as between commercial and non-commercial SIDC is an important first step. However, research points to the need to further differentiate between different qualities or degrees of consent and commerce (e.g., consensual but still unwanted sexting or unpaid but still incentivized sex). Here more research is needed to explore, for example, the different causes, characteristics and consequences of online sex dating that (a) involves no commercial benefit, (b) provides incentives such as invitations to dinners and events or other gifts, (c) includes the direct exchange of money. So far, no validated measures have been developed to collect data on different types of commercial sex in digital contexts such as regular sex dating apps and so-called “sugaring” apps.

Furthermore, we encourage studies that cover causes and consequences in a multi-dimensional way and measure both negative and positive consequences for sexual and overall health in a balanced way. For example, engaging in commercial sex in digital context can be both beneficial and detrimental to general and sexual health (e.g., relief from financial stress and related health issues but at the same time increased vulnerability to STI transmission and stigmatization and, hence, increase in related health issues).

A multi-dimensional analysis is also recommended, according to our SIDC model, when it comes to analyzing the causes or predictors of certain effects of sexual interaction in digital contexts. For example, factors contributing to successful online sex dating can be biological, psychological, social, technological, and economic.

The proposed new SIDC model is meant to help identify research gaps (see, e.g., the empty cells in **Tables 4–6**) and to provide a systematic framework that assists in incorporating the most relevant variables in future research. To put the model to research practice we suggest to design studies that incorporate those variables that have been neglected. For example, **Tables 4–6** reveal that we don't know much about the incorporation of technologies in commercial sex (e.g., use of pornography, sex dolls or sex robots during interactions with a sex worker).

Last not least we need to point out that much work still needs to be done: The systematization and theoretical framework we present here need to be transformed to a theoretical model which specifies causal mechanisms and processes. Moreover, a long-term or lifespan-perspective when investigating SIDC needs to be incorporated. Ever new and emerging technologies will make sure that the prospective model needs to be constantly checked for potential amendments (e.g., incorporation of new subtypes of SIDC) based on new socio-technical developments.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

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AUTHOR CONTRIBUTIONS

ND, NK, MB, TK, and GV contributed to planning the manuscript, doing the conceptual analysis, developing the conceptual model, and revising the manuscript. ND and VM took the lead in writing and editing the manuscript. All authors contributed to the article and approved the submitted version.

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A Longitudinal Study on Online Sexual Engagement, Victimization, and Psychosocial Well-Being

Felix Reer^{1*}, Ruth Wendt² and Thorsten Quandt¹

¹Department of Communication, University of Münster, Münster, Germany, ²Social Media Lab, Leibniz-Institut für Wissensmedien, Tübingen, Germany

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Anja Schultze-Krumbholz,
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Germany
Joaquín Manuel González Cabrera,
Universidad Internacional De La
Rioja, Spain

*Correspondence:

Felix Reer
felix.reer@uni-muenster.de

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Several cross-sectional studies have shown that online sexual engagement (OSE) in the form of *sexting* or *sexy self-presentation* on social media is associated with an increased risk of experiencing negative consequences, such as online sexual victimization (OSV) or lower levels of psychosocial well-being. However, representative and longitudinal studies are scarce. The current study follows three research goals: (1) examining the prevalence of OSE and OSV among a random-quota sample of 1,019 German Internet users aged 14–64 years, (2) examining gender and age-related differences in OSE and OSV, and (3) examining the longitudinal relationships between OSE, OSV, and psychosocial well-being over a period of 1 year. Our results indicate that OSE and OSV are relatively widespread: 17.7% of the participants had already experienced OSV, 25.3% indicated that they had presented themselves online in a sexualized manner at least once in the past 2 months, and 22.7% showed a certain willingness to engage in sexting. We found higher rates among the younger participants. However, to a certain degree, older individuals were also affected. Male participants showed higher sexting willingness and more often presented themselves in a sexualized manner than females, whereas only small differences related to OSV were found. Concerning relationships with psychosocial well-being, our cross-sectional results showed that OSE, OSV, and mental problems are intercorrelated. Furthermore, we detected a significant long-term relationship between higher sexting willingness at time 1 and more victimization experienced 1 year later, whereas no significant longitudinal associations with lower levels of psychosocial well-being were identified.

Keywords: sexting, online sexual victimization, sexy self-presentation, anxiety, loneliness, depression, psychosocial well-being, longitudinal

INTRODUCTION

The sharing and publication of personal sexual content and information have recently garnered wide scientific and public attention (e.g., Del Rey et al., 2019; Burić et al., 2020; Cornelius et al., 2020; Gassó et al., 2020, 2021a,b; van Ouytsel et al., 2020; Barroso et al., 2021; Wachs et al., 2021). Practices, such as *sexting* (e.g., Wolak and Finkelhor, 2011; Döring, 2014) or sexualized forms of self-presentation on social media platforms (*sexy self-presentation*; e.g., van Oosten and Vandenbosch, 2017; van Ouytsel et al., 2020), are

increasingly popular, especially among adolescents and young adults. These sexualized online media usage behaviors carry risks of misuse, as private and intimate material may be misunderstood or forwarded without knowledge and permissions and to an unlimited audience (Heirman and Walrave, 2008).

Sexting can broadly be defined as “the sharing of personal, sexually suggestive text messages, or nude or nearly nude photographs or videos *via* electronic devices” (Mori et al., 2020, p. 1103). According to recent meta-analyses (Madigan et al., 2018; Mori et al., 2020), sexting is a quite common behavior among the younger generation. For example, Mori et al. (2020) meta-analyzed 50 studies and found that on average, 38.3% within the age group of 18–29 years have already send a sexting message, 41.5% have received a sexting message, and 47.7% have engaged in reciprocal sexting. Further, 15% were victims of non-consensual forwarding of sexting content (Mori et al., 2020).

Sexy self-presentation refers to sexualized forms of self-presentation on social media platforms, such as Instagram or Facebook, and, for example, “includes posting images in which someone is scarcely dressed, has a sexy gaze or in which sexual willingness is suggested” (van Ouytsel et al., 2020, p. 1/15). In comparison to sexting, which typically occurs in inter-personal conversations and is quite explicit, sexy self-presentation is a more suggestive and less private form of sexual self-expression (van Oosten and Vandenbosch, 2017). Similar to studies on sexting, research has found that engagement in sexy self-presentation is relatively widespread among adolescents (Festl et al., 2019; van Ouytsel et al., 2020). For example, Festl et al. (2019) conducted a survey among German Internet users aged 14–20 years and found that 35% of the participants had made experiences with sexy self-presentations within the last 2 months.

Both sexting and sexy self-presentation have been considered sexual risk behaviors that may result in severe negative consequences, such as cyberbullying, sexual victimization, or different forms of psychological distress (e.g., Klettke et al., 2014; Gámez-Guadix et al., 2015; Festl et al., 2019; Gassó et al., 2019, 2020, 2021b; Mori et al., 2019; Burić et al., 2020; Barroso et al., 2021; García-González et al., 2021; Lu et al., 2021; Tamarit et al., 2021; Wachs et al., 2021). Indeed, several empirical studies have identified direct relationships between engagement in sexting and decreased mental health (Klettke et al., 2014; Gassó et al., 2019; Mori et al., 2019). For example, Frankel et al. (2018) surveyed 6,021 high school students and found that consensual as well as non-consensual sexting is positively associated with suicide attempts, self-harm, and depression symptoms. The finding that sexting is positively related to higher levels of depression symptomatology has been confirmed by several studies (e.g., Temple et al., 2014; van Ouytsel et al., 2014; Chaudhary et al., 2017; Gámez-Guadix and de Santisteban, 2018; Festl et al., 2019; Kim et al., 2020). Sexting has also been found to be positively related to anxiety (Chaudhary et al., 2017), emotional problems (Ševčíková, 2016), low self-esteem (Ybarra and Mitchell, 2014), and increased conduct disorder scores (Kim et al., 2020).

A plausible explanation for these findings may be that engagement in sexting can increase the risk of unintended sexual attention, unpleased contacts, and, in general, being victimized online (Gámez-Guadix et al., 2015). Accordingly, sexting and sexualized forms of online self-presentation have been found to be positively associated with a higher risk of online sexual victimization (OSV) and cyberbullying (e.g., Reyns et al., 2013; Gámez-Guadix et al., 2015; Medrano et al., 2018; Festl et al., 2019). Some studies found that victimization experiences mediate the relationship between online sexual engagement (OSE) and psychological distress (Medrano et al., 2018; Festl et al., 2019). For example, Medrano et al. (2018) showed that individuals who more often engage in sexting have a higher risk of becoming a victim of cyberbullying, which, in turn, is associated with higher scores in measurements of depression and suicidal ideation.

Although the number of studies on OSE and its correlates has increased in recent years, the existing research still suffers from some limitations. One issue concerns the fact that most studies were cross-sectional and thus did not allow examining the direction of the relationships between the measured constructs (Gassó et al., 2019; Mori et al., 2019). As pointed out by Gassó et al. (2019, p. 11), “some studies explored the psychological variables as predictors of sexting [...], while others measured them as consequences of the behavior [...]”. In principal, both directions of relationships would make sense. On the one hand, it can be argued that behaviors, such as sexting and sexy self-presentation, increase the risk of experiencing negative psychosocial consequences. On the other hand, it can be argued that individuals with preexisting mental problems more often engage in online sexual risk behaviors owing to insufficient coping skills and a stronger need to feel popular and desired (Gassó et al., 2019). More longitudinal studies are needed to shed light on how OSE, OSV, and psychosocial well-being are related to each other over time (Mori et al., 2019).

Another limitation concerns the participant samples most studies are based on. A large majority of studies examine OSE among teenagers and adolescents (Klettke et al., 2014; Gassó et al., 2019; Mori et al., 2019, 2020) probably because younger users are considered an at-risk group for negative consequences. However, some empirical evidence suggests that sexting not only is a youth phenomenon but also is engaged in by quite a high percentage of middle-aged and older adults (Gámez-Guadix et al., 2015). More representative studies covering broader segments of society would be useful to allow for a better assessment of the prevalence of OSE and OSV (Klettke et al., 2014).

The Current Study

The first goal of the current study was to investigate the prevalence of OSE (sexy self-presentation and sexting) and OSV based on a more representative and more heterogeneous sample than that typically used in this field of research. In particular, we aimed to examine OSE and OSV among a random-quota sample of German Internet users aged 14–64 years. Our first research question reads as follows:

RQ1: How prevalent are OSE and OSV among German Internet users aged 14–64 years?

Research among adolescents found that a higher willingness to engage in sexting is associated with older age (Klettke et al., 2014; Madigan et al., 2018), whereas studies that covered a broader age range showed the opposite effect (a higher willingness among younger participants; e.g., Gámez-Guadix et al., 2015). Concerning gender, few studies showed that females are more willing to send sexts (e.g., Mitchell et al., 2012; Ybarra and Mitchell, 2014), few indicated higher sexting willingness among males (e.g., West et al., 2014; Festl et al., 2019), and some found no significant differences between the genders (e.g., Kim et al., 2020). In general, females are often considered to have a high risk of experiencing negative consequences of OSE (e.g., Bianchi et al., 2019; Burić et al., 2020). Against this background, we examined whether age and gender-related differences in OSV and OSE were identifiable in the current random-quota-based study:

RQ2: Are there gender and age-related differences in OSV and OSE?

As outlined above, several cross-sectional studies identified positive associations between OSE, OSV, and decline in psychosocial well-being. However, the directions of these relationships often remained unclear because longitudinal studies are still scarce. Following a cross-lagged panel approach, the main goal of the current study therefore was to examine the longitudinal relationships between OSE, OSV, and psychosocial well-being. Based on existing cross-sectional research (Festl et al., 2019), we selected three different relevant indicators of psychosocial well-being, namely, depression/anxiety, life satisfaction, and loneliness.

RQ3: How are OSE, OSV, and psychosocial well-being related over time?

MATERIALS AND METHODS

Participants and Procedures

The study was conducted as an online survey. We cooperated with a professional German survey research institute (adhering to the ICC/ESOMAR ethics code) that provided access to an online panel. A random-quota procedure with the criteria age, gender, living region, and education was applied to increase the representativeness of the sample. The initial sample (T1) was collected in 2018 and (after data cleansing) comprised of 1,019 German Internet users aged 14–64 years. The mean age of the initial sample was 41.30 years ($SD=13.91$), and gender was almost equally distributed (50.9% males; 49.1% females).¹

The second wave of the study was conducted 1 year later in 2019 (T2). In total, 586 usable datasets (58% of T1) were

collected from the individuals who participated in both study waves.²

Measurements

The different constructs were measured with translated versions of established instruments. German language versions of the scales measuring OSV, sexting willingness, and sexy self-presentation were adopted from Festl et al. (2019). To assess reliability, we calculated Cronbach's alpha three times for each scale: for the initial sample of 1,019 German Internet users collected in 2018 ($T1_{\text{initial}}$) and separately for those participants who took part in both study waves ($T1_{\text{panel}}$ and $T2_{\text{panel}}$).

Sexting Willingness

Participants' willingness to engage in sexting was measured with items originally developed by van Oosten and Vandenbosch (2017). The participants indicated the likelihood that "they would send a picture *via* the Internet or text message of them being naked or almost naked, if this was asked of them by (a) their partner, (b) someone they are dating, (c) a friend, (d) a stranger, or (e) their ex-partner." A seven-point scale ranging from 1 = "very unlikely" to 7 = "very likely" was used to rate the items ($T1_{\text{initial}}$: $\alpha=0.903$; $T1_{\text{panel}}$: $\alpha=0.914$; and $T2_{\text{panel}}$: $\alpha=0.909$).

Sexy Self-Presentation

To get an impression of the participants' self-presentation behaviors on social media, we adopted the sexy self-presentation scale by van Oosten and Vandenbosch (2017). The participants were asked "how often in the past 2 months they had uploaded pictures on their social media profile portraying themselves (a) with a sexy gaze, (b) with a sexy appearance, (c) scantily dressed (e.g., bathing suit or underwear), and (d) in a sexy posture." Each of the items was answered on a scale ranging from 1 = "never" to 7 = "very often" ($T1_{\text{initial}}$: $\alpha=0.961$; $T1_{\text{panel}}$: $\alpha=0.971$; and $T2_{\text{panel}}$: $\alpha=0.960$).

Online Sexual Victimization

We used the OSV scale developed by Gámez-Guadix et al. (2015) to measure how often the participants had negative sexuality-related experiences when using the Internet. The scale consisted of 10 items (e.g., "Somebody has disseminated or uploaded to the Internet photos or videos of you with erotic or sexual content without your consent") that address three different dimensions of OSV experiences: threats and coercion, insistence, and the dissemination of personal sexual content/information without consent. A five-point scale was used to assess how often the participants had made such experiences online (0 = "never," 1 = "1 or 2 times," 2 = "3 or 4 times," 3 = "5

¹Comparing the sample characteristics with statistics on the German general population (Destatis – Statistisches Bundesamt, 2021) shows quite a close match cornering gender (population-wide ratio in 2019: 49.3% males and 50.6% females) and age (population-wide mean age in 2019: 44.5 years).

²Comparing the panel respondents ($n = 586$) with those who only participated in the first wave ($n = 433$), we found that the panel respondents were older ($M = 43.75$ compared to $M = 37.99$ years; mean difference: -5.76 [BCa 95% CI: $-7.50, -4.01$], $t = -6.47$, $df = 816.31$, $p < 0.01$, $d = -0.423$) and that the panel contained more male than female respondents (54.4% compared to 46.2%; $\chi^2 = 6.78$, $df = 1$, $p < 0.01$). There were no significant differences regarding the amount of respondents Internet use or their sexual orientation.

or 6 times,” and 4=“7 or more times”; $T1_{\text{initial}}$: $\alpha=0.969$; $T1_{\text{panel}}$: $\alpha=0.972$; and $T2_{\text{panel}}$: $\alpha=0.970$).

Loneliness

Loneliness was measured with a German translation (Reer et al., 2019) of the short version (Hughes et al., 2004) of the revised UCLA loneliness scale (Russell et al., 1980). The scale consisted of three items (e.g., “How often do you feel that you lack companionship?”) that had to be rated from 1=“never” to 4=“often” ($T1_{\text{initial}}$: $\alpha=0.828$; $T1_{\text{panel}}$: $\alpha=0.847$; and $T2_{\text{panel}}$: $\alpha=0.850$).

Life Satisfaction

The German version (Schumacher, 2003; Glaesmer et al., 2011) of the life satisfaction scale by Diener et al. (1985) was filled out by the participants using a seven-point scale ranging from 1=“strongly disagree” to 7=“strongly agree.” An example item of the scale reads as follows: “In most ways, my life is close to my ideal” ($T1_{\text{initial}}$: $\alpha=0.897$; $T1_{\text{panel}}$: $\alpha=0.904$; and $T2_{\text{panel}}$: $\alpha=0.932$).

Depression/Anxiety

We measured the participants’ mental health using the patient health questionnaire (PHQ-4) by Kroenke et al. (2009) (German version by Löwe et al., 2010). The PHQ-4 asks to indicate how often someone experienced depression symptoms (e.g., “Feeling down, depressed, or hopeless”) and anxiety symptoms (e.g., “Feeling nervous, anxious, or on edge”) during the last 2 weeks. The four items (two per sub-dimension) were rated on a scale ranging from 0=“not at all” to 3=“nearly every day” and were composed to build a depression/anxiety index for each participant ($T1_{\text{initial}}$: $\alpha=0.891$; $T1_{\text{panel}}$: $\alpha=0.903$; and $T2_{\text{panel}}$: $\alpha=0.899$).

Control Variables

Like previous studies (e.g., Festl et al., 2019), we considered control variables that might be relevant in the context of OSE and OSV. In addition to age and gender, we asked the participants to indicate their amount of Internet use (minutes) in a typical week ($T1_{\text{initial}}$: $M=1,250.69$, $SD=1,028.83$; $T1_{\text{panel}}$: $M=1,239.65$, $SD=1,007.62$). Further, we asked the participants about their sexual orientation using the following categories: “heterosexual,” “bisexual,” “gay/lesbian,” or “other” (following Savin-Williams, 2014). Following the approach by Festl et al. (2019), we dichotomized the responses to distinguish between heterosexual (=0; $T1_{\text{initial}}$: 91.6%; $T1_{\text{panel}}$: 92.0%) and non-heterosexual (=1; $T1_{\text{initial}}$: 8.4%; $T1_{\text{panel}}$: 8.0%) individuals.

Data Analysis

Descriptive statistics concerning the prevalence of OSE and OSV (RQ1) were calculated based on the initial sample ($T1_{\text{initial}}$). Following the approach of Festl et al. (2019), the reported percentages refer to the participants who at least once had made experiences with sexualized forms of self-presentation or OSV. For sexting, the percentage refers to those who showed

willingness to engage in sexting by answering at least one item of the corresponding measurement as 5 or higher on the provided seven-point scale.

RQ2 asks about gender differences in OSE and OSV. We again followed the approach of Festl et al. (2019) and performed chi-square tests (prevalence rates) and independent *t*-tests (mean differences) to examine how OSE and OSV differed between gender and age groups. For all *t*-tests, bootstrapped CIs of the mean differences (2,000 samples, 95% bias-corrected and accelerated method) were additionally calculated to account for the non-normality of the data (Field, 2018). Cohen’s *d* was reported as a measure of the effect size.

Based on the panel data ($T1_{\text{panel}}$ and $T2_{\text{panel}}$), we used a cross-lagged model to examine the long-term relationships between OSV,³ sexting willingness, sexy self-presentation, and the three indicators of psychosocial well-being (RQ3). The model was estimated using the software R (FIML imputation) and the lavaan package (Rosseel, 2012). We used the MLR estimator, which features “maximum likelihood estimation with robust (Huber-White) standard errors and a scaled test statistic that is (asymptotically) equal to the Yuan-Bentler test statistic” (Rosseel, 2012, p. 27). Established criteria were applied to evaluate the fit of the model: TLI and CFI close to 0.95, RMSEA close to 0.06, and SRMR below 0.08 (Hu and Bentler, 1999).⁴

RESULTS

Prevalence Rates

Concerning RQ1, a summary of our descriptive findings on the prevalence of OSE and OSV at T1 ($N=1,019$) is provided in **Table 1**.

According to our data, several participants already had experienced OSV (17.7%). Further, 25.3% indicated that they had presented themselves in a sexualized manner on social media at least once in the past 2 months, and 22.7% showed willingness (“rather probable,” “probable,” or “highly probable”) to engage in sexting.

RQ2 addressed age and gender differences in OSE and OSV.

We found that males scored higher on the instruments measuring sexting willingness (mean difference: 0.584 [BCa 95% CI:0.437, 0.735], $t=7.37$, $df=879.01$, $p<0.001$, $d=0.467$), engagement in sexy self-presentation (mean difference: 0.400 [BCa 95% CI:0.249, 0.559], $t=5.12$, $df=875.93$, $p<0.001$, $d=0.321$), and OSV (mean difference: 0.112 [BCa 95% CI:0.041, 0.183], $t=3.23$, $df=788.01$, $p<0.01$, $d=0.205$). Moreover, a higher percentage of males than females had presented themselves in a sexualized manner on social media (males: 28.8%; females:

³Note that item parceling was used for the construct OSV.

⁴To analyze the effects over time, it is necessary to measure identical constructs at both panel waves. For each reflective construct, we conducted measurement invariance analyses prior to the main data analyses using the *longInvariance* function of the *semTools* package and checked whether removing the equality constraints on factor loadings would significantly improve the fit indices for each model: comparative fit index (CFI, increase of ≥ 0.010) and root mean square error of approximation (RMSEA, decrease of ≥ 0.015 ; see Chen, 2007). Measurement invariance could be confirmed for all constructs.

TABLE 1 | Gender and age group differences in means and prevalence rates of sexting willingness, sexy self-presentation, and OSV.

	All complete datasets			Males			Females			Age: 14–35			Age: 36–64		
	N	M (SD)	% (n)	N	M (SD)	% (n)	N	M (SD)	% (n)	N	M (SD)	% (n)	N	M (SD)	% (n)
Sexting Willingness (1–7)	987	1.72 (1.28)	22.7 (224)	499	2.00* (1.46)	30.3* (151)	488	1.42* (0.99)	15.0* (73)	363	2.06* (1.46)	33.6* (122)	624	1.51* (1.12)	16.3* (102)
Sexy Self-Presentation (1–7)	996	1.58 (1.26)	25.3 (252)	510	1.77* (1.47)	28.8* (147)	486	1.38* (0.95)	21.6* (105)	363	1.81* (1.43)	34.7* (126)	633	1.45* (1.13)	19.9* (126)
OSV (0–4)	974	0.17 (0.55)	17.7 (172)	493	0.22* (0.67)	17.0 (84)	481	0.11* (0.38)	18.3 (88)	356	0.27* (0.67)	29.2* (104)	618	0.11* (0.45)	11.0* (68)

OSV: online sexual victimization. Results were calculated based on the initial sample at T1 (N = 1,019). Incomplete datasets were excluded. The reported prevalence rates refer to participants that at least once had made experiences with sexualized forms of self-presentation or OSV. For sexting, the percentage refers to those that showed a certain willingness to engage in sexting by answering at least one item of the corresponding measurement with 5 or higher on the provided seven-point scale. *group differences are significant with $p < 0.01$.

21.6%; $\chi^2 = 6.86$, $df = 1$, $p < 0.01$) and showed a certain willingness to engage in sexting (males: 30.3%; females: 15.0%; $\chi^2 = 32.93$, $df = 1$, $p < 0.001$). No significant gender difference was found concerning the percentage of those who at least once had made a victimization experience (males: 17.0%; females: 18.3%; $\chi^2 = 0.26$, $df = 1$, $p = 0.607$).

Two age groups (group1: 14–35 years; group2: 36–64 years) were built to examine age differences. As illustrated in **Table 1**, we found that younger participants received higher scores on the scales measuring sexting willingness (mean difference: 0.545 [BCa 95% CI: 0.357, 0.743], $t = 6.15$, $df = 612.16$, $p < 0.001$, $d = 0.434$), sexy self-presentation (mean difference: 0.362 [BCa 95% CI: 0.203, 0.530], $t = 4.15$, $df = 624.30$, $p < 0.001$, $d = 0.291$), and OSV (mean difference: 0.165 [BCa 95% CI: 0.094, 0.236], $t = 4.14$, $df = 545.45$, $p < 0.001$, $d = 0.173$). Further, a higher percentage of the younger participants showed a certain willingness to engage in sexting (group1: 33.6%; group2: 16.3%; $\chi^2 = 38.98$, $df = 1$, $p < 0.001$), and had made at least one experience with sexy self-presentation (group1: 34.7%; group2: 19.9%; $\chi^2 = 26.76$, $df = 1$, $p < 0.001$) and OSV (group1: 29.2%; group2: 11.0%; $\chi^2 = 51.51$, $df = 1$, $p < 0.001$).

Cross-Lagged Panel Analysis

RQ3 was examined based on the subsample of participants who participated in both study waves ($N = 586$). A visualization of the cross-lagged analysis is shown in **Figure 1**. An overview of all the longitudinal relationships is provided in **Table 2**. In addition, the correlations between all latent and observed variables measured at $T1_{\text{panel}}$ that were calculated as part of the cross-lagged model are reported in **Table 3**.

The analysis revealed several significant correlations between the main study variables at $T1_{\text{panel}}$ (see **Table 3**). Both increased willingness to engage in sexting and more frequent use of social media for sexualized self-presentation were positively correlated with an increased risk of being victimized online. Further, sexy self-presentation and sexting willingness were both positively related to more loneliness and more depression/anxiety and showed small positive relationships with life satisfaction. Regarding experiences of OSV, we found significant positive correlations with higher levels of loneliness and depression/anxiety. No significant cross-sectional relationship was found between OSV and general life satisfaction.

Despite these cross-sectional findings, we found that the longitudinal relationships between the main study variables were mostly non-significant (see **Figure 1**; **Table 2**). Psychosocial well-being at T1 did not predict OSE or OSV at T2; and OSE and OSV at T1 did not predict psychosocial well-being at T2. We, however, found that more sexting willingness at T1 was related to more victimization experiences at T2. Further, significant longitudinal relationships were identified for younger age (higher sexting willingness and more OSV at T2) and male gender (more sexting willingness at T2). In the model, the autoregressive path from OSV at T1 to OSV at T2 was non-significant. An examination of the bivariate relationship showed a moderate positive relationship ($\beta = 0.49$, $p < 0.001$).

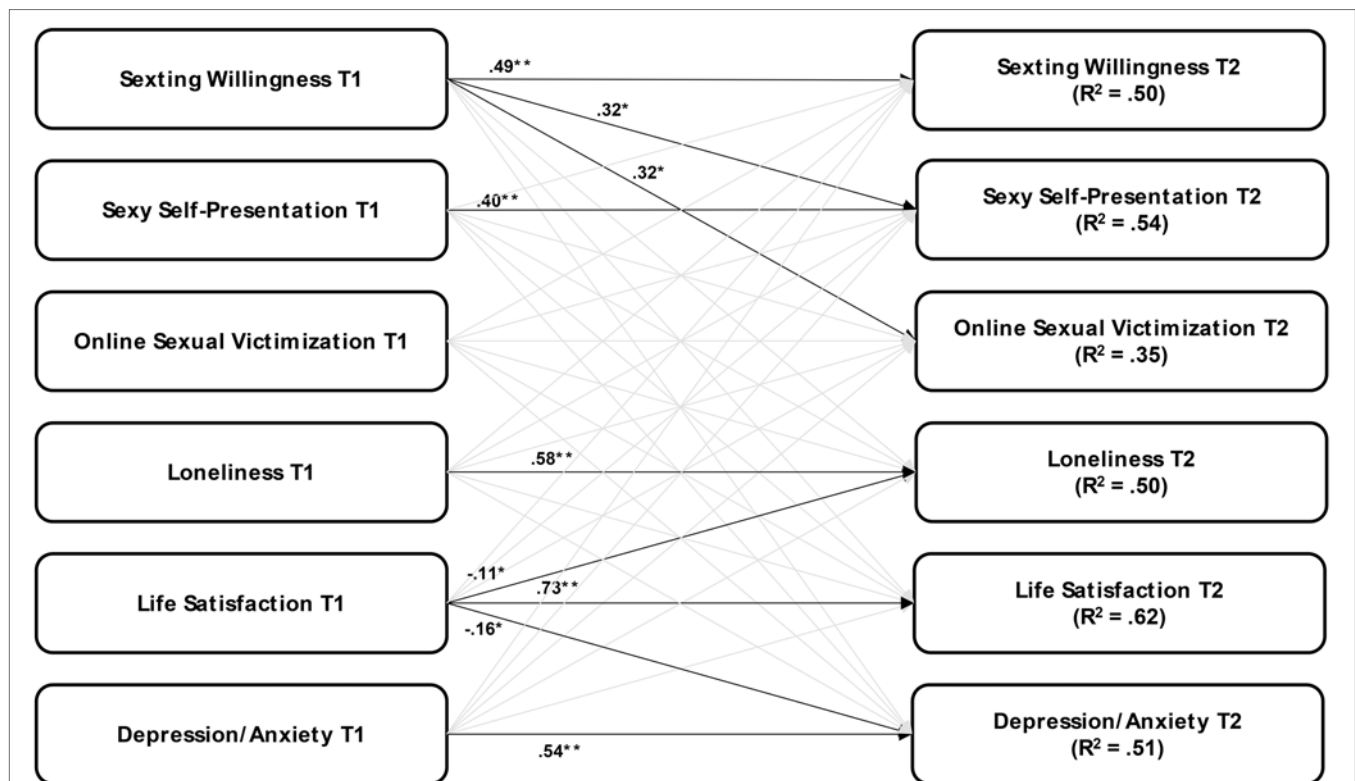


FIGURE 1 | Cross-lagged panel model to explain the longitudinal relationships between online sexual engagement (OSE), online sexual victimization (OSV), and psychosocial well-being. $\chi^2(df=2,062(1,070), p<0.001, CFI=0.951, TLI=0.943, RMSEA=0.047$, and $SRMR=0.038$. Indicated are the significant standardized path coefficients (β). ** $p<0.01$ and * $p<0.05$. Non-significant paths are greyed out. Co-variances were calculated, but omitted for better overview. The model was additionally controlled for a person's age, gender, sexual orientation, and amount of online use.

DISCUSSION

Although many existing studies have investigated OSE and OSV among (convenience) samples of adolescents and younger adults (Klettke et al., 2014; Madigan et al., 2018; Mori et al., 2020), the prevalence of OSE and OSV among older segments of society has so far remained understudied. Thus, the first aim of the current study was to examine the prevalence of OSE and OSV among a more heterogeneous sample than that typically used in this field of research. The initial random-quota sample of the current study comprised 1,019 German Internet users aged 14–64 years. Our data showed that almost 20% of the participants had made at least one experience with OSV, more than 20% showed a certain willingness to engage in sexting, and more than 25% had presented themselves in a sexualized manner on social media in the past 2 months.

The second aim of the current study was to examine gender and age differences in OSE and OSV. Research among adolescents showed that sexting willingness increases with age (Klettke et al., 2014; Madigan et al., 2018). However, it was considered that this effect might disappear or even change its direction within samples covering a broader age range (Klettke et al., 2014). Affirming this assumption and previous findings (Gámez-Guadix et al., 2015), our results showed that younger participants aged 14–35 years had higher OSE and had encountered more

OSV than participants aged 36–64 years. However, our data also confirmed that behaviors, such as sexting and sexy self-presentation, as well as experiences with OSV, to a lower extent also occurred among middle-aged and older adults. Thus, future research should give more attention to these older age groups.

Concerning gender differences, we found that males were more willing to engage in sexting and more often had presented themselves in a sexualized manner on social media than females. Females have often been discussed to have a higher risk of experiencing negative consequences of sexting, such as cyberbullying, sexual harassment, insults, or online shaming (Ringrose et al., 2013; Lippman and Campbell, 2014; West et al., 2014; Bianchi et al., 2019; Burić et al., 2020). This might be a reason why some recent studies solely focused on girls (e.g., Bianchi et al., 2019; Burić et al., 2020). According to our data, males showed slightly higher mean scores on the scale measuring the frequency of OSV experiences, whereas no significant gender difference was found when comparing the percentage of individuals who had made at least one experience with OSV. Thus, our results indicate that OSV is not a topic that only concerns females. Research on all sexes is necessary to understand the issue in all its breadth.

The main aim of the current study was to examine the relationship between OSE, OSV, and psychosocial well-being.

TABLE 2 | Longitudinal relationships between online sexual engagement, victimization, and psychosocial well-being.

	Online Sexual Engagement and Victimization (T2 _{panel})									Psychosocial Well-Being (T2 _{panel})								
	Sexting Willingness			Sexy Self-Presentation			OSV			Depression/Anxiety			Loneliness			Life Satisfaction		
	β	<i>p</i>	<i>B (SE)</i>	β	<i>p</i>	<i>B (SE)</i>	β	<i>p</i>	<i>B (SE)</i>	β	<i>p</i>	<i>B (SE)</i>	β	<i>p</i>	<i>B (SE)</i>	β	<i>p</i>	<i>B (SE)</i>
Control Variables (T1_{panel})																		
Age	-0.09	0.006	-0.10 (0.04)	-0.04	0.204	-0.05 (0.04)	-0.08	0.006	-0.05 (0.02)	-0.07	0.029	-0.05 (0.02)	-0.11	0.003	-0.05 (0.02)	0.03	0.289	0.05 (0.04)
Male Gender	0.07	0.045	0.16 (0.08)	0.04	0.222	0.09 (0.08)	-0.00	0.928	-0.00 (0.04)	-0.07	0.041	-0.10 (0.05)	-0.05	0.135	-0.05 (0.03)	0.00	0.922	0.01 (0.09)
Non-Heterosexual	0.06	0.129	0.26 (0.17)	0.03	0.408	0.14 (0.17)	0.00	0.935	0.01 (0.08)	0.02	0.618	0.06 (0.12)	0.04	0.293	0.08 (0.07)	-0.03	0.381	-0.18 (0.20)
Internet Minutes	0.07	0.127	0.08 (0.05)	0.04	0.322	0.05 (0.05)	0.01	0.856	0.01 (0.03)	0.01	0.782	0.01 (0.03)	-0.04	0.392	-0.02 (0.02)	-0.04	0.382	-0.06 (0.07)
Online Sexual Engagement and Victimization (T1_{panel})																		
Sexting Willingness	0.49	0.003	0.46 (0.15)	0.32	0.017	0.31 (0.13)	0.32	0.046	0.15 (0.08)	0.05	0.644	0.03 (0.06)	0.08	0.410	0.03 (0.04)	0.02	0.825	0.03 (0.12)
Sexy Self-Presentation	0.20	0.162	0.17 (0.13)	0.40	0.001	0.36 (0.11)	0.10	0.464	0.04 (0.06)	-0.01	0.938	-0.00 (0.05)	-0.02	0.864	-0.01 (0.04)	-0.03	0.708	-0.04 (0.10)
OSV	-0.01	0.898	-0.03 (0.19)	0.02	0.825	0.04 (0.20)	0.20	0.156	0.19 (0.13)	-0.02	0.750	-0.03 (0.09)	0.05	0.478	0.04 (0.06)	-0.02	0.702	-0.06 (0.15)
Psychosocial Well-Being (T1_{panel})																		
Depression/Anxiety	-0.05	0.496	-0.07 (0.11)	-0.04	0.560	-0.06 (0.10)	-0.02	0.749	-0.02 (0.06)	0.54	0.000	0.53 (0.07)	0.03	0.685	0.02 (0.05)	-0.10	0.125	-0.20 (0.13)
Loneliness	0.05	0.313	0.11 (0.10)	0.06	0.176	0.13 (0.10)	0.02	0.674	0.02 (0.05)	0.10	0.060	0.13 (0.07)	0.58	0.000	0.55 (0.05)	-0.01	0.863	-0.02 (0.13)
Life Satisfaction	-0.09	0.119	-0.07 (0.05)	-0.03	0.601	-0.02 (0.04)	-0.09	0.089	-0.04 (0.02)	-0.16	0.003	-0.08 (0.03)	-0.11	0.041	-0.04 (0.02)	0.73	0.000	0.78 (0.06)
R ²		0.50			0.54			0.35			0.51			0.50			0.62	

N = 586. OSV: online sexual victimization Age and Internet minutes were centered. Significant effects are marked bold (*p* < 0.05).

TABLE 3 | Cross-sectional correlations between latent and observed variables in the cross-lagged model.

	1	2	3	4	5	6	7	8	9	10
Age	-									
Male	0.006	-								
Non-Heterosexual	-0.053	0.061	-							
Internet Minutes	-0.013	0.107**	0.118	-						
Sexting Willingness	-0.235**	0.164**	0.077	-0.036	-					
Sexy Self-Presentation	-0.164**	0.157**	0.126*	0.020	0.846**	-				
OSV	-0.197**	0.131**	0.056	-0.000	0.713**	0.674**	-			
Depression/Anxiety	-0.177**	0.002	0.070	0.056	0.468**	0.473**	0.457**	-		
Loneliness	-0.128**	0.064	-0.014	0.045	0.417**	0.391**	0.332**	0.584**	-	
Life Satisfaction	-0.060	-0.008	0.035	-0.133**	0.112**	0.141**	0.057	-0.447**	-0.361**	-

T1 panel correlations calculated as part of the cross-lagged model. *N* = 586. OSV: online sexual victimization. ***p* < 0.01. **p* < 0.05.

Several existing cross-sectional studies have shown that OSE is related to decline in mental health and well-being (Klettke et al., 2014; Gassó et al., 2019; Mori et al., 2019). Confirming these findings, we found that sexting willingness and sexy self-presentation were both positively related to higher levels of depression/anxiety and loneliness. Further, we found that both examined forms of OSE showed positive cross-sectional associations with a higher risk of being victimized online, which is also in line with several previous studies (e.g., Reyns et al., 2013; Gámez-Guadix et al., 2015; Medrano et al., 2018; Festl et al., 2019). Further, OSV was positively related to more loneliness and more depression/anxiety. However, OSV does not seem to threaten general life satisfaction because no significant relationship between these constructs was identified. In fact, life satisfaction showed small significant positive relationships with OSE, which might indicate that individuals more satisfied with their lives act more confident online.

Concerning the long-term relationship between sexting and psychosocial well-being, the results of the few existing studies are rather heterogeneous. For example, Chaudhary et al. (2017) surveyed a sample of middle school students from Texas and found that engagement in sexting predicted higher levels of depression and anxiety experienced 1 year later. In a similar study among Spanish adolescents, Gámez-Guadix and De Santisteban (2018) found that higher levels of depression at baseline predicted more sexting 1 year later, whereas self-esteem was no significant predictor of later OSE. In a recent study among adolescent girls covering a period of 20 months, Burić et al. (2020) found that sexting and psychological well-being were unrelated over time.

We found that neither sexting willingness nor sexy self-presentation showed any significant longitudinal relationship with depression/anxiety, loneliness, and life satisfaction. This can be interpreted as a hint that OSE does not threaten mental health in the long run and that lower levels of psychosocial well-being do not necessarily increase the likelihood for later OSE. The discrepancies with some existing studies may be attributable to the different sampling strategies (convenience adolescent samples vs. random-quota representative sample), different analysis strategies, or different measurements used. In particular, it might be possible that longitudinal relationships between OSE and psychosocial well-being primarily occur

among particular groups of individuals (e.g., very young adolescents), which should be examined in more detail in future studies.

Few existing longitudinal studies among adolescents found reciprocal relationships between sexting and victimization experiences – that is, sexting was found to increase the risk to later being a victim of unwanted sexual solicitation and cyberbullying, and cyberbullying and sexual solicitation victimization were identified as significant predictors of later engagement in sexting (Gámez-Guadix and Mateos-Pérez, 2019; van Ouytsel et al., 2019). In the current study, we found that sexting willingness at T1 was a significant predictor of OSV measured 1 year later, whereas the reverse path (OSV at T1 to later sexting willingness) was non-significant. Concerning sexy self-presentation, no significant longitudinal relationships with OSV were found. These findings indicate that sexting is indeed a longitudinal risk factor for victimization, also among a random-quota sample spanning a wider age range than that typically covered in existing works. In contrast, sexualized forms of social media self-presentation seem to be less risky from a long-term perspective, which might be explained by the fact that this form of OSE is less intimate and explicit than sexting (van Oosten and Vandenbosch, 2017). Notably, higher levels of OSV showed no long-term relationship with lower psychosocial well-being.

Research on cyberbullying suggests that victimization experiences are only moderately stable over time (e.g., Marciano et al., 2020), which might be explained by specific characteristics of online media (such as the high anonymity). We found that (despite a significant bivariate relationship) OSV measured at T1 did not significantly predict OSV measured at T2 in the cross-lagged model. A plausible explanation might be that the perception of what was enforced behavior and what was done out of free will may change over time. Further, it might be difficult for victims to remember the exact number of such incidents. An interesting yet challenging task for future studies would be to examine what role psychological defense mechanisms, such as repression and denial play, in the context of OSV and how this could influence study results.

Our study is subject to some limitations. As is the case with every survey study, we cannot completely rule out that social desirability influenced response behaviors. Therefore,

studies based on behavioral data would be desirable. Further, the dropout in participants between study waves may influence the representativeness of the longitudinal data. The final panel sample was not sufficiently large to allow for conducting more complex analyses (e.g., multi-group longitudinal analyses between genders or sexual orientations).

CONCLUSION

Taken together, the current random-quota-based study showed that sexting, sexy self-presentation, and OSV are relatively widespread among German Internet users. According to our data, OSE and victimization experiences concern both males and females and, to a certain degree, also occur among older individuals. There have been lively debates among scholars about whether behaviors, such as sexting, are common sexual expressions in a digitalized world or whether they are deviant practices that expose individuals to unpredictable risks with consequences for their mental health and well-being (Burić et al., 2020). The results of our study paint a rather heterogeneous picture. Our cross-sectional results confirm previous findings that OSE, OSV, loneliness, and mental problems are intercorrelated (e.g., Festl et al., 2019; for overviews, see Klettke et al., 2014; Gassó et al., 2019; Mori et al., 2019). Concerning long-term associations, we detected a significant relationship between sexting willingness at T1 and more victimization experienced 1 year later, whereas no significant longitudinal associations with lower levels of psychosocial well-being were identified. However, note that the findings might be very different for specific and more vulnerable groups, such as children, young adolescents, or persons with specific sexual orientations.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because they are part of a larger representative survey study that covers several different topics and is subject to further analysis in other contexts. However, the raw data supporting the conclusions of this article are available to qualified researchers, upon reasonable request. Requests to access the datasets should be directed to FR, felix.reer@uni-muenster.de.

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ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The study was conducted in cooperation with a professional survey research institute adhering to the ICC/ESOMAR ethics code for social research and data analytics. All participants were informed, agreed to participate in the study and had the right to opt-out at any time. All data was collected in anonymized form. The authors had no access to any identifying information. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislations in Germany and the institutional requirements.

AUTHOR CONTRIBUTIONS

RW and FR conceptualized the study. FR administrated the project, coordinated the cooperation with the survey research institute, wrote the manuscript, and conducted parts of the statistical analyses. RW conducted parts of the statistical analyses and contributed to the writing of the manuscript. TQ obtained the funding and supported the conceptualization, analysis, and writing process. All authors contributed to the article and approved the submitted version.

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Sexual Boundary Violations via Digital Media Among Students

Juergen Budde^{1*}, Christina Witz¹ and Maika Böhm²

¹ University of Flensburg, Flensburg, Germany, ² Merseburg University of Applied Sciences, Merseburg, Germany

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University of Antwerp, Belgium

*Correspondence:

Juergen Budde
juergen.budde@uni-flensburg.de

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As digital media becomes more central to the lives of adolescents, it also becomes increasingly relevant for their sexual communication. Sexting as an important image-based digital medium provides opportunities for self-determined digital communication, but also carries specific risks for boundary violations. Accordingly, sexting is understood either as an everyday, or as risky and deviant behavior among adolescents. In the affectedness of boundary violations gender plays an important role. However, it is still unclear to what extent digital sexual communication restores stereotypical gender roles and restrictive sexuality norms or, alternatively, enables new spaces of possibility. In this sense, current research points to a desideratum regarding adolescents' orientations toward sexting as a practice between spaces of possibility and boundary violations. This paper discusses the possibilities, but also the risks, of intimate digital communication among adolescents. The main question is, how adolescents themselves perceive sexting practices and how they position themselves between both spaces for possibility and for the exchange of unwanted sexual content. For this purpose, orientations toward normalities and gender of students are reconstructed. To answer these questions, twelve single-sex, group discussions were carried out with students aged 16 and 17 at five different secondary schools in northern Germany. A total of 20 boys and 22 girls took part. The group discussions were structured by a narrative generating guideline. The analysis draws its methodology from the Documentary Method, regarding implicit and explicit forms of knowledge and discourse. It results in a typology of three types with different orientations. The study shows, that most of the students consider sexting to be a risky practice; only one type shows normality in the use of sexting. At the same time, some of the young people are interested in experimenting with image-based intimate digital communication. Further, gender differences in use and affectedness are also documented. In this way, orientations toward gender stereotypes "favor" both the attribution of responsibility to girls, and overlook the responsibility of students who perpetrated the boundary violation. The orientations of adolescents should be taken more into account in research as well as in educational programs for the prevention of sexual violence.

Keywords: sexting, sexual boundary violations, group discussion, gender, adolescents, sexual identity, sexual socialization

INTRODUCTION

Sexuality is a culturally and historically mutable concept that has transformed markedly over the past 100 years – and continues to do so. Representations of sexuality, norms, values, and practices are adaptable, and are closely connected to specific historical and cultural contexts. From early childhood onward, the process of sexual socialization allows individual attitudes, positions and structures of desire to form in engagement with social sexual norms and values. These individual sexual “scripts” both describe sexual identity and shape individual sexual experiences and actions. Especially during adolescence, the formation of sexual identity is characterized by specific dynamics.

In recent decades, the environments of children, adolescents and adults have rapidly digitalized. In particular for adolescents, digital media represent an important part of their lived reality, and are also used to shape sexual activity and communication online (Wachs et al., 2021). Correspondingly, the significance of digital media in the process of sexual socialization for adolescents has increased. The range of media on offer means that instances and forms of sexual communication and interactions during adolescence are becoming more varied, shaping sexual socialization in the process (Murray and Crofts, 2015). This allows further spaces for the development of a self-determined sexuality to emerge; the use of such spaces, however, brings with it multiple risks for sexual self-determination due to boundary violations, misconduct, and victimization.

One particular phenomenon that has gained increasing attention in public, educational science and pedagogical practice in recent years is the so-called practice of sexting: that is, the “private exchange of self-produced sexual images via cell phone or the internet” (Döring, 2014, 1). Almost no empirical data has been gathered on how sexting is experienced by adolescents in Germany. Additionally, very few studies have been carried out on adolescent experiences of non-consensual image-based sexting in, through and with digital media. For Germany, there is still a lack of reliable data on the prevalence among adolescents (Vogelsang, 2017), evidence on prevalence can be found in United States studies (e.g., the reviews by Döring, 2014; Klettke et al., 2014).

This paper explores the orientations toward the exchange of intimate images and boundary-violating communication through digital media in a school setting. The basis is a qualitative research project, which analyzes the orientations – defined by Bohnsack as patterns of meaning that suggest shared forms of communicable knowledge (2010, 104) – on sexting among school students. The study will address how students interpret and interact with intimate, image-based content, including implications for sexual boundary violations online. Further, the study describes how adolescents position themselves in the field of tension between spaces for possibility and spaces for sexual boundary violation. In the course of the liberalization of society and increasing sexual self-determination in Germany, the former sexual morality has been more and more replaced by a negotiation morality (Schmidt, 1998; Sigusch, 2006). Now the actors – assumed to be equal – themselves define consensus and boundary

violation in sexuality in both analog and digital space. The importance of consensus is also reflected in the reform of §177 in the German Criminal Code since 2016, a (sexual) assault is punishable even without any violence or its threat. A special focus will be placed on the reconstruction of orientations toward normalities and sexuality. The study aims to contribute to a more nuanced discourse on both sexting and gendered readings of sexting.

This paper sets out by reviewing recent research on sexual communication and boundary violations through digital media that draws on the phenomenon of sexting and focuses specifically on the aspect of gender (see section “Research on Image-Based Sexual Communication Through Digital Media – Between Self-46 Determination and Boundary Violations”), before detailing the study on which this paper is based (see section “Materials and Methods”). Based on group discussions, see Section “Results” offers insights into the orientation of students in Germany. The paper then summarizes the findings in a conclusion (see section “Discussion”).

RESEARCH ON IMAGE-BASED SEXUAL COMMUNICATION THROUGH DIGITAL MEDIA – BETWEEN SELF-DETERMINATION AND BOUNDARY VIOLATIONS

Sexuality and Digital Media During Adolescence

Given that sexuality is a socially constituted practice, it is important to consider the specific historical and cultural contexts that inform adolescents’ sexual development. Within this cultural context, sexuality takes shape via highly individual, socially and historically mutable sexual norms and values (Gagnon and Simon, 2000). In the process of sexual socialization, individuals must tackle sexual norms and values; it is through this engagement that they both constitute and contextualize their sexual identities (Marcia, 1980). Drawing on Lanuza (2006) and with reference to Bourdieu’s (2010) terminology, it might thereby be possible to speak of a “sexual habitus,” although this is not yet an established concept in debates that have, to date, focused primarily on psychology.

During the process of sexual socialization (Gagnon and Simon, 2000; Stein-Hilbers, 2000; Simon and Gagnon, 2003), adolescence is influenced by psychosocial and sexual aspects of development (Havighurst, 1972). These could include first intimate and romantic relationships; first explorations of sexual identity; confrontations with (societal) sexual norms, values, and practices; as well as a process of detachment from the parental home (ibid.). All of these aspects are accompanied by increased distancing from adults. It is during the adolescent period, in particular, that individual attitudes, positions, and structures of desire are restructured; pre-existing scripts are updated to realign with an internally perceived, habituated sexual identity (Attwood, 2006). Sexual boundary violations, however, can negatively influence the process of sexual socialization, restricting sexual

forms of expression and modes of experience (see for example, Brown et al., 2014).

From the moment the smartphone entered the life of adolescents as an omnipresent device, it has enabled low-threshold, uncomplicated access to the internet and thereby also to sexual communication and interactions online (Hasinoff, 2013). Digital media represent key spaces for information exchange, communication and interaction, which young people use to organize their social and erotic relationships, deal with issues related to sexuality, and engage in (initial) sexual experiences. Online sexual activity is an everyday part of adolescent life. Additionally, Döring (2014) identifies an intensified engagement with media-based sexuality during this period, meaning that young people are increasingly actively turning to various representations and information about sexuality in the media. Through this, they task themselves with independently determining their sex-related media use – and correspondingly, with acquiring the media competency required to do this. This means that drawing a dichotomy between digital and analog sexual communication and interaction is no longer relevant for adolescents today (Kerstens and Stol, 2014; Ringrose and Naezer, 2018). During the transition process between childhood and adulthood, digital spaces offer adolescents countless possibilities to realize their aspirations toward autonomy, testing sexual boundaries beyond parental supervision and control and gaining recognition among their peers (Baumgartner et al., 2015).

A Spanish study on 2,356 high school students documents that being involved in digital sexual communication “does not appear to generate a negative impact among those involved, in a short term.” Adolescents who feel the need to be popular may consider sharing and disseminating sexual content as a strategy to be accepted among their peers (Del Rey et al., 2019, 8). Moreover, the cyberfeminist perspective puts forward the thesis that digital contexts offer new spaces of possibility for the (further) development and differentiation of self-determined and genderqueer sexual identities (Haraway, 1991; Ringrose and Eriksson, 2011). At the same time, digital spaces are also sites where sexual boundary violations can take place (Koops et al., 2018). Because digital spaces harbor specific risks due to their particular contours, insofar as they offer high levels of anonymity, detachment from a concrete time and place, a broad scope, potential high visibility, and the possibility to disseminate content rapidly.

“Sexting” as an Expression of Intimate Digital Communication

Sexting involves sending intimate sexually explicit messages, photos, or videos via smartphones and computers, and describes a mode of connecting sexuality and digital media (Döring, 2014; Barrense-Dias et al., 2017). As one aspect of digitality experienced by adolescents, it offers an opportunity for a self-determined mode of sexual communication that is generally characterized by reciprocity. By the same token, sexting is a phenomenon that is rapidly changing, meaning that academic studies relating to its definition, but also to its prevalence – as well as researchers’

analyses of it – tend to vary dramatically, and can very quickly become outdated (see Bonilla et al., 2020). The definition of sexting differs depending on the type of media being investigated, as well as – within academic research – on the form (text, photo, and video), the content (ranging from suggestive to explicit in terms of the degree of nudity and the sexual activity depicted), intention (ranging from non-sexual to sexual) and the medium (generally digital forms, from email through to instant messaging). A further factor is the degree to which participants freely engage in sexting (see Döring, 2014; Dekker et al., 2019).

Sexting is often incorrectly equated with cyberbullying, meaning that the dimension of sexuality is rarely taken into account. Nor is sexting a form of “sextortion,” which refers to the attempt to blackmail another person with sexually explicit images for money, for example (Gassó et al., 2019). Additionally, at least in its original definition, sexting does not involve sending or forwarding sexually explicit images without the knowledge and agreement of the represented person or persons – an act that would constitute a criminal offense; nor does it involve recording erotic or intimate images without consent (Strasburger et al., 2019)¹. Public and academic debates around adolescent sexuality in digital contexts have long revolved primarily around questions of risk. This tendency is most prevalent in debates where the repercussions of adolescent use of pornography are discussed (see for example, Smith et al., 2014). Similarly, in recent years the phenomenon of sexting has increasingly gained attention and been a topic of debate (Dekker et al., 2019). In international publications, sexting is generally classified as a deviant behavior, and accordingly it is discussed from the perspective of the risks it entails (Hasinoff, 2015; García-Gómez, 2019). In particular in United States contexts, sexting is perceived as a risky form of misconduct even when carried out by adults (Döring and Mohseni, 2018; Mori et al., 2019; Wachs et al., 2021). Here, three dangers are assumed: social exclusion and criminal consequences, sexual victimization, and reckless sexual behavior.

While the discourse of deviancy maintains that sexting is an aberrant form of behavior, the normalization discourse emphasizes how widespread digital sexual communication is (Hasinoff, 2013). This discourse frames sexting as a “normal, contemporary form of intimate communication” (Döring, 2015, 25) within a process of sexual socialization that involves a broad segment of adolescents, offering spaces of possibility for the (further) development and differentiation of sexual identities. As Kerstens and Stol state, “research suggests that the Internet provides adolescents with opportunities to explore and express their sexuality” (Kerstens and Stol, 2014, n. page). A meta review by Madigan et al. also concludes the “credence [...] that youth sexting may be an emerging, and potentially normal, component of sexual behavior and development.” (Madigan et al., 2018, 332).

In this view, which focuses on the perspective of users, mutually consensual sexting represents a positive and satisfying expansion of one’s own sexual life and relationships, making it an expression of a successful and self-determined sexual

¹Relevant here is the fact that, according to German law (§184c, [4]), the self-determined exchange of intimate images by adolescents does not constitute child pornography insofar as those involved have created the images exclusively for personal use and with the consent of the person(s) depicted (Hoven, 2018).

identity (Attwood, 2007). Interactions with sexual visual self-representations can therefore be viewed as a significant factor in the culture of adolescent online communication, and a mode of structuring and upholding relationships. This understanding can lead studies to frame sexting as a mutual expression of experimentation with sexual identity, while also addressing the potential for non-consensual exchanges or the extensive dissemination of content without consent, which brings with it psychological and social consequences (see for example, Hasinoff, 2013; Madigan et al., 2018).

Among adults, sexting is common as a form of sexual communication. Data gained from an international meta-analysis of 31 studies show, for example, that more than half of the surveyed adults have sent or received sexts (Klettke et al., 2014). The prevalence of sexting among adolescents has also been the subject of empirical research. A survey study by Madigan et al. (2018) established an average prevalence of 14.8% for sending and 27.4% for receiving sexts among adolescents, although the incidence increases with age, and has been rising in general in recent years. A study in Spain with 3,314 adolescents between the age of 12 and 16 demonstrates that “more than 2 in 25 teenagers send or forward sexual content, while more than 1 in 5 receive it directly from the creator, and more than 1 in 4 teenagers receive it via an intermediary” (Ojeda et al., 2020, 14). According to the meta-analysis of Klettke et al. (2014), in total only 10% of the surveyed adolescents had sent images; 16% indicated that they had received images. Results from a Dutch study with 4,453 adolescent participants “indicated that receiving sexual requests is quite common and that producing sexual images is relatively rare” (Kerstens and Stol, 2014, n. page). In a research project with 357 adolescents, Symons et al. (2018) point out the high probability that sexting will take place in the context of a romantic relationship. A study by Boer et al. (2021) demonstrates different usages of sexting dependent on the gender and socio-economic status of the adolescents.

Sexing and Sexual Boundary Violations

Sexting becomes the starting point for sexual boundary violations when photos or videos in the correspondence are recorded or forwarded, and in some cases publicly disseminated, without the consent of the persons depicted; or when images are received in an unsolicited manner, that is against the wishes of the recipient. In legal terms, recording and/or disseminating sexually explicit images in a non-consensual manner entails a criminal violation of privacy in most countries. Additionally, such acts, in a German context, violate a person's right to their own image (Strasburger et al., 2019), as well as constituting a criminal offense in the area of child pornography – although these laws may vary from country to country. Drawing on a Canadian study with 800 adolescents between 16 and 20 years, Johnson et al. (2018) point toward non-consensual sexting as a daily and collectively recognized occurrence, drawing a distinction between the non-consensual forwarding of images via third parties from the consensual sharing of intimate images as an expression of self-determined sexual communication. Boundary violations can negatively influence the process of sexual socialization insofar as self-determined forms of sexual expression and experiences

become, through their abuse, restricted (see for example, Brown et al., 2014).

Pre-existing studies that focus on connections between sexual boundary violations and digital media suggest that the manifestations, prevalence, and forms of victimization vary widely in terms of both form and severity. In an older, representative United States study on sexting, 3% of those surveyed indicated that they had forwarded sexually explicit images to third parties without consent at least once (Knowledge Networks, 2009). In a recent study by Barrense-Dias et al. (2020), involving 7,142 adolescents in Switzerland 6% of those surveyed indicated that they had shared sexually explicit photos or videos without consent on one occasion. A further 9% reported that they had done so on multiple occasions. Central motivations included fun (62%), showing off (30%), and a lack of understanding of what they were doing (9%). A study with 4,281 Portuguese adolescents reports of “4.8% engaged in abusive sexting behaviors and 4.3% self-identified as being a non-consensual sexting victim” (Barroso et al., 2021). In the overview study from Madigan et al. (2018), 12% of adolescents surveyed indicated that they had made public a sext without consent, and 8.4% knew that images of their person had been non-consensually disseminated. As Ojeda states, “typically non-consensual sexting behaviors are more frequent than typically consensual ones” (Ojeda et al., 2020, 15).

Overall, it can be assumed that the particularities of digital space (anonymity, scope, speed, visibility, detachment from a concrete time and place) mean that online sexual boundary violations are comparatively more severe than in “analog” spaces (Walrave et al., 2018) – although the relation between the digital and analog experience of boundary violations to date remains unclear. Moreover, isolated cases suggest that challenging situations can be easier to end online (Henry and Powell, 2016). Choi et al., however, demonstrate through a study with 450 adolescent girls with ethnically diverse backgrounds from Texas that “sexting could function as an online extension of offline forms of sexual coercion” (Choi et al., 2016, 167), pointing toward the interconnection between both areas from the perspective of adolescents.

The Dimension of Gender

Understandings of gender have significant influence on the development of sexual identities, and on the risk of sexual boundary violations. Sexuality and gender identity are developed above all during adolescence. In data on participation in sexting, the non-consensual dissemination of sexually intimate content and the emotional distress this can cause, gender factors are often discussed. In the main, it has been established that there is very little difference in participation levels between boys and girls when it comes to sexting (see Madigan et al., 2018). At the same time, girls and boys are affected by sexting in very different ways (Murray and Crofts, 2015; van Ouytsel et al., 2021). Studies have shown that when the same sexting activities are performed by boys and girls, it is mostly girls who are confronted with negative consequences such as bullying, stigmatization, insults, and slut-shaming when their images are disseminated. While on the one hand women and girls are expected to conform to

the hegemonic representation of ideal femininity, on the other hand they run the risk of being labeled “sluts” for suggesting or explicitly showing sexual activity (Naezer and van Oosterhout, 2021, 3). For girls, this can mean that even when they are victims of non-consensual dissemination of their images, they are viewed as being responsible in a typical case of victim-blaming (see for example, Fein, 2011; Ringrose et al., 2013; Bonilla et al., 2020). In non-consensual sharing of intimate images, similar to the dynamics of offline sexual violence, the responsibility for the dissemination of the images is often placed on the victims and not on the publishers and forwarders (Naezer and van Oosterhout, 2021, 4). Boys, on the other hand, tend to be viewed as more masculine through self-generated sexual images (see for example, Ringrose et al., 2013; García-Gómez, 2019). Additionally, boys are more likely than girls to share images without the consent of the depicted person (Morelli et al., 2016a; Johnson et al., 2018; Barrense-Dias et al., 2020). This dynamic reinforces double standards along gendered lines as well as gender inequality (Ringrose et al., 2013). Moreover, it strongly influences both the discourse around sexting, and adolescent orientations toward sexting (Crawford and Popp, 2003; Dobson and Ringrose, 2016).

In this sense, this discussion generally plays out within the dominant order of the gender binary, insofar as the terms “boys” and “girls” create two homogenous groups that reinforce asymmetric vulnerabilities in relation to sexual boundary violations through the representation of gender. A recent Canadian study, however, suggests that the central question is not so much the representation of gender, but the attitudes toward gender stereotypes (Johnson et al., 2018). According to the authors, “youth who believe in traditional gender stereotypes are significantly more likely to share sexts” (ibid., 16). And further: “Although the correlation between adherence to gender stereotypes and sharing behavior is significant for both boys and girls, it is considerably stronger for boys” (ibid.).

Desiderata

As documented by this brief review of recent research, there are a number of quantitative surveys available on participation in sexting, on non-consensual behavior and the role of gender with regard to sexting. However, Döring (2019, 312) has identified a gap in research on cognitive and emotional processes involved in sexting-related activities, noting that as a result the perspective of adolescents is not taken into account. In particular, there is a need for qualitative studies that reconstruct young people’s orientations in order to understand processes, perceptions and practices (see also Burkett, 2015). Additionally, only rarely is insight gained into how these activities influence sexual biographies, including how the sexual development of adolescents might also profit from self-determined sexual online activity such as cybersex or the consumption of internet pornography (Döring, 2019, 321). However, it is still unclear to what extent digital sexual communication restores stereotypical gender roles and restrictive sexuality norms or, alternatively, enables new spaces of possibility. In this sense, current research points to a desideratum regarding adolescents’ orientations

toward sexting as a practice between spaces of possibility and boundary violations.

This paper addresses the ways that adolescent school students deal with intimate digital visual content and offensive communication within digital media. Additionally, it questions how adolescents position themselves in the field of tension between spaces of possibility and sexual boundary violations. A particular focus lies in the reconstruction of orientations toward normalities and gender.

MATERIALS AND METHODS

The data gathered by the following empirical reconstruction of school students’ orientations is drawn from the research project ‘SaferSexting – Perspectives of School Students,’ conducted by the BMBF (Federal Ministry of Education and Research in Germany) between 2018 and 2021 within the funding stream ‘Research on sexualized violence against children and adolescents in educational contexts’. The research project looks at sexting and its largely uninvestigated connections to sexuality, non-consensual sexual conduct, digital media, and the school context.

Sampling

In total, 12 group discussions were carried out in 2018 and 2019 with students aged 16 and 19 at five different secondary schools in rural as well as in urban regions in northern Germany². Two of them were grammar schools (*dt. Gymnasium*) and three (more applied) comprehensive schools (*dt. Gemeinschaftsschule*), so the entire range of the German secondary school system is represented in the sample. Nine of these discussions are taken up in the following analysis. Group discussions with students were gender homogeneous, due to the fact that the current research findings outlined above indicates gendered differences both in relation to sexual boundary violations and sexual communication via digital images. Thus the 12 groups each contained 2 to 6 participants, who were interviewed in a single-sex setting. Five group discussions were held with male participants, seven with female. A total of 42 students (20 boys; 22 girls) took part (see Table 1).

Data Collection

In order to attract participants, eight schools were asked for participation, that were rated as particularly interesting due to their profile or existing collaborations. The research project was then first discussed with the school administration at five

²It proved to be more difficult to find boys who were willing to participate in group discussions than girls, it was also more difficult to bring together interested student groups in (more academic) grammar schools (*Gymnasien*) than in (more applied) comprehensive schools (*Gemeinschaftsschulen*) in the multi-tiered German school system.

TABLE 1 | Number of participants and group discussions.

	Boys	Girls	total
Participants (total)	20	22	42
Group discussions (total)	5	7	12

schools and then presented to students aged 16 and 17. The researchers made appointments for the group discussions within the classrooms and during class time with interested students. Each group was composed voluntarily and according to the wishes of the students. The interviews with the girls were carried out by the female research assistant, the group discussions with the boys mostly by trained male members of the research group.

The group discussions were structured by a communicatively validated semi-structured questionnaire that included an initial stimulus on dealing with sexuality and sexual issues in everyday school life to generate narrative (“please tell me: How do you deal with sexuality and sexual issues in your everyday school life?”) In addition to immanent questions to maintain the narrative exmanent – like “can you tell more about it” or “do you remember other situations” – follow-up questions were asked about sexuality and digital media, sharing of sexts and sexual boundary violation (for example “what exactly are sexual boundary violations for you”). The duration of the group discussions ranged between 45 and 106 mins. These were transcribed in accordance with the TiQ (Talk in Qualitative Social Research) guidelines³. In total, 17.5 h of material were gathered. The interviews were conducted in German and the interview passages in this text have been translated into English⁴.

Data Analysis

The analysis of the group discussions draws its methodology from the Documentary Method, in which both implicit and explicit forms of knowledge and discourse are analyzed (Bohnsack et al., 2010). This allows for the identification of collective “orientations” (Bohnsack, 2010, 104), which are assumed to guide actions in everyday social practice based on the notion of “structures of practice” (Bourdieu, 2010). Along these lines, our research in this paper focuses on habituated practices rather than on communicable, explicit knowledge. In the case of group discussions, the task of analysis lies in reconstructing the way discourse is (formally) organized. The group discussions are interpreted, compared and contrasted, before being condensed into identified characteristics or types. In the process of formulating and reflecting on interpretations of the discussions, two predetermined analyzing steps were taken in order to analyze the orientations framing participants’ actions. The construction of types “builds on the components of the framework of orientation common to all the cases” (Bohnsack, 2010, 111). A sociogenic set of types as often prescribed for the documentary method was in this case not possible, as social milieus could not be allocated to the participants on the basis of the two types of school visited; moreover, stable differences in the various orientations prevalent in the discussions vis-à-vis the type of school were not identifiable. Further, the study documents few behavioral differences between genders; rather, differences were

present in attitudes held toward gender stereotypes, regardless of the gender of the student. This means that a relational set of types were established that allow specific social formations to be registered, even though their development may not yet be complete or solidified (see Nohl, 2013, 61). This reveals the “systematic context in which the various dimensions of type-specific orientations are found” (ibid., 62).

RESULTS

The documentary analysis carried out through the relational construction of types yielded a typology with three different orientations: “The Experimenters,” who uncritically view and use sexting as an everyday form of sexual communication; “The Reflexive-Criticals,” who likewise consider sexting to be normal, but are critical of violations; and “The Disapprovers,” who reject all forms of sexual digital communication. Each type contains three of the nine group discussions examined. Group discussions with both girls and boys are represented in each type. In what follows, each type will be described in terms of its orientations toward norms and toward gender, drawing on exemplary excerpts from the group discussions.

Type A: “The Experimenters”

The first type practices sexting in an experimental fashion. This involves both self-determined and non-consensual forms. The groups *Gamblers* and *Girls’ Night* differ only minimally, in terms of how they position themselves in relation to adolescent ‘normality’ through their actions.

Orientations Toward Norms

The students belonging to the group *Gamblers* describe sending sexts as an everyday practice among adolescents that involves both girls and boys.

B5: *It’s kind of like, you hear about it from other people, if someone sends something around, like in the year level or whatever.*

B3: *A dick pic?*

B5: *Yeah or like @(.)@ also of a*

I: *[A what please?*

B3: *A dick pic.*

B5: *Also from the girls’ side. ah you just kind of hear about it and then of course people talk about it, let’s say.*

[...]

B3: *Yes. um (1 s) if you have a girlfriend then it’s also, I’d say, pretty normal that you’d get um these sorts of pictures from your girlfriend. and of course ah @you’d then be a gentleman and ah you wouldn’t forward something like that or show it ah to other friends. (1) and (1) I hope after the relationship ends it’d stay that way, that ah it stays anonymous and private, kind of.*

(Group: *Gamblers*, 2_S, P:4, 2–11 and 52–58)

The students frame the practice of sending sexts as being commonplace among fellow students in their year group – a practice that is both widespread and openly acknowledged (the students “hear about it”). Established practices include sending

³The TiQ guidelines as outlined in Bohnsack et al. (2010) implement a number of notational shorthands, including: (.) Pause up to one second; (2) Number of seconds of a pause in speech;| overlapping speech acts; *hello-* termination of a word; *combi:ned* elongation; *@no@* laughing, *@.@* short laughter, *Oh°* spoken very quietly. In this instance, the interviewer is abbreviated to *I* and interview subjects are allocated with a number and the prefix *G* (girl) or *B* (boy).

⁴The quality of the translation was controlled by external experts.

“dick pics” and receiving images “from the girls’ side.” Here, laughter points toward the shared fun of being involved. In particular within heterosexual relationships, for boys, receiving images from their partner is described as being “relatively normal,” and confidentiality in this matter is framed as a question of “honor.” The question of whether sexting takes place with consent is not further discussed by the students, implicitly suggesting that the potential for sexual misconduct or violation here appears to be an irrelevant detail.

Similarly, the orientations of the group *Girls’ Night* are characterized by normative assumptions about sexting as a “normal” sexual form of communication among adolescents.

G2: Well I would say, because really a lot of people do it, maybe not nudes, but like (.) kind of (.) revealing, ah, images. Sure (.) um on Snapchat. [...] and I’d say that I don’t really think it’s bad either, because I think it’s pretty much normal, that you um kind of try it out at some point and also maybe that um you want to get an opinion about yourself, if you’re not really sure. like um if your body or I don’t know it’s like-. that’s a feeling, I think, that lots of girls have, that they need confirmation. so um I don’t mean that in a negative way, that’s I think totally normal, that you um also um just want to know what other people think about you. and that’s why, I think that’s why it’s normal, every girl or also every boy, at some point.

(Group: *Girls’ Night*, P:4, 6–34)

There is no doubt that the students in this group present sexting for girls as a legitimate space of possibility, of positive affirmation during adolescence. Sexting is a way of attaining validation about one’s appearance and one’s body, and represents a means of dealing with insecurities about one’s own attractiveness. This option is less tied to the recipient of the sext, meaning to exclusively erotic relationships; rather, it represents a legitimate possibility for the sender of the sext to find out “what other people think about you,” on the sender’s own terms. Here, self-recognition and the recognition of others takes place through reciprocal exchange. This process of verification is explicitly framed as being a “normal” adolescent need.

The term “normal” here relate not only to self-determined sexting practices, but also to the non-consensual receipt of sexually explicit images. One female student, for example, recounts having received unsolicited and sexually explicit images. She points out that she believes “plenty of people have received images like that before” – in doing so framing non-consensual sexual communication as a normal activity. The shared laughter in response to her statement documents agreement; the experience of this non-consensual practice is shared by others in the discussion. Speaking through her laughter, the student explains her strategy in dealing with such experiences: “I’m personally not interested in that stuff and I usually just delete the chat or block him or whatever, yeah.” Through this statement, the experience of shame, of having one’s boundaries violated, is not entirely dismissed, but rather is accepted as a part of adolescent experience that can be countered through simple technical steps. Sexual boundary violations are thereby assumed to be a self-explanatory part of sexting, and are accepted

as the inevitable negative price to be paid for the personal self-affirmation otherwise afforded by the practice.

Orientations Toward Gender

The type “The Experimenters” reflect traditional ideas about constructions of gender, positioning themselves affirmatively within practices that differentiate between two genders. Girls and boys are allocated different roles in the representation of gender, in the sense that boys are sexually active, while girls are positioned on a fine line between the demand to be attractive and sexual passivity. This holds true for the group *Girls’ Night* as well as for the group *Gamblers*, in which this orientation is particularly prevalent.

B5: Generally though I’d say that the girls cop more than the boys

B6: Cop more, what do you mean by that?

B3: [What do you mean?

B5: [sure, I mean, I know a lot of guys who um would secretly, like, record sex with a girl.

B3: [@Oh God@.

B5: And uh

B6: [Ah, that’s what you mean. yeah, totally.

[...]

B2: I think it’s often like um, like for example um, [...] for guys who don’t post them themselves, but they get shared around a lot anyway um, that it really doesn’t matter, um whether they wanted that or not. but the guy involved, the guy, (.) he isn’t hated on. mostly other guys just say: “Oh, nice one, nice work.” And the girls get hated on. then it’s mostly like

B6: [Yeah, like: “Oh, what a slut.” And for the guy: “Oh, what a cool guy.”

(Group: *Gamblers*, P:2, 6–34)

This orientation points toward gendered differences based on an asymmetric value system involving sexual double standards. In the example detailed, although the boy involved both creates and spreads non-consensual sexual content, he receives confirmation as a “cool guy,” while people develop a “negative impression” of the girl, and she is “hated on” as a “slut.” The boy is completely exonerated of responsibility, while the girl – the victim of the situation – is condemned. In this sense, a judgment is made via a double standard (Döring, 2014; Naezer and van Oosterhout, 2021). The boy is let off the hook, while the girl is denigrated. This orientation is founded in traditional, gendered assumptions on male and female sexuality.

Although the participants appear to be aware of the asymmetries in the effects of these gendered conceptions (as demonstrated by shared agreement), this does not lead them to take a critical position. Participants neither express criticism of the non-consensual recording of sexual content, nor do they address the non-consensual publication of the recordings. Rather, they maintain an apparently neutral narrative voice, meaning that their own position remains ‘suspended’. At the same time, the narrative itself is not at all neutral. Laughter and obvious delight signal a collectively shared agreement that not only supports but amplifies the labeling of the boy involved as a “cool guy,” and the girl as a “slut.” Bindesbøl Holm Johansen

et al. argue, that “non-consensual sharing acts as a form of visual gossip to maintain social bonds and gendered recognition” and that this has “gendered implications as it rests on and reproduces gendered values” (Bindesbøl Holm Johansen et al., 2019, 1029). This humorous and ironic approach, working through the narrative, means that normative constructs relating to “doing masculinity” are stabilized (Connell, 2012). Collecting sexts operated as a way “through which boys could gain status and respect among their peers” (Ringrose et al., 2012, 54).

The girls in type A also orient themselves according to gender stereotypes. Along these lines, when the group *Girls' Night* addresses the non-consensual forwarding of sexually explicit images of girls among boys, they state that “it's not really that bad when people talk about it.” Thus, practices of sexual misconduct or violation among boys are viewed as “talk” that might be “interesting,” and are thereby marked as being integral for adolescent sexuality. The discrepancy in how boys and girls are affected by these activities is accepted as a given, and is not interrogated.

Type B: “The Reflexive-Criticals”

The second type is made up of “The Reflexive-Criticals,” represented by two groups of girls and one group of boys. Within type B, two subgroups could be identified: *Negotiators of Responsibility* and *Feminists*. Type B positions itself in opposition to dominant societal notions of normativity and gender (see also Naezer and van Oosterhout, 2021).

Orientations Toward Normalities

As with type A, members of the type “The Reflexive-Criticals” indicate active involvement in the practice of exchanging intimate images. However, unlike type A, this orientation is distinguished by a critical distance. The group *Feminists* focuses on perceptions of experiences of boundary violations, leading to a reflection on responsibility and a critique of the contexts in which sexual socialization take place.

G4: So (.) well mostly on Snapchat and then um he kind of wrote to her and then he like straight away sent her um photos of himself topless and wrote really sexual things to her. I mean really, really exactly like in porn. and um then she didn't um answer, she goes: “yeah, um leave me alone, I don't want this stuff.” And then he totally spammed her with photos of his penis, also it was really his penis.

G?: [°Shit°.

G4: and that and um after that I think she then also blocked him and um you also see stuff like that maybe also sometimes on Instagram

G5: [Mhm. ((agreement))

G4: And you can also report it. the thing is that Instagram doesn't usually acknowledge it. No, um not

G?: [Nah.

G4: n-, really. So I, when I see something like that and report it, because I don't I find it, I mean, it's not OK, there are actually pages, they're like from some people and they um promote child pornography [...]

(Group: *Feminists*, P:2.1, 22–40)

The female students describe an exchange on a social media platform in which an unspecified male individual begins by sending revealing images with “sexual” and “pornographic” texts. The girl refuses this attempt to make contact. Instead of accepting her refusal, the person intensifies the level of boundary violation, “spamming” the girl with images of his penis. Here, too, the female students of the group *Feminists* point toward the option of blocking as a simple technical step to prevent further unwanted contact. Unlike the group *Girls' Night*, however, the female students here collectively position themselves against an unwanted attempt to initiate contact, including against the sending of images of penises. The group additionally criticize the lack of responsibility of operators of social media services, which react inadequately to reports of sexual misconduct. As the narrative on the topic of social media services continues, they criticize the fact that such platforms do not react when users advertise abusive images of children, so they are confronted with unwanted sexts. Unlike type A, they thereby criticize the described “normalities” as a culture of non-consensual sexual communication experienced by (girl) adolescents, and actively reject it.

In a similar way, the group *Negotiators of Responsibility* discuss a fake account that a fellow student set up on a social media platform. The male student used the account to pretend to be a woman and convince a fellow student to send images of his penis, before showing these images to the class. This practice is rejected by the *Negotiators of Responsibility*.

B1: Because it just went too far. um, because (.) writing to someone with a fake account and then getting him to um (.) put his um

B3: [Private parts.

B1: his penis um online. that's actually- that's really not cool. that's really seriously messed up, actually.

B3: It's more than just messed up, it's

B1: [and then to um show this image to others. and laugh about it.

B5: Yeah.

B1: I didn't find it funny at all.

(Group: *Negotiators of Responsibility*, P:2, 87–98)

The students' strong disagreement with this transgressive practice increases throughout the duration of the conversation in the sense that a boundary is marked out (“it just went too far”). Their shared, normalized judgment of being “really not cool” intensifies to “seriously messed up, actually.” Not only do they condemn the deception of the victim, but they also mark the act of sharing the image within the class – and the resulting ridicule – as an intensification of the boundary violation, and they distance themselves from this act (“I didn't find it funny at all”).

Type B, then, also see the practice of sexting as a daily component of peer interactions. In other parts of the group discussion, they also detail their own, self-determined experiences with sexting. This type, however, reports above all on the non-consensual sharing and publishing of intimate images, suggesting that a self-determined form of sexual communication online remains an unrealized dream to be fought

for. Sexual boundary violations are identified as such, and are rejected without responsibility being relativized. Type B attribute responsibility for violatory sexting practices on a number of levels, but they do not attribute guilt to victims (thereby avoiding both victim-blaming and slut-shaming). This means that they not only discuss the acts of fellow students who perpetrate misconduct and boundary violations, but also address their own behavior, thereby reflecting on possibilities for acting. While boys critically reflect upon their own reactions in retrospect, girls also relate their criticism to further contexts of socialization.

Orientations Toward Gender

The type “The Reflexive-Criticals” maintains a critical distance to contemporary gendered sexual norms and taboos (Naezer and van Oosterhout, 2021). The validity of such norms and taboos is rejected by the participants on the basis of their respective orientations. That said, differences are present within type B. While the group *Negotiators of Responsibility* reflect on their own actions, the *Feminists* criticize sexualized power relations and proclaim self-determination.

G3: (.) But also this thing um with women and how they should present themselves, I just had this big discussion with my sister about it, because she's taking photos for her Bachelor and um in none of my outfits in the photos was I wearing a bra. and you could see my nipples. and that's a discussion for sure, in a porno all the guys see naked women and think breasts are super nice. but if a girl walks around with a tight top and isn't wearing a bra and you can see the breasts and nipples, then it's all of a sudden this huge drama and I just don't get it, because it just doesn't make any sense-, um it makes absolutely no sense to me. These types of things, the way they just

[...]

G1: [It's so shitty.

G3: [If it was up to me I would just run around on the beach topless.

[...]

G2: For me it's like, I don't wear a bra quite often, and I know that people look at me, but I'm honestly really not interested. they can look if they want. I mean that's basically their problem. so long as they don't grope or whatever, I really don't care what they all think.

(Group: *Feminists*, P:2-2, 1–40)

The students reflect together on socially accepted norms for clothing for young women. In doing so, they unanimously problematize the restrictive nature of such norms. The three female students recognize the danger of sexualization and of “groping” when young women do not wear a bra under their clothing, or “run around on the beach topless.” The students oppose these restrictive norms with the notion of free choice, protesting that they will wear what they want. They have each had their own experiences of harassment due to their choice of clothing, and take up the position that they “don't care” what others think of them, “so long as they don't grope.” In this sense – unlike in type A – a self-determined sexual identity is declared. The threat of violence that sexualization brings with it is also marked as being a part of their experiences. The girls’

self-representations are guided by their own wishes, in contrast to external expectations (from boys/men). The position of being a victim is linked exclusively to the position of girls, and in delineating their own defense strategies, the female students declare their right to self-determination. Boys are referred to in the passage only as “them,” without further detail.

For the male students of this type, resistance to gender norms takes a different form, but it can be compared with the orientations of the female students insofar as it constitutes a break with prevailing notions of gender that legitimize sexual boundary violations. This also becomes apparent through the discussion on the case of the faked account (see section “Orientations Toward Normalities”).

B5: [Yeah, yeah. (.) Um, for sure um someone from a, from our class um made a fake account um on Instagram. and then um sent messages to another guy in our class and pretended to be a woman. and um and sent suggestive messages that she wanted him. um and um the guy from our class, um, he reacted to that. um and I think he then sent um pictures of his penis. (.) the guy who made the fake account, he showed us those images and stuff. and um, so then I told him that I thought what he did was really shitty. because that's just not OK. and (.) yeah [...]. I thought it was totally not OK of him that he pretended to be someone else and (.) um (2) then um lied and stuff. Like, pretended to have feelings for someone else. [...]

(Group: *Negotiators of responsibility*, P:2, 12–67)

As depicted above, the boys indicate that they find the practices detailed to be “really shitty” and “seriously messed up,” because the person “pretended to have feelings for someone” and the images were “shown to others.” In confronting the fellow student in question with their rejection, they take up a position, signal resistance, and take on responsibility in order to clarify the situation. Although – unlike the group *Feminists* – they do not explicitly criticize gender relations, their orientation appears to demonstrate critical distance in relation to the reiteration of forms of masculinity in interactions among males, and refuse to be complicit in hegemonic masculinity (see Connell, 2012). This is demonstrated not only in the confrontation of the perpetrator, as narrated, but also in the rejection of the collective “laughter” in relation to the images. Here, participants revoke the conditioning, through irony and boundary violations, of male dominance, and show responsibility and care, demonstrating an “inclusive masculinity” (Anderson, 2011). The gender-critical potential here lies in a concerted break with the sort of conditioned, hegemonic masculinity that is documented in type A's orientation.

Type C: “The Disapprovers”

The third type is identified as “The Disapprovers.” The subgroups *Formalists* and *Values-Oriented Girls' Group*, who belong to this type, are characterized by the fact that they reject and abstain from digital sexual practices.

Orientations Toward Normalities

In the following passage, the students of the *Formalists* group discuss the exchange of sexts as a form of intimate communication. One male student in the group reports of a

suggestive conversation with a girl within an otherwise non-romantic friendship, during which the girl offered the boy to send him a sexually explicit picture of herself. The boy is “kind of shocked,” because he had not seen her in this light (“in fact she wasn’t - she wasn’t like that”). This creates occasion for the group *Formalists* to discuss sexting in a largely critical way:

B1: Yes, it's because, somehow it's just assumed to be normal

B3: [Yeah.

B1: That's my feeling. I don't know. or people don't think it's so bad or something.

B3: Yeah, that's it, yes, that's how it is. and it's your business if you send something like that or if you do something like that. that's always what (.) people say in the end.

B1: Mh.

B3: But for me, I have to say I'm glad, um, that I've never received something like that or anything else, because I, (.) I'm just fundamentally against sending things like that at all.

(Group: *Formalists*, 4-S_2, P:6, 61–73)

The students criticize the assumption that image-based intimate communication is normal. In doing so, they suggest that the consensual exchange of images should also be refused. They are guided discursively by restrictive moralizing norms, and reject an orientation toward consensual processes of negotiation and individual possibilities for action.

The *Values-Oriented Girls' Group* also distances itself from the practice of exchanging images. In the following passage, the students discuss a situation in which the sext of a fellow student is made public among their year group. The event is associated, for these students, with “forgetting.”

G1: So I-. so, if we're talking about images-. So, I can still remember. I don't know if you know, um. [..] but, a girl from our year group sent her boyfriend a shot of her arse and that image also got around.

G2: Ah, yeah.

G4: Yes.

G3: Yes.

I: And what happened?

G1: So the girl said it wasn't her in the picture, although you could tell that it was her jumper and stuff in the picture. and yeah, then people shit-talk about her. a- like calling her bitch, whore and stuff. And yeah.

G4: But also with things like that for example. so I wouldn't really have thought about it again. things like that also get forgotten pretty quickly I think.

G2: Yeah.

[...]

I: Can you say a bit more about it, what it was like and what happened afterward?

G1: So I don't know exactly really. but, the girl sent it to her boyfriend. and when they broke up, the image like, (.) the image got around. and then some people got in trouble for sending it and stuff, actually in my friend group. um, and (.) yeah, then there was a fight. then there were arguments too, yeah, you're not my friend anymore, that's, (2)

G4: [Mhm

G1: [yes so, but (.) we were younger back then. that all happened one, maybe 2 years ago. and yeah, (.) now i- it's more or less forgotten. now people don't really think about it and it's forgotten. (2) Yeah.

(Group: *Values-Oriented Girls' Group*, 4-S_innen_2, P:2, 1–58)

The group reports that an intimate image was forwarded – although the formulation “the picture got around” side-steps naming an involved human actor in this process. The female student depicted in the image was apparently “shit-talked” as a “bitch, whore.” The denigration of the girl, including using an insult that implies she might be selling sex, is not contradicted by the participants in the group discussion. Instead, the shared act of remembering is coupled with the statement that “things like that . . . get forgotten pretty quickly.” That the image was shared among their immediate friends is a fact, yet the *Values-Oriented Girls' Group* positions itself as being detached from the events. They are only affected in the sense that there were arguments that arose within their own friend group; the girl who is the victim of the incident is not mentioned at all. Thus it is not the event itself, but rather its victim that has been forgotten. Questions relating to the responsibility of the person who shared the image, or about caring for a fellow female student whose rights were violated, are not important to the *Values-Oriented Girls' Group* – unlike for type B. The only relevant frame of reference is one's own circle of friends, which in this case was threatened with division due to an argument over possible participation in sharing the image. By using “forgetting” as a model for defense and repression, the *Values-Oriented Girls' Group* positions itself as being beyond the practice of sexting and denies its own involvement in this practice.

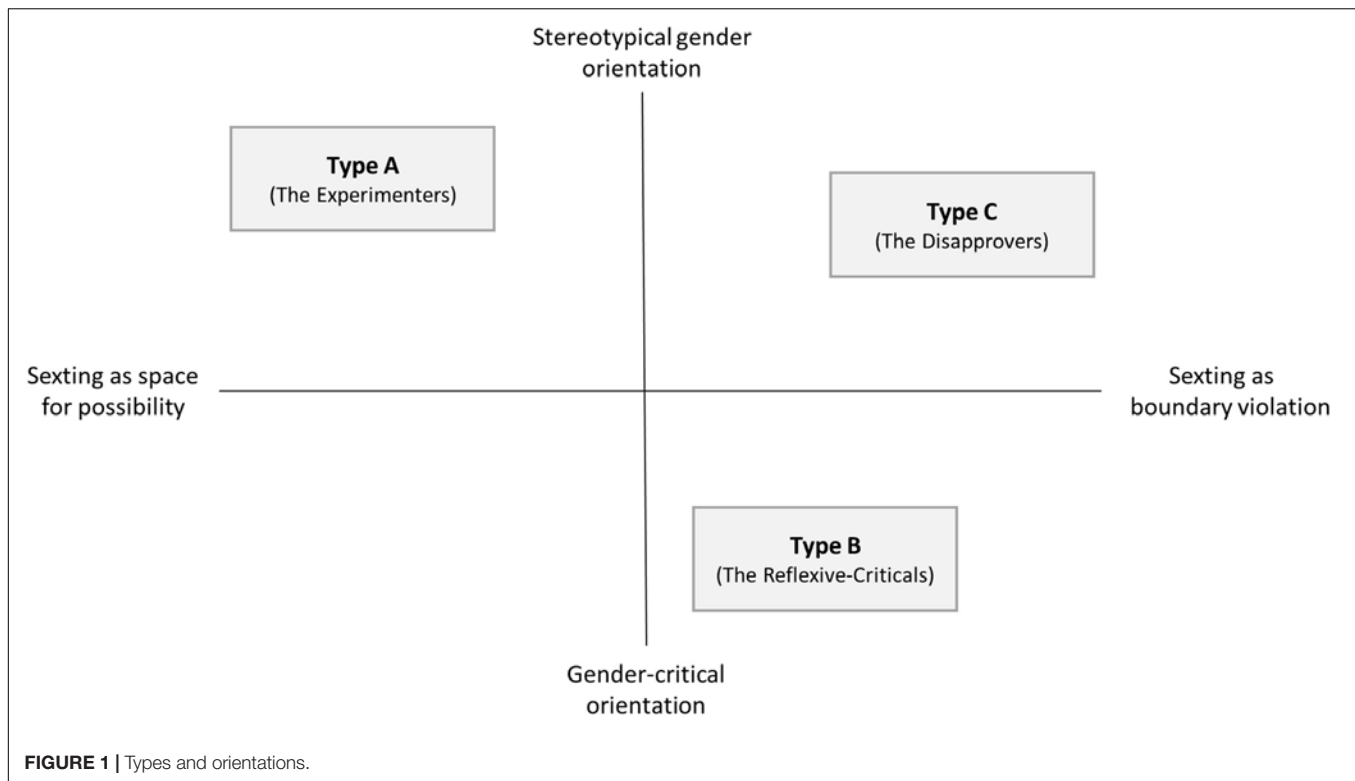
Orientations Toward Gender

Those belonging to the type “The Disapprovers” position themselves as being both outside of, and individually unaffected by, societal discourses in relation to gender. Although this type refers to pre-existing gender differences, and even reflects on them by drawing on examples of gender-specific clothing, they dismiss these differences as being irrelevant on a personal level.

G4: Ah yes, um, there's also a boy, wh-who I also know. and his girlfriend also like online (.) very provocatively-. I mean, they broke up. and she reacted to that very provocatively [..] I mean, writing that he's a son of a bitch, that sort of thing. and that you-, that we should keep away from that wanker and that kind of thing. and, um, so that was then-. that was what happened. and this girl for example, she's pretty explicit. now she shares around that she has a new boyfriend, and she shares things about herself around a lot too. I mean, like she's in a white shirt, only has a bra and undies on, and her boyfriend's lifting her up, that kind of thing. I mean, she also uploads stuff like that.

(Group: *Values-Oriented Girls' Group*, P:4, 151–162)

This female student from the *Values-Oriented Girls' Group* details the behavior of another girl who sends out “very provocative” digital warnings after the end of her relationship. The students criticize that the girl publishes intimate images



of herself with her new boyfriend. Similar to type A, here, a denigration of feminine erotic self-representations takes place in the mode of slut-shaming, without further connecting this to gender roles. Males are mentioned in this narrative only as ‘appendages’ of the apparently ‘morally corrupt’ actions of the girl. The representation focuses exclusively on the individual orientations of the girl; the narrative voice remains consistently distanced. A personal criticism is not formulated, nor are alternative forms of sexual communication mentioned. Rather, the behavior is detailed from a distanced position.

The boys’ group the *Formalists*, too, entirely exclude gender relations from their narrative, and do not reflect on the framework of social conditions. Rather, the orientation they bring to the conversation is an individualization that eradicates gendered difference. For example, they state that it does not make a difference if girls are seen in the changing room in their underwear or in a bikini in the swimming pool. Additionally, they do not recognize a difference between boys and girls in underwear, establishing that there is no need to make “a big drama” out of such aspects. Through this – unlike with type B – prevailing gender relations are not criticized, but are denied completely and in that sense also implicitly fortified.

DISCUSSION

This research project investigates sexting among adolescents through the interrelation between sexual boundary violations and digital media, aspects that have rarely been illuminated to date. As described above, adolescence is a key phase in the

process of sexual socialization – a phase that increasingly unfolds in part via digital media. Digital media, like analog spaces, provide both spheres of possibility for the crystallization of a self-determined sexual habitus, and also pose risks due to the possibility of non-consensual sexual communication. Through such boundary violations, the process of sexual socialization can be negatively influenced, insofar as it restricts self-determined sexual forms of expression and modes of experience (see, for example, Brown et al., 2014). According to the most recent research findings, girls are more affected by this than boys. This clear point of departure opens out toward gaps in recent research, in particular in relation to the orientations of adolescents. The group discussions were analyzed with this in mind, in order to identify which orientations adolescent students exhibit in relation to their modes of dealing with intimate digital images, as well as with boundary-violating communication taking place through digital media.

CONCLUSION

Working with the method of forming relational types, this analysis allows three different types to be identified:

For type A, “The Experimenters,” sexting is viewed as an everyday part of intimate communication among adolescents, and one which offers a space of possibility for recognition in the eyes of others. Sexting is thereby understood as a space where individually determined possibilities might unfold. This can also imply risks, as in this view, boundary violations are assumed to be part and parcel of sexting practices in the

process of structuring sexual communication on a daily basis. The responsibility for boundary violations is identified as lying in the hands of the producers of the images themselves. The validation students receive and the spaces of possibility these activities offer, as well as the risks involved, are understood as being normative in the process of adolescent experimentation with sexuality. Those who are not familiar with how to protect themselves (technically) are ‘themselves to blame’: this is the individualizing assumption operating within this orientation. Such a construction of normativity goes hand-in-hand with orientations toward gender stereotypes that allow sexually active boys to fulfill masculine norms with confidence and irony, objectifying masculinity (García-Gómez, 2019). On the other hand, sexually active girls are understood to be responsible when images are shared in a non-consensual manner, and are confronted with victim-blaming and slut-shaming (Attwood, 2007). The asymmetrical modes of judgment at play when boys and girls are subjected to boundary violations are acknowledged by adolescents, but they are seen as being a normative part of adolescent reality. Here, traditional gender stereotypes dominate (Ringrose et al., 2013).

Members of type B, “The Reflexive-Criticals,” are also involved in sexting practices. While for type A, adolescent experimentation and the possibility for mutual recognition are foregrounded, type B additionally reflects on the non-consensual forwarding and publishing of intimate images as a transgressive practice. In this group, such practices are repudiated. The normativity of adolescent affirmation through sexting is acknowledged and – in the spirit of sexual self-determination – both actively claimed and partly tested out, even as it is called into question as a potentially precarious illusion due to boundary violations. The efficiency of digital reality is framed as being inimical to the potential of self-defined spaces of possibility. Type B does not place responsibility for non-consensual sexual content in the hands of the persons depicted, but seeks to identify those responsible, while posing questions about personal possibilities for effecting change. “The Reflexive-Criticals” thereby distance themselves from societal gender stereotypes (Anderson, 2011). Through their actions, the boys contradict traditional notions of masculinity which do not respect the personal boundaries of women: they confronted the perpetrator and reflected on possibilities for supporting the victim (although these measures were not taken). The girls of this type, on the other hand, criticize normative and restrictive demands of femininity that lead to boundary-violating behavior, which they see as curtailing their desire to realize sexual self-determination (Dobson and Ringrose, 2016).

Type C, “The Disapprovers,” distances itself from digital adolescent cultures that engage in sexual forms of communication and performances of gender. Students belonging to this type view sexting in general as a practice carried out by ‘others’, a practice they say they do not come into contact with. In their orientations, they view sexting in a blanket way as a “non-normative” practice. Its potential significance for adolescent culture is refuted, and – unlike for type A and B – there is no identifiable interest in adolescent experimentation through intimate digital communication.

The relevance of sexual digital communication for one’s own sexual socialization is rebuffed. This abstinent orientation is applied not only to these student’s own positions, but is extended to others who view sexting as a legitimate part of sexual communication. In line with this wholesale rejection, the orientations of type C do not differentiate between consensual and non-consensual sexting practices. Rather, they consider being confronted with sexual communication as a boundary violation in itself. Orientations toward gender, too, renounce differentiation in favor of a supposed existence of equality. Gender-based asymmetries in the experience of sexting are not reflected upon, meaning that gendered stereotypes and power imbalances are implicitly reproduced. This presumed neutrality indicates that orientations to sexual norms that are understood as different are excluded and marginalized. The distanced position in relation to sexting practices makes it impossible to recognize non-consensual sexting practices, meaning that responsibility for boundary violations is *de facto* ascribed to the depicted person. The experimentation of autonomy of this type in the course of sexual socialization occurs in the form of boundary violations against persons considered not being male.

The interviewed adolescents position themselves within the field of tension between spaces of possibility and boundary violations (see **Figure 1**). Most of the students consider sexting to be a risky practice because of the potential for sexual boundary violations; only one type shows normality in the use of sexting. Thus, the study confirms the reported findings that understand sexting as a normal part of adolescent sexual communication, however, this practice is by no means commonplace among the adolescents interviewed (Döring, 2015; Madigan et al., 2018). While many young people are familiar with sexting practices and are involved in various ways, this does not mean that they actively use sexting themselves. At the same time, some of the young people are interested in experimenting with image-based intimate digital communication in the process of sexual socialization and would like safe spaces for this, where they can practice consent and get help from adults if something unpleasant happens to them in their dealings with intimate content. It becomes clear that only type A experiences sexting as an unrestricted field of possibility; in doing so, this type aligns itself with the normalization discourse around sexting. In this context – in which their sexual identity finds a space to crystallize –, those belonging to this type seek and experience recognition through sexting, but also receive sexual material non-consensually through this practice. Type A reflect upon their orientations toward norms primarily in relation to themselves. This means that boundary violations are seen as being normal; beyond deploying technical measures (“blocking”), they are not further problematized. Type B, on the other hand, imagines sexting to represent a possible self-determined mode of sexual communication that, due to existing patterns of behavior, is considered to be precarious and risky. The wish to realize a self-determined sexual identity is constantly threatened by societal norms relating to sex and gender, and the normalization of hierarchical gender stereotypes. Type B, however, also sees the possibility for action when

boundary violations take place as being a matter of their own initiative without support from teachers or other actors in school. In comparison to Type A and Type C, for this type social recognition is less dependent on external factors but more influenced by the struggle for self-recognition. On the other hand, when boys and girls of this type come together as a group, they show greater empathy toward victims of sexual boundary violations in their social environment than do those from the other two types. On the opposite, type C aligns itself with the deviancy discourse, rejecting sexting as a form of intimate communication and characterizing it as fundamentally threatening and abnormal. This type, like type A, relates its normative orientations toward sexting primarily to individual experiences. The crystallization of sexual identity here is viewed as taking place in opposition to intimate digital communication, while the normativity of gender stereotypes and boundary violations is not questioned. Overall, for the majority of adolescents, sexting does not offer a space of possibility for a self-determined sexual identity.

Gender-critical positions are present only within type B. Gender stereotypes are explicitly reproduced by type A, and implicitly by type C. This finding is particularly relevant in light of the tendency to slut-shame when dealing with sexually experimental girls, and to victim-blame in order to ascribe responsibility for boundary violations to (for the most part female) victims, as also reported in other studies (Fein, 2011; Ringrose et al., 2012, 2013; Bonilla et al., 2020; Naezer and van Oosterhout, 2021). These patterns form a central orientation toward the dimension of gender, both for “The Disapprovers” and “The Experimenters.” Type B, however, criticizes these patterns; members of this type do not seek to ascribe responsibility to the victim. Given that in all three types both boys and girls are represented, these orientations are evidently not dependent on the category of gender. Far more, victim-blaming and slut-shaming are closely linked to shared orientations toward gender (Johnson et al., 2018; Bindesbøl Holm Johansen et al., 2019). In this way, orientations toward gender stereotypes ‘favor’ both the attribution of responsibility for boundary violations to girls (and in isolated cases also to boys who publish images), and overlook the responsibility of the boys and girls who perpetrated the boundary violation in the first place. One should not mistakenly equate the normality shown by young people during group discussions with a consensual attitude. Rather, adolescents of all types find ways to deal with the fact that boundary violations are part of normal sexual socialization. By implication, the adolescent’s characteristic striving toward autonomy during sexual socialization involves a normalization of boundary violations. However, as the expression of a collectively shared orientation that transcends gender and generation, this also limits young people’s ability to address boundary violations vis-à-vis their peers or adults.

Beyond this, the general construction of normativity is linked to orientations toward gender. Those types who view sexting exclusively within the horizon of individual orientations toward norms – regardless of whether they support or reject the practice – tend to reinforce gender stereotypes and negate real

boundary violations, in particular through the mode of slut-shaming (on the significance of gender roles, see also Morelli et al., 2016a,b). Thus, orientations toward gender stereotypes, and the acceptance of non-consensual sexual communication as a normality, are mutually co-dependent on one another.

Limitations

Limitations of the study exist due to the sex-homogeneous design of the group discussions, which may contribute to reifications of gender. In addition, non-binary youth are not represented in the sample. Further, only few adolescents participated in the study who reported own positive experience with intimate digital communication. A broader study with a larger number of participants with diverse backgrounds could differentiate and validate the findings. Including non-binary youth, as well as broader consideration of diversely oriented youth overall, would help to further differentiate the findings on dichotomous heteronormative understandings of normality. It could also lead to greater sensitivity to the risk of reifying these adolescents through the research process. Furthermore, in order to explicitly reach non-binary and gender-non-conforming youth and fruitfully explore their lifeworld interaction via digital media and sexuality, we would need a more gender-diverse sampling. In addition, lgbq adolescents would have to be explicitly addressed, since a significantly higher level of media-mediated erotic and sexual communication is recognizable in this group (Beynns and Eggermont, 2014).

Outlook

Further studies would need to look for settings in which a positive attitude toward sexting is associated with a gender-critical orientation. Further research is needed with mixed-sexed groups to control for possible gender bias. However, a study based on mixed-gender group discussions of adolescents in Australia generated findings similar to our analysis (Albury, 2015). In addition, it would be important to analyze the orientations of non-binary adolescents. Furthermore, studies on the effects of pedagogical interventions in cases of sexual violation would be necessary. Because as a practical result, apparent attempts to prevent boundary violations – which primarily address the responsibility of girls – not only encourage the tendency toward victim-blaming, but reinforce both gender-stereotypical orientations and normalizations that tend to restrict the formation of self-determined sexual identities.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Board of the German Educational

Research Association. The participants provided written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JB initiated the study and did the sections Introduction, Methodologies, and Findings. JB and CW collaborated the data preparation and analysis, did the section Results, and wrote the literature review section. All authors discussed the design,

interpreted the results, contributed to drafting and revision of the manuscript, and approved the final manuscript.

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Flirting With or Through Media: How the Communication Partners' Ontological Class and Sexual Priming Affect Heterosexual Males' Interest in Flirtatious Messages and Their Perception of the Source

Jessica M. Szczuka*

Social Psychology: Media and Communication, University of Duisburg-Essen, Duisburg, Germany

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Edited by:

Nicola Döring,
Technische Universität Ilmenau,
Germany

Reviewed by:

James Pfaus,
Universidad Veracruzana, Mexico
Rohangis Mohseni,
Technische Universität Ilmenau,
Germany

*Correspondence:

Jessica M. Szczuka
jessica.szczuka@uni-due.de

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Because technologies are frequently used for sexual gratification it seems plausible that artificial communication partners, such as voice assistants, could be used to fulfill sexual needs. While the idea of sexualized interaction with voice assistants has been portrayed in movies (e.g., “Her”), there is a lack of empirical research on the effect of the ontological class (human versus artificial) on the voice’s potential to evoke interest in a sexualized interaction and its perception in terms of sexual attractiveness. The Sexual Interaction Illusion Model (SIIM), which emphasizes influences on sensations evoked by artificial interaction partners, furthermore suggests that there may be contextual influences, especially sexual arousal, that may be crucial for the question of engaging in a sexualized interaction with an artificial entity. To empirically investigate whether the ontological class of the speaker (computer-mediated human in comparison to voice assistants) and the level of sexual arousal affects the heterosexual males’ interest in hearing more flirtatious messages and the perception of the communication partner’s sexual attractiveness, an online experiment with between subject design was conducted. Two hundred and fifty seven respondents were confronted with at least four, and voluntarily six messages from either a computer-mediated human or a flirtatious voice assistant, in interaction with being previously primed sexually or neutrally. The results demonstrated that the effect of sexual arousal was not prevailing on the interest in further messages and the attractiveness perception of the interaction partners, while the ontological class did so. Here, the voice assistant evoked more interest in further messages and the technology itself, while the computer mediated human was perceived to be more sexually attractive and flirtatious, and evoked more social presence. The communication partners social presence was shown to be the predictor with most explanatory power for the interaction partners perceived sexual attractiveness, regardless of whether it

was human or artificial. The results underline differences between artificial and human interaction partners, but also underline that especially social presence and the feeling that the user is addressed (in terms of flirtatiousness) is crucial in digitalized intimacy regardless of the ontological class.

Keywords: digitalized sexuality, digitalized intimacy, voice assistants, computer-mediated communication, sexual arousal, human-computer interaction

INTRODUCTION

The voice plays an undeniably important role in sexual interactions. Besides the fact that human voice can be sexually arousing, it also provides cues important for partner perception and selection (e.g., sex, age, and health status, Babel et al., 2014). Research demonstrated that sexual auditory inputs can facilitate sexual arousal through a cognitive two-step process, consisting of an evaluation and a translation of the voice into a visual mental representation (Przybyla and Byrne, 1984). As artificial voices of machines become more human and sophisticated by using linguistic strategies that enhance authenticity (Google Duplex; Leviathan and Matias, 2018), market research surveys could already find that some people are aroused by their system's voice or fantasize about their voice assistants and can even imagine falling in love with an Artificial Intelligence (AI) (e.g., Kaspersky, 2020). While commercial state-of-the-art voice assistants are predominantly used to entertain (e.g., play music), control smart home features or gather knowledge among different domains (Ammari et al., 2019), the technology also has the potential to be used for ongoing conversations and represent a companion. Since throughout history, various technologies invented for a non-sexual purpose were then used for sexual gratification (e.g., telephone, photography, internet, Gordon, 1980), it stands to reason that voice assistants will meet the same fate. An example of what such sexual gratification with a voice assistant might look like has already been picked up in science fiction: In the movie *Her* (Jonze, 2013), a man develops a relationship with his voice assistant and starts to use the auditory input as a stimulus during masturbation.

The idea of people reacting toward media in the same way they would with other people is in line with the media equation theory, suggesting that media and therefore artificial entities can mindlessly activate social scripts, if equipped with social cues (Reeves and Nass, 1996). However, empirical research on digitalized sexuality is scarce and still aims to investigate whether mindless reactions toward media also apply to more intimate or sexualized interactions. The sexual interaction illusion model (SIIM) by Szczuka et al. (2019) conceptualized factors that can positively and negatively impact whether humans engage in sexualized interactions with artificial entities. One important concept, which is activated by the perception of a sexualized artificial stimuli (in the present study voice) is the sexual arousal that is evoked in the respondent. In line with research by Ariely and Loewenstein (2006) and Skakoon-Sparling et al. (2016), the authors argue that enhanced sexual arousal can be accompanied by an enhanced motivation to fulfill the aroused sexual need. This in turn could evoke a state comparable to a tunnel vision

in which potential negative influences on the arousal (e.g., reflections on potential violations of sexual or social norms) are neglected. Following the SIIM, the evoked sexual arousal might then also interact with the evaluation of the interaction partner and the content of the sexualized interaction. Banks and van Ouytsel (2020) conducted an empirical study in which they explored reactions toward a sexualized chatbot compared to an interaction partner presented as a human. The results were mostly consistent with the SIIM, as they found that artificialness interfered with the arousal for some participants, while others engaged in the interaction because they had what the authors called a goodness-of-fit with either the content of the messages and/or the ontological class of the interaction partner. It is, however, questionable whether this also applies to synthetic voices and whether these have the potential to raise interest in further sexualized interactions.

The aim of the present study is to empirically investigate the effect of ontological class (human versus voice assistant) and sexual arousal on interest in the messages and the communication partner and its/her evaluation. Since previous studies (e.g., Szczuka and Krämer, 2017) as well as the SIIM suggest that engaging in digitalized sexuality may be affected by both, personal characteristics as well as evaluations of the technology/artificial persona. Both aspects are also investigated.

Sexual arousal and reactions toward potential flirtatious interactions strongly differ based on the person's sex and sexual orientation. Moreover, males were found to have a more positive attitude toward online sexual activities (which thus includes voice assistants and computer-mediated messages; Shaughnessy et al., 2011). Therefore, this initial study focuses on processes within heterosexual males.

Research in this realm is not only important to understand more about human sexuality and how it is affected by technological advances, but also to gather data that may serve as a foundation for discussions about responsible handlings of technologies used within intimate interactions that have previously taken place between humans. The results provide further knowledge on the role of ontological class within sexual gratification and empirically tests assumptions of the SIIM.

THEORETICAL OVERVIEW

Communication, Sexuality, and the Role of Technologies

Acoustic signals of humans play an important role within mating and human sexuality (Levin, 2006). This includes vocal

information of the person (e.g., the pitch, compare Leongómez et al., 2014), different vocalizations (especially during coitus), and the usage of language. Recent success of audio porn platforms (e.g., Dipsea, 2021; Femtasy, 2021; compare Cookney, 2020) demonstrated that there are numerous users getting sexually aroused by stories that feature erotic communication. The platforms promote that they evoke sexual fantasies, which are accompanied by sexual arousal. Researchers found that visual stimuli work as a moderator for the relationship between erotic auditive input and sexual arousal and that actual pictures of attractive persons are just as effective as mental imaginations (Przybyla and Byrne, 1984; Hawk et al., 2007).

As already addressed, technologies can play a role in mediating erotic communication, but also serve as interaction partners themselves. Consistent with Döring et al. (2021), technologies can be incorporated into sexualized interactions in three different ways; first, they can enable sexualized interactions by connecting people (e.g., online dating platforms). Second, technologies can mediate sexualized interactions (e.g., webcam sex), and finally, people can have a sexualized interaction with the technology itself (e.g., with sexualized chatbots or robots). The first two constellations focus on interpersonal contact between humans, which would include, for example, computer-mediated contact with another human (e.g., *via* chat). Messaging apps, often equipped with the option to call each other or leave voice messages, are particularly useful for spatially separated interaction partners by enabling a constant communication. Sexualized communicative interactions with technologies on the other hand include counterparts equipped with an artificial persona. These artificial interaction partners can have varying degrees of embodiment, ranging from text-only chatbots to voice-based voice assistants to graphic representations of virtual assistants and sex robots. All these formats have been used for sexual gratification. Given the work's emphasis on voice and communication, voice assistants will be used as a research objective, since they are also frequently confronted with sexualized queries (UNESCO, 2019). While one may argue that some of the requests are meant to test the system, initial user studies demonstrated that people do have sexual fantasies about their voice assistant (Cherian and Pounder, 2017). As elaborated beforehand, the system can theoretically perform a sexualized interaction, similar to how humans interact with each other. Voice assistants already have the function of reading out messages that could theoretically be sexualized messages from another person. This leads to the question whether a sexualized voice assistant would be of interest to a human interaction partner. The basis for the assumption that people can engage in intimate interactions with artificial entities is the media equation theory, which assumes that people react toward technologies as they would if the interaction were with another human (Reeves and Nass, 1996). Szczuka et al. (2019) postulated the SIIM, which emphasizes the artificiality of the partner as a major influence on the willingness to engage in a sexualized interaction with an artificial partner. Sexual arousal, on the other hand, acts as a potential facilitator of the willingness to engage in an interaction that might differ from the interactions humans are used to with other humans.

Therefore, the following sections will address sexual arousal and the type of interaction partner (computer-mediated or voice assistant) as potential inferences on the desire to start and continue a sexualized interaction with a human or an artificial partner.

The Role of Sexual Arousal Within Sexualized Interactions

According to the SIIM, sexual arousal can play a crucial part in the process of facilitating a sexualized interaction with an artificial persona (Szczuka et al., 2019). Sexual arousal evokes physiological and psychological changes within the person, based on an existing or imagined stimulus and manifests the intention to engage in sexual behavior (Chivers, 2005). Skakoon-Sparling et al. (2016) conducted a study on the impact of sexual arousal on risk-taking and explained that the attentional focus shifts when humans are sexually aroused. They explain that the state is associated with a kind of “tunnel vision” that is focused on the self and gratification rather than on “distal factors” such as concern for others or future considerations” (p. 34). Consistent with this, Ariely and Loewenstein (2006) demonstrated that sexually aroused males rated different sexuality related activities (e.g., various bondage activities, threesome) as more attractive than when they were not aroused. Furthermore, ethical considerations of how to behave to obtain sexual gratification (e.g., “Would you encourage your date to drink to increase the chance that she would have sex with you?”, p. 94) become less important when aroused. The results underline the importance of intra-individual differences, or situational factors, in contrast to individual factors that may affect how people evaluate different sexuality related aspects. The SIIM aimed to translate this finding into digitalized sexuality and concluded that this may also mean that people who are sexually aroused do not question the artificialness of, for instance, the voice assistant and associated reflective thoughts that could suppress sexualized interaction (Szczuka et al., 2019). To test whether sexual arousal influences the perception of the interaction partners (both artificial and computer-mediated), the following hypothesis was formulated:

(H1) Respondents who are sexually aroused and/or have sexual thoughts (a) have a higher interest in hearing flirtatious messages, (b) perceive the communication partner as more sexually attractive, (c) perceive the communication partner as more flirtatious, (d) have less interest in the technology than respondents who are not primed sexually.

Flirtatious Interactions and the Potential Effects of the Interactions Partner Ontological Class

The objective of the present study is to find out not only whether sexual arousal makes a difference in the partner perception and desire to hear more flirtatious messages, but also whether the ontological class of the interaction partner, here computer-mediated human or artificial voice assistant, makes a difference.

To better understand the objective of the study, it is helpful to define flirtatious interactions and potential influences on how these interactions are perceived. O'Farrell et al. (2003) defined flirting as communication which "expresses sexual interest, declaring the beginnings of sexual pursuit and demanding some sort of response" (p. 663). Henningsen et al. (2008) moreover noted that flirting can be understood as "a ubiquitous human activity" and further explained that "People may flirt in a wide array of settings and in a variety of different ways" (p. 483). In his research on motivations for flirting Henningsen (2004) found six different reasons for flirtatious communication. These include sexual motivation, relational motivation, fun motivation, exploring motivation, esteem motivation and instrumental motivation. Among other differences between how different people of different sexualities and sexes flirt, he demonstrated that females flirt significantly more often for fun reasons. This is in line with Guerrero et al. (2018) who stated that flirting is not necessarily related to a romantic relationship or sex. Researchers found that being the target of a flirt can be perceived as flattery and interest in the own person, which, consequently, can be associated with positive emotions and a confidence boost, even in a computer-mediated setting (Hall, 1993; Cialdini, 2009; Tanner and Tabo, 2018). It is likely that this boost of confidence is associated with the fact that flirting also represents a sign of genuine interest in another person (Hall et al., 2010).

There is a lack of research about whether flirting follows similar rules when the interaction partner is artificial. Especially because artificial social interaction partner until today do not develop their own motivations, potential differences in how males react to flirtatious messages of voice assistants could also be grounded in the missing ability to be sincerely motivated to flirt with the other. However, in line with the aforementioned media equation theory it is plausible that respondents interacting with an artificial entity will react toward it in a comparable manner as they would when interacting with another human (Reeves and Nass, 1996). At this point it needs to be mentioned that mindlessness is an important aspect of the theory. This implies that the reactions occur naturally because humans are fundamentally social, but that, reflecting on the interaction, respondents understand that the technologies do not warrant this kind of reactions. Consistent with this, research on sexualized technologies demonstrated how people evaluate sexual interactions with machines differently when asked explicitly and implicitly. Szczuka and Krämer (2017) demonstrated that heterosexual males do rate women to be more attractive than sexualized robots if asked explicitly through an survey, but that this difference disappears when affective priming is used to access evaluative strengths of attractiveness of both stimuli groups. Based on evolutionary psychological reasoning and familiarity, it is plausible that humans rate their own species as more appealing in comparison to artificial replications. However, social desirability and the potential to derive from social and sexual norms may also contribute to differences in perceptions of human and artificial sexual interaction partners. Moreover, media does portrait sexualized interactions with machines as something for people who experience difficulties in their social lives (Döring and Poeschl, 2019), and while this may be

a valid and important point (compare Fosch-Villaronga and Poulsen, 2021), sexualized interactions with technologies have the potential to be appealing for a wide range of users (e.g., as they enable the user to act out sexual fantasies on his/her own). However, it should also be mentioned that research on the transmission of evolutionary psychological processes of mate perception demonstrated that heterosexual males have different gaze behaviors when confronted with a sexualized robot in comparison to a woman as they, for instance, paid more attention to the face, which is known to convey important emotional and motivational information (Szczuka and Krämer, 2019). And while this finding puts an emphasis on visual attention and sexualized robots, it can still be interpreted as a hint that, although the artificial stimuli evoke similar reactions in humans, authentic signals of partner perception could be unique within the own species as these signals are important not only for hedonistic (in terms of sexual gratification), but also evolutionary purposes (reproduction).

While no concrete research has yet been conducted on how voice assistants are perceived in this context compared to humans, Banks and van Ouytsel (2020) conducted an empirical study on how people interacted with a sexualized chatbot that either displayed human or machine-like cues (e.g., extended typing delays or visual and textual indicators of sex). While manipulation checks indicated that most of the respondents were aware that the chatbot showing human-like cues, was also a bot instead of a human, results also showed that the participants experienced sexual arousal across both conditions. Analysis of additional qualitative data demonstrated that some participants even climaxed based on the messages received from the chatbot. The authors discuss their findings by highlighting the importance of personal fit (as theoretically conceptualized within the SIIM, Szczuka et al., 2019) concluding that "it may be that the ontological class of the partner matters less than the sex-chat content and structure adherence to the norms and preferences for a fit partner" (p. 11). And although it should be interpreted carefully, as data was collected *via* self-report, a survey among voice assistant users demonstrated that almost one third of the respondents reported having sexual fantasies about their voice assistant (Cherian and Pounder, 2017; Kuzminykh et al., 2020).

In summary, there are empirical studies that provide reasons to believe that people evaluate and react to humans more positively compared to artificial entities in the context of digitalized sexuality (e.g., Szczuka and Krämer, 2017). However, there is also theoretical considerations (media equation theory, Reeves and Nass, 1996) as well as first qualitative reports that indicate that people may enjoy a sexualized interaction with an artificial entity (e.g., Banks and van Ouytsel, 2020). Based on these considerations, the following research questions were conducted:

(RQ1) *Is there a difference in (a) the interest to hear flirtatious messages, (b) the perception of the communication partner's sexual attractiveness, (c) the perception of the interaction partner's flirtatiousness based on the ontological class of the communication type (computer-mediated human vs. artificial voice assistant)?*

(RQ2) *Are there interaction effects that influence the perception of the communication partner based on the priming and the type of communication partner?*

Personal Characteristics and Interaction Evaluations as Influences on Attractiveness Perceptions and Willingness to Engage in Sexualized Interactions

The willingness to engage in sexualized interactions with both artificial entities and humans is influenced by person characteristics but also by characteristics of the interaction partner, or technology.

Regarding personal characteristics, the study puts an emphasis on sociodemographic variables, attitudes revolving around human-computer-interaction and more sexuality-related characteristics. The sociodemographic variables that influence interest in sexualized interactions with an unknown person are age and relationship status. From an evolutionary psychological perspective, age plays an important role in mating and the way humans react to others who belong to the group of their preferred sex. Being or, in the case of the present study, sounding sexually mature can be a key component for females to attract heterosexual males at a wider range of age. This is grounded in women's childbearing capacity at young to middle age. In line with this, research by Collins and Missing (2003) and Feinberg et al. (2008) shows a correlation between attractive voices and physical attractiveness, and that higher-frequency voices, an indicator of younger age, are rated as more attractive among male participants across a wider age range. Regarding voice assistants, a qualitative study by Kuzminykh et al. (2020) demonstrated that voices of commercial voice assistants, namely Apple Siri, Amazon Alexa, and Google Assistant, are perceived in the age range of 20–40 years, respectively middle aged, and therefore theoretically fertile women. Because both, the age of the recipient and the speaker as well as the voice itself and attractiveness ratings were shown to be connected, age was included as a covariate and predictor.

It is moreover likely that the relationship status as well as the sexual satisfaction of the participant plays a role in the willingness to engage in a sexualized interaction. While O'Farrell et al. (2003) demonstrated that singles and people in relationships differ in their responsiveness toward flirts, Hall et al. (2010) showed that flirting can also be platonic or intended to entertain the participants.

Regarding sexual satisfaction and relationship status as potential influences on willingness to engage in sexual interactions, research in pornography consumption provides a reason to include the variables. Even though pornography cannot be compared to sexualized communication, the idea that one may engage in it less because of the relationship status and/or sexual satisfaction has already been subject of research. While studies have found negative relations between sexual satisfaction and porn consumption, they also emphasize that it can "boost" one's sex life (e.g., Dwulit and Rzymiski, 2019; Miller et al., 2019). Because this is also plausible for sexualized interactions with a voice assistant, the variables were included in the present study.

The last two personality traits to be included are technology affinity and experiences people have had with sexual activities online. Both represent how open-minded and accepting people

are toward technology, even in a sexualized context (Shaughnessy et al., 2011; Franke et al., 2019). A systematic literature review about motives for engaging in online sexual activities (including for instance pornography consumption and computer-mediated sexualized communication) demonstrated that the characteristics of the Internet itself are an important reasoning (Castro-Calvo et al., 2018). In accordance with the so-called triple A-Engine, the authors found that ease of access and associated safety, anonymity, and the ability to act out sexual fantasies, complemented by affordability (also in terms that sexual gratification can be achieved with less costs compared to offline) are important reasons why people engage in sexual online activities. A study by Daneback et al. (2012), however, found that private access to these internet resources seems to be crucial.

Despite these personality traits that might influence how people react toward digitalized sexuality, research on how people react and evaluate machines, as well as the SIIM, give reason to believe that the context, respectively the interaction and/or the technology used might influence how users respond. To understand whether the social perception of the persona, as well as technology related dangers might affect the evaluations, social presence and privacy concerns were included.

Social presence is defined as "feeling of being there with a "real person" (Oh et al., 2018, p. 1). The conceptualization of presence addresses the connection to the identity of an artificial interaction partner. Following Short et al. (1976) and Oh et al. (2018) discuss social presence in the realm of intimacy due to the connectedness that can be created during interactions in virtual settings. Regarding whether these aspects can play a role within digitalized sexuality it should be noted that the variable is close to what Szczyka et al. (2019) called sexual interaction illusion within the SIIM, a mental state in which the artificialness of the sexual interaction partner is not questioned. This state is crucial for the participation in a sexualized interaction with an artificial entity, as it (additionally to sexual arousal) shifts the focus on sexual gratification rather than potential deviations from sexual and social norms. Social presence has also been linked to perceived attractiveness (compare e.g., Fromberger et al., 2015; Croes et al., 2016) and was shown to be related to intention to meet a dating partner when meeting on a dating website (Jung et al., 2017). However, these studies have been primarily focusing on visual and informational stimuli (e.g., pictures, videos, information about geographical proximity) so far. Chérif and Lemoine (2019) conducted a study on the social presence of voices and found that human voices generate a stronger sense of social presence compared to more synthetic voices. This seems plausible against the background that social presence underlines the social and therefore human nature of an interaction partner. However, especially with better communication skills, this variable could play an important role in the investigation of digitalized sexuality with voice assistants.

The other important variable that could affect how people react toward sexualized online communication with a voice assistant or computer-mediated message is privacy concerns. Whenever technologies that are connected to the internet are used, it should be considered that data (from meta data about the user to data about the actual usage) can be stored. The

EU'S General Data Protection Regulation (GDPR) has declared data about sexual orientation and sex life to be sensitive, and that it must only be processed if, for instance, the user gives explicit consent. However, there have been first incidents involving digitalized sexuality where sensitive data have been leaked or hacked (e.g., audio recordings derived from an app that simultaneously enabled control over a vibrator and sexualized communication or user data from online dating sites, Sundén, 2020). Moreover, it should be highlighted that different technologies are associated with different privacy concerns. Voorveld and Araujo (2020), for instance, demonstrated that interactions *via* smart speakers created higher data security concerns compared to the same interactions with a voice assistant on a smartphone. The authors discuss that this might be due to the fact that voice within the voice assistant is designed to continuously "listen" to users. Lau et al. (2018) argue that this could especially be due to missing transparency and complicated trust relations to the companies behind the state-of-the-art speakers.

Based on the expounded importance of not only the personal characteristics but also the interaction evaluations, the following research questions and hypotheses were formulated:

(RQ3) *Are personal characteristics as well as the evaluations/perceptions of the communication (technology) predictors for (a) the interest to hear more flirtatious messages by a computer-mediated human, (b) the interest to hear more flirtatious messages by an artificial voice assistant, (c) the perceived sexual attractiveness of a computer-mediated human, and for (d) the perceived sexual attractiveness of an artificial voice assistant?*

(H2a) *The social presence within the sexualized messages with the human is higher in comparison to the artificial entity.*

(H2b) *The privacy concerns about sexualized communication and c) the interest in the technology is higher within interactions with an artificial voice assistant in comparison to the computer-mediated human.*

MATERIALS AND METHODS

In the following, the sample and procedure will be explained, followed details concerning the measurements. To meet the criteria of transparency and replicability, the used stimulus material and measures can be found online: https://osf.io/df79m/?view_only=356d50cbf6944ae8bf6382b0532bb33a.

Sample

In total, 295 heterosexual male participants took part in the study. As the study had to be conducted online but contained elements which usually require assistance and attention (e.g., the priming and the thought experiment), quality fails, manipulation checks, as well as a long string analysis (Landers, 2020) were performed to ensure that the participants followed all instructions and actively participated in the study. The quality fails for instance included items checking for the participants careful response and the exclusion of participants who finished the questionnaire within a time that does not allow the participants to carefully

read the instructions and participate in the study, while the long string analysis allowed for the detection of careless responders who, at the end of the questionnaire, had no variance in their response behavior (across multiple items/pages of items). Thus, 38 datasets were excluded from further analyses. Consequently, the data of 257 participants was used. To participate in the study, the respondents were asked to indicate whether they associated themselves to the male sex and whether they identified their sexuality as at least predominantly heterosexual in reference to the Kinsey Scale of Sexual Orientation (Kinsey et al., 1998). The age of the participants ranged from 20 to 85 ($M = 43.74$, $SD = 16.74$). Regarding the relationship status, 27.6% stated to be single while 72.4% indicated to be in a relationship or married. In line with the 2×2 design, four conditions that differed in priming and the communication partner were designed. The condition assignment was randomized. Eventually, 23.3% ($N = 60$) completed the condition including sexual priming and human message partner, 25.7% ($N = 66$) finished the sexual priming and voice assistant condition. Additional 26.1% ($N = 67$) took part in the neutral priming and human communication partner condition, whereas the remaining 24.9% ($N = 64$) participated in the neutral priming and voice assistant condition. The sample was recruited *via* two different panels to provide a more balanced sample of both, younger, as well as middle aged respondents.

The software program G*Power was used to conduct a power analysis. The goal of the present study was to obtain 0.95 power to detect a medium sized effect ($f^2 = 0.0625$) at a standard 0.05 alpha error probability. The number of groups were 4, the number of predictors 2 and the response variables 6 (all these parameters were used to calculate the main effects for the priming and ontological class, and its interaction effects). The results of the *a priori* tests for MANOVA with special effects and interactions revealed a minimum sample size of 213 respondents. Following Dattalo (2013), G*Power can also be used to calculate the minimum sample size for a MANCOVA. This follow-up calculation showed that the sample should include at least 235 respondents.

Procedure and Stimulus Material

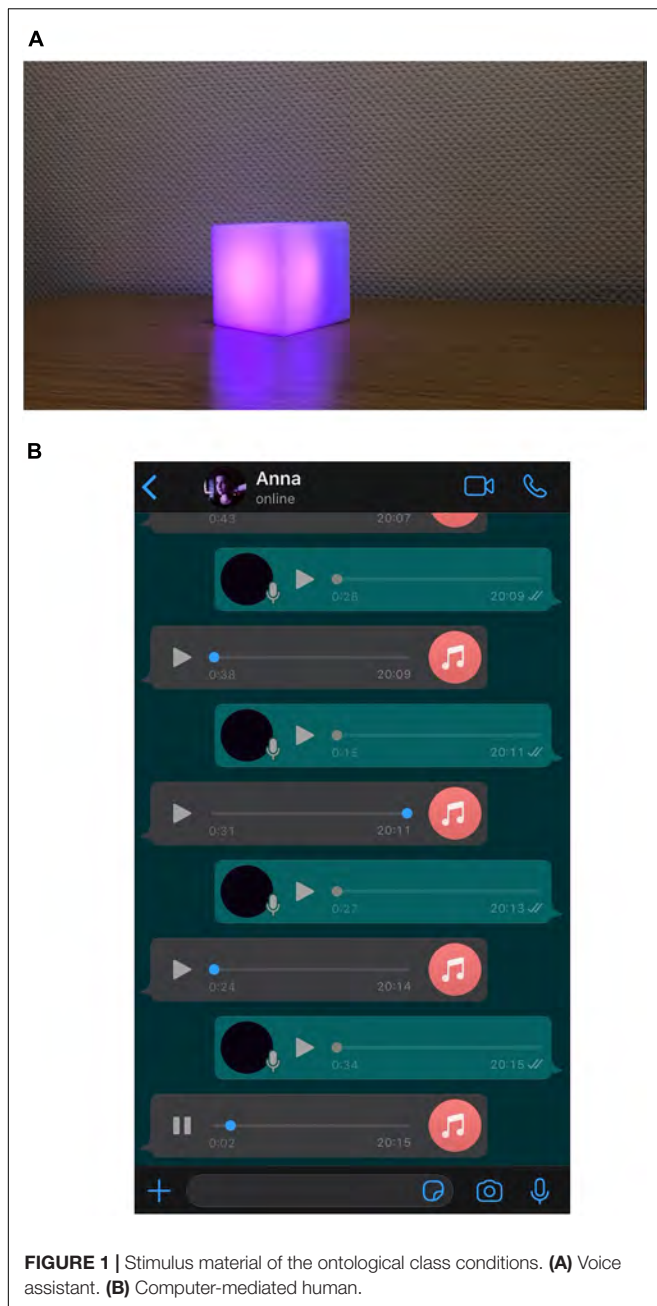
After the participants had qualified for the present study (e.g., in terms of their sex, sexual orientation, and age) and completed the socio-demographic questions, they were confronted with questionnaires assessing the personal characteristics relevant for this study (affinity for technology, evaluation of the sex life and experiences in online sexual activities). The participants were then primed, either with sexual or neutral stimuli. To achieve an initial sexual arousal or a state in which the participants had neutral feelings, the participants were confronted with ten pictures, a video and the imagination task (which will be explained within this paragraph). To ensure that the used pictures and videos would induce either a state of sexual arousal or neutral feelings, both the photographs as well as the videos were pretested by 13 heterosexual adult males (the pretest also included pictures and videos for the neutral priming, which consequently were also pretested). Here, 50 pictures and 12 videos were rated regarding their level of eroticisms, how

neutral they were perceived and the unpleasantness. Based on these ratings, ten neutral pictures, ten erotic pictures, three erotic scenes and three neutral videos (the three scenes were combined to one video) were chosen and used for the present study. As sexual arousal plays an important part in the present study, the priming needs to be explained in more depth. Even though other studies which induced sexual arousal with pictures and videos showed sexually explicit behaviors and/or primary sexual characteristics (compare for instance Brand et al., 2011), this would have been problematic in an online study because it was theoretically accessible to underaged persons. However, it is important to mention that the pictures showed erotic scenes, including naked women in sexualized poses, covering their primary sexual characteristics and couples during sexual activities covering their sexual characteristics with their poses. The video was composed of three different scenes which displayed sexualized content (women touching their bodies in underwear and a naked woman and men laying on top of each other while the men is caressing the back of the female) which displayed women in underwear or naked without any visible primary or secondary sexual characteristics. No pictures included blurred parts or censor bars. Examples for the pictures used in the can be seen in the OSF project. The ten pictures used for the priming were presented for at least 50 s (five times repeated ten second timer in which two pictures were presented), whereas the video took about 20 s. In order to not only rely on the effects of the pictures and videos, the respondents were moreover instructed to take part in a thought experiment in which they were asked to think about a sexual fantasy they had (based on a method used by Birnbaum et al., 2012). In the neutral condition, the participants saw pictures and a video showing objects or landscapes (also pretested material). The respondents, too, participated in a thought experiment in which they were encouraged to think about their living room. The thought experiment was accompanied by a timer which gave the participants about 25 s to focus on their thoughts. To test whether the pictures, videos and thought experiment were successful, the participants indicated whether they felt sexually aroused, how strong their sexual thoughts were, how neutral the participants felt and how neutral their thoughts were. Four *t*-tests demonstrated that the priming worked within both groups. The participants confronted with the sexualized content had significantly stronger sexual thoughts [$M = 3.86$, $SD = 1.33$; $t(234.63) = 14.61$, $p < 0.001$, *Cohen's d* = 1.83] than the respondents in the neutral condition ($M = 1.69$, $SD = 1.02$) and experienced a significantly higher sexual arousal [$M = 3.33$, $SD = 1.39$, $t(241.79) = 10.78$, $p < 0.001$, *Cohen's d* = 1.35] compared to the participants who were confronted with neutral content ($M = 1.61$, $SD = 1.14$). In contrast to that, the participants in the neutral condition had stronger neutral thoughts [$M = 4.63$, $SD = 1.37$, $t(249.54) = -6.917$, $p < 0.001$, *Cohen's d* = 0.87] than the participants in the sexualized condition ($M = 3.37$, $SD = 1.53$) and felt more neutral [$M = 4.59$, $SD = 1.46$, $t(255) = -5.78$, $p < 0.001$, *Cohen's d* = 0.73] in comparison to the respondents in the sexual priming conditions ($M = 3.52$, $SD = 1.47$). This suggests that the participants were successfully primed.

After the priming, the participants were introduced to either the voice assistant named Ada, or the computer-mediated human called Anna. In both introductions, the participants were told that they would be presented with a new technology, a voice assistant that is focused on interpersonal and flirty interactions or a dating platform which focuses on voice messages between the humans as preferred communication form. The respondents then watched videos in which they could either see a cube lighting up during the spoken message (**Figure 1A**) or a messenger view in which voice messages could be heard (**Figure 1B**). Please note that the videos can also be found in the OSF project of the present study. Both conditions were spoken by the same female speaker and followed the same script. However, the conditions varied in the usage of human- and machine-like auditive cues. In the voice assistant condition there were, for instance, no sounds of breathing between the sentences (compare Wagner and Schramm-Klein, 2019), while the computer-mediated human voice messages contained different filler words (e.g., *I mean, like, uh, um*) which can be considered as social and personality markers (Laserna et al., 2014). The analysis of the item which asked to rate the partner in terms of human- and machine-likeness (a semantic differential that was rated on a five-point Likert scale ranging from 1 = *machine-like* to 5 = *human-like*) demonstrated that the conditions differed significantly in terms of the perceived human-likeness [$t(253.33) = 11.19$, $p < 0.001$, *Cohen's d* = 1.40], with higher human-likeness ratings for the computer-mediated condition ($M = 3.81$, $SD = 0.94$) and a stronger tendency toward machine-likeness for the voice assistant ($M = 2.42$, $SD = 1.04$). In total, there were six videos, outputs or messages, of which only four were mandatory to watch and listen to. The last two videos were therefore optional. This choice was designed to quantify the participants' interest in the messages. The videos had a length ranging from 21 to 35 s and aimed to cover subjects relevant in the initial contact and flirting phase. The first and second video focused on a person description and the expression of a desire to have a sexualized interaction online. The third and fourth video were composed of the description of a desired date (including what the speaker would wear and what they could do, implying that she would like to have a sexual interaction). In the optional fifth video, the protagonist asked how the interaction partner would imagine the date to be, including references to his sexual preferences. In the sixth and last optional video, the female protagonist highlighted how much she enjoyed the conversation, to a point where she feels sexually aroused and would therefore like to continue the conversation some other time. Each video was accompanied by the person perception measures described in the Measures section. Afterward, questions about the messages in general were asked. Lastly, the participants received an extensive debriefing.

Measures

In the following, the used measures will be explained in more depth, separated by the perceptions and evaluations of the communication partners that are part of the main analysis (MANCOVA) and the personal traits that serve as additional predictors for further regression analyses.



Perceptions and Evaluations of the Communication Partner and Technology

Desire to Hear More Flirtatious Messages: Number of Messages/Outputs Heard by Choice

To investigate whether the participants were interested in hearing more flirtatious messages from the voice assistant or the computer-mediated human, they had the choice of whether to watch and listen to two additional messages of their communication partner (asked for one after the other). As there was no additional incentive for the participants to listen to the messages or outputs (e.g., monetary), it serves as a quantification of interest, intended to have a higher reliability

than a theoretical self-report. The interest was coded into 1 (*no interest*), 2 (*low interest*) or 3 (*high interest*), depending on whether the participants wanted to listen to no, one or two additional messages. 37% ($N = 47$) of the participants who interacted with the computer-mediated human Anna wanted to hear no further message, 15.7% ($N = 20$) listened to one additional message and the majority of 47.2% ($N = 60$) wanted to hear all additional messages. The pattern was the same for the artificial communication partner Ada. Here, 37.7% ($N = 49$) had no interest in further outputs, followed by 13.1% ($N = 17$) who wanted to hear one additional output. Almost half of the participants who listened to the voice assistant (49.2%, $N = 64$) had a high interest in hearing two additional messages.

Perception of the Communication Partner's Sexual Attractiveness

To measure the sexual attractiveness of the computer-mediated human and the voice assistant, different adjectives were rated with semantic differentials. In total, 13 adjectives were chosen from both the Godspeed Questionnaire (Bartneck et al., 2009) which aims to evaluate different aspects of how people perceive robots, and a measure used by study of Szczuka and Krämer (2017) which encompasses adjectives that have been used to measure attractiveness in the context of digitalized sexuality. Consequently, the items included different concepts ranging from attractiveness (e.g., sexually unattractive/sexually attractive) to anthropomorphism (e.g., machinelike/humanlike) to likeability (e.g., unfriendly/friendly). However, since I predominantly aimed to investigate the communication partner's perceived attractiveness (with a focus on sexual attractiveness), four items related to the construct of sexual attractiveness were chosen. Consequently, the other nine items served as distractor items and should shift the focus from the perception of sexual attractiveness. The internal consistency of the used factor was $\alpha = 0.96$. The mean of the computer-mediated human Anna was 3.36 ($SD = 0.86$), while the average perceived sexual attractiveness of the voice assistant Ada was lower with 2.56 ($SD = 0.86$).

Privacy Concerns

To measure whether the participants had privacy concerns with regard to the voice assistant Ada or the human computer-mediated communication partner Anna, three items of a scale by Xu et al. (2008) were adapted. Statements such as "*I am concerned that [the voice assistant/the human that was computer-mediated] is collecting too much personal information about me*" were rated on a five-point Likert scale ranging from 1 (*not at all*) to 5 (*very much*). The internal consistency of the factor was $\alpha = 0.91$. The mean of the privacy concerns raised by the messages of the computer-mediated human was 3.59 ($SD = 1.14$) and for the interactions with the voice assistant 3.72 ($SD = 1.18$).

Social Presence

To measure whether the artificial and human communication partner evoked a sense of social presence, a subscale of a questionnaire that aims to evaluate virtual assistants by Gefen and Straub (2003) was used. The participants were asked to rate the five items (e.g., "*I felt a sense of human contact in [the voice*

assistant/the human that was computer-mediated])” on a five-point Likert scale ranging from 1 (*not at all*) to 5 (*very much*). The internal consistency was $\alpha = 0.96$. The average social presence of the computer-mediated human ($M = 3.23$, $SD = 1.15$) was higher than of the artificial voice assistant ($M = 2.26$, $SD = 1.14$).

Interest in Technology or Content of Message

The interest in the used technology or the content of the sexualized messages was rated on two single items ranging from 1 (*uninteresting*) to 5 (*very interesting*). For the computer-mediated human Anna, the mean for the interest in the used technology was 2.80 ($SD = 1.42$), whereas the average interest in the content of the messages was 3.24 ($SD = 1.29$). For the voice assistant Ada, the descriptive data revealed a mean of 3.00 ($SD = 1.34$) for the interest in the technology, and an interest in the content of the messages of 2.37 ($SD = 1.24$).

Flirtatiousness of the Communication Partner

Because attraction is facilitated by reciprocity, a single item was used to measure whether the participants felt that the communication partner was flirting with them. The item was measured on a five-point Likert scale ranging from 1 (*not at all*) to 5 (*very much*). The mean of the item was higher for the messages of the computer-mediated human ($M = 3.38$, $SD = 1.31$) compared to the voice assistant ($M = 2.44$, $SD = 1.22$).

Personal Characteristics

Sociodemographic Variables

The two sociodemographic variables that were of interest were age and relationship status (single or relationship) which was assessed via self-report.

Affinity Toward Technology

To access whether the participants are drawn toward technology, the German version of the Affinity for Technology Interaction (ATI) Scale by Franke et al. (2019) was used. The scale consists of nine items, such as “*I enjoy spending time becoming acquainted with a new technical system*” that were assessed on a five-point Likert scale ranging from 1 (*not at all*) to 5 (*very much*) ($M = 3.48$, $SD = 0.87$). The internal consistency was $\alpha = 0.91$.

Evaluation of the Own Sex Life: Sexual Satisfaction

Items from different scales were used to cover the multifaceted aspect of sex life, including the concepts of sexual self-esteem, sexual self-efficacy and the frequency of sexual encounters. The items were merged to add different perspectives to the evaluation of the own sex life and to encounter the problem that measuring all scales completely would have gone beyond the constraints of the online questionnaire’s length.

For the included items that captured whether participants have a positive appraisal of themselves in the context of sexuality, the Sexual Self-Esteem subscale from Ferrer-Urbina et al. (2019) was used. It was composed of four items such as “*I would not change anything in my current sex life.*” Moreover, an additional item from the Sexual Self-Efficacy subscale was included: “*I think I know how to stimulate my partner(s) well.*” Four items from Meston and Trapnell’s (2005) Sexual Satisfaction Scale were used to measure overall satisfaction with one’s sex life (e.g.,

“*I often feel that something is missing in my current sex life*”; reversed). Following Stulhofer et al. (2010), sexual satisfaction is associated with the frequency and variety of sexual encounters, which includes masturbation, sexual interactions with partners and sexual thoughts. Therefore, six items that were based on the New Sexual Satisfaction scale were included (e.g., “*Within the last six months, how satisfied have you been with the frequency of your sexual activities?*”). All items were answered on a five-point Likert scale.

To investigate the variance between the items, an explorative factor analysis using promax rotation was performed (Horn, 1965). The results yielded a two-factor solution with differences between items that asked for the evaluation of the sex life associated with other people and the rest (e.g., sexual solo-activities and sexual thoughts). Because the sexual satisfaction with not only the sexual encounters but more importantly also the self within these encounters is of more interest within the study the items were chosen that merely focused on the evaluations of the self. Therefore, the ten items with loadings higher than 0.500 were used for the present study. The factor measuring satisfaction with sexual encounters had a mean of 3.24 ($SD = 1.13$) and an internal consistency of $\alpha = 0.96$.

Online Sexual Experiences

The Online Sexual Experience Questionnaire by Shaughnessy et al. (2011) was used to measure how experienced the participants were in terms of sexual gratifications that can be fulfilled online. The scale consists of ten items that cover activities associated with no arousal (e.g., “*Visited an educational web site on sexuality*”), solitary arousal (e.g., “*Masturbated while watching sexually explicit videos online*”) or partnered arousal (e.g., “*Repeatedly engaged in private discussion online about sexual fantasies with the same person*”). The items were rated on a five-point Likert scale ranging from 1 (*never*) to 5 (*very often*). The mean was 2.18 ($SD = 0.78$) and the internal consistency was $\alpha = 0.85$.

RESULTS

Effects of Sexual Priming and Communication Partner Conditions (H1a-d, RQ1a-c, H2a-c, RQ2)

A Multivariate Analysis of Variance and Covariance (MANCOVA) was computed to test whether both primary experimental conditions and the ontological class of the communication partner, affected the evaluations and perceptions of the communication partner. The dependent variables included were all evaluative measures about the messages and its sender. That is, the number of voluntarily heard additional messages or outputs (interest in further messages), the interaction partner’s sexual attractiveness, social presence and flirtatiousness, privacy concerns, and the interest in the technology. Because the literature suggests that the participant’s age and relationship status could influence how the interaction partner is perceived (see section on the influence of personal characteristics) but also whether the men want to listen to further flirtatious messages,

both variables were included as covariates. Following Simon and Gagnon (1986), the sexual scripts may influence how assertive flirting communication is perceived. Therefore, the interest in the content of the message but also in the interaction partner (as it provides social cues that could be in favor of one's scripts or not, e.g., the speaker's voice that suggests her age) were furthermore included as covariates. The results of Box's Test for Equivalence of Covariance Matrices and Levene's Test for Equality of Variance demonstrated that the included variables meet the criteria of homogeneous covariance matrices [$F(63,148082.72) = 1.02$, $p = 0.432$] and homoscedasticity. The Kolmogorov–Smirnov test of normality revealed that the five dependent variables reached significance, except for the evaluation of the interaction partner's sexual attractiveness. Meaning that they predominantly did not meet the criterion of normality. However, Following Field (2013), the used statistical methods (MANOVA and multivariate regressions) are both robust against this criterion, especially because the sample groups of the present study are large enough and equally distributed.

There was a significant main effect of the ontological class of the communication partner [$F(6,244) = 10.483$, $p < 0.001$; $Wilk's \Lambda = 0.795$, $\eta_p^2 = 0.205$] on the combined dependent variables, but not of the priming condition [$F(6,244) = 1.548$, $p = 0.163$; $Wilk's \Lambda = 0.963$, $\eta_p^2 = 0.037$]. Furthermore, no interaction effect between the ontological class of the interaction partner and the priming condition could be found [$F(6,244) = 0.499$, $p = 0.808$; $Wilk's \Lambda = 0.499$, $\eta_p^2 = 0.012$]. After controlling for the participants' age, relationship status, the interest in the content of the messages and in the interaction partner itself, the between-subjects effects demonstrated that the ontological class of the communication partner had an influence on the desire to hear more flirtatious messages [$F(1,256) = 5.483$, $p = 0.020$; $\eta_p^2 = 0.022$]. The descriptive data revealed that there was a slightly higher interest in hearing messages from the voice assistant ($M = 2.11$, $SD = 0.92$) compared to the computer-mediated human ($M = 2.10$, $SD = 0.91$). Moreover, the perception of the communication partner's sexual attractiveness was significantly affected by the interaction partners ontological class [$F(1,249) = 23.344$, $p < 0.001$; $\eta_p^2 = 0.086$], with higher scores for the computer-mediated human Anna ($M = 3.36$, $SD = 0.86$) compared to voice assistant Ada ($M = 2.56$, $SD = 0.87$). Furthermore, the interaction partners significantly differed in terms of social presence [$F(1,249) = 15.135$, $p < 0.001$; $\eta_p^2 = 0.057$], with the computer-mediated human being perceived as more socially present ($M = 3.23$, $SD = 1.15$) than the voice assistant ($M = 2.26$, $SD = 1.13$). Another between-subjects effect of the type of interaction partner was shown regarding the perceived flirtatiousness [$F(1,249) = 12.045$, $p < 0.001$; $\eta_p^2 = 0.046$]. The computer-mediated human more strongly ($M = 3.38$, $SD = 1.31$) evoked the impression that she was flirting with the respondents than the artificial voice assistant ($M = 2.43$, $SD = 1.22$). The last significant effect of the communication partner condition was on the interest in the technology [$F(1,249) = 23.855$, $p < 0.001$; $\eta_p^2 = 0.087$]. The mean values demonstrate that the voice assistant evoked more interest in the technology ($M = 3.00$, $SD = 1.33$) compared to the computer-mediated human ($M = 2.80$, $SD = 1.42$). Consequently,

the ontological class of the communication partner had no effect on the interaction-related privacy concerns [$F(1,249) = 0.260$, $p = 0.611$; $\eta_p^2 = 0.001$].

Even though the priming condition had no significant effect on the combined dependent variables, one significant between-subjects effect was found that should not remain unreported. The priming had an effect on the perceived flirtatiousness of the interaction partner [$F(1,249) = 5.396$, $p = 0.021$; $\eta_p^2 = 0.021$]. Respondents in the neutral condition ($M = 3.12$, $SD = 1.34$) felt more strongly that the interaction partner was flirting with them than the respondents in the sexualized condition ($M = 2.66$, $SD = 1.32$).

Taken together, almost all hypotheses concerning the sexual priming need to be rejected. The priming had either no effect (H1a, H1b, H1d, H1e) or unexpected effects in the neutral conditions (H1c; flirtatiousness of the communication partner). In contrast to this, the ontology of the communication partner affects almost all dependent variables. Consequently, RQ1a, RQ1b, and RQ1c can be positively answered as there are differences based on the ontological class of the communication partner. While the computer-mediated human Anna scored significantly higher on sexual attractiveness (RQ1b) and flirtatiousness (RQ1c), the voice assistant evoked more interest regarding additionally heard outputs (RQ1a). Since data revealed that the computer-mediated human evoked more social presence, H2a was supported. In terms of effects where the voice assistant scored higher than the computer-mediated human, H2b needs to be rejected as there were no differences regarding interaction related privacy concerns, while H2c can be accepted; the voice assistant evoked more interest in the technology. Because no interaction effects were found between the priming condition and the type of communication partner, RQ2 needs to be answered negatively.

Characteristics of the Respondent and Communication Evaluations as Predictors of the Desire to Hear More Flirtatious Messages and the Perception of the Communication Partner's Sexual Attractiveness

To investigate which personal characteristics and aspects of the communication with the computer-mediated human or artificial voice assistant predict the desire to listen to further messages and the perception of sexual attractiveness, four hierarchical linear regression analyses (two for each interaction partner) were conducted. The respondent's characteristics age, relationship status, affinity for technology, sexual satisfaction, and experiences with online sexual activities were entered in the first block. The second block was composed of variables that evaluated the messages: the perception of the communication partner's sexual attractiveness (which was only entered within the first two regressions as it served as a dependent variable for the latter two), the social presence of the communication partner, privacy concerns within the interaction, the feeling that the interaction partner was flirting with one, the interest in the used technology,

and the interest in the content of the messages. The regression analyses were controlled for multicollinearity with a Variance Inflation Factor (VIF) below five (Menard, 2001). Please consider that answering the research questions required multiple analyses, which did not allow to control for the familywise error rate.

Predictors of Consuming Additional Flirtatious Messages (RQ3a and RQ3b)

As explained, the first two multiple regression analyses investigated the predictors of the additionally consumed messages. The hierarchical linear regression examining effects regarding the computer-mediated human revealed that the regression model which contained the respondent's characteristics as predictors was non-significant [$F(5,121) = 1.463, p = 0.207; R^2 = 0.057$, Adjusted $R^2 = 0.018$], while the one containing the communication evaluation was significant [$F(6,115) = 5.735, p < 0.001; R^2 = 0.292$, Adjusted $R^2 = 0.292$]. The coefficient analysis revealed that, once the two blocks were entered, the only variable that predicts whether the participants chose to listen to additional messages by the computer-mediated human is the level of social presence she conveys [$\beta = 0.376, t(126) = 2.57, p = 0.011$]. It should, however, be mentioned that the experiences the respondents had had with online sexual activities were significant before the communication evaluations were entered in the second block. **Table 1** presents all regression coefficients.

The same hierarchical linear regression was conducted to investigate the predictors of the number of additional messages heard from the voice assistant. The model for the first block, containing age, relationship status, affinity for technology, sexual satisfaction, and experiences with online sexual activities was only just significant [$F(5,124) = 2.311, p = 0.048; R^2 = 0.085$, Adjusted $R^2 = 0.048$]. The model composed of the communication evaluation variables (perception of Ada's sexual attractiveness, her social presence, interaction related privacy concerns, the feeling that Ada was flirting with one, the interest in the used

technology, and the content of the messages) was also significant [$F(6,118) = 2.120, p = 0.024; R^2 = 0.165$, Adjusted $R^2 = 0.087$]. All additional values are presented in **Table 2**.

The predictors formulated in RQ3a and RQ3b mostly need to be rejected. Even though the analyses showed significant regression models and some significant predictors, the explanatory power of the analyses is limited.

Predictors of the Communication Partner's Sexual Attractiveness (RQ3c and RQ3d)

The next two hierarchical linear regressions were computed to investigate which variables predict the perception of Anna's and Ada's sexual attractiveness. As within the first two regressions, the first block contained personal characteristics (age, relationship status, affinity for technology, sexual satisfaction, and experiences with online sexual activities) while the second block was composed of communication evaluation variables (social perception, interaction related privacy concerns, the feeling that the interaction partner was flirting with one, the interest in the used technology, and the content of the messages).

The results of the analyses revealed that both the characteristics of the respondent [$F(5,121) = 2.879, p = 0.017; R^2 = 0.106$, Adjusted $R^2 = 0.069$] as well as the communication evaluations [$F(5,116) = 27.195, p < 0.001; R^2 = 0.701$, Adjusted $R^2 = 0.675$] explained significant variance in the perceived sexual attractiveness of the computer-mediated human Anna. The coefficients analysis demonstrated that the respondents' age serves as the only personal characteristic that explains variance in the sexual attractiveness ratings of the computer-mediated human [$\beta = 0.178, t(126) = 2.51, p = 0.014$]. The jump in the explained variance between the models seems to be driven by the explanatory power of the perceived social presence [$\beta = 0.544, t(126) = 6.37, p < 0.001$] and the impression that the computer-mediated human was flirting with the respondent [$\beta = 0.310, t(126) = 3.65, p < 0.001$]. **Table 3** presents all values.

TABLE 1 | Hierarchical regression analysis of additionally heard flirtatious messages of the computer-mediated human.

	Model 1			Model 2		
	B (SE)	β	p	B (SE)	β	p
Constant	0.85 (0.72)		0.244	0.02 (0.72)		0.977
Age	0.01 (0.01)	0.20	0.083	0.01 (0.01)	0.20	0.064
Relationship status	0.09 (0.20)	0.04	0.651	-0.03 (0.17)	-0.01	0.882
General sexual satisfaction	-0.01 (0.08)	-0.01	0.931	0.02 (0.07)	0.03	0.741
Experiences with online sexual activities	0.28 (0.12)	0.25	0.017	0.12 (0.10)	0.11	0.257
Affinity to technology	0.05 (0.10)	0.05	0.639	-0.08 (0.10)	-0.08	0.434
Perception of (sexual) attractiveness				0.16 (0.15)	0.15	0.267
Social perception/presence				0.30 (0.12)	0.38	0.011
Perceived flirtatiousness of interaction				-0.10 (0.09)	-0.14	0.278
Interest in content of message				0.15 (0.09)	0.22	0.082
Interest in used technology				0.01 (0.07)	0.01	0.899
Privacy concerns				-0.04 (0.06)	-0.05	0.500
			$F(5,121) = 1.46, p = 0.207,$ Adj. $R^2 = 0.02$			$F(11,115) = 5.74,$ $p < 0.001, \text{Adj. } R^2 = 0.29$

TABLE 2 | Hierarchical regression analysis of additionally heard flirtatious messages of the voice assistant.

	Model 1			Model 2		
	<i>B</i> (<i>SE</i>)	β	<i>p</i>	<i>B</i> (<i>SE</i>)	β	<i>p</i>
Constant	0.95 (0.64)		0.136	0.57 (0.71)		0.420
Age	0.01 (0.01)	0.11	0.286	0.01 (0.01)	0.14	0.154
Relationship status	0.03 (0.19)	0.01	0.878	0.13 (0.19)	0.06	0.493
General sexual satisfaction	−0.11 (0.08)	−0.14	0.140	−0.12 (0.08)	−0.14	0.141
Experiences with online sexual activities	0.29 (0.12)	0.24	0.017	0.23 (0.12)	0.19	0.061
Affinity to technology	0.18 (0.10)	0.15	0.085	0.14 (0.10)	0.12	0.175
Perception of (sexual) attractiveness				0.03 (0.17)	0.03	0.852
Social perception/presence				0.13 (0.13)	0.16	0.313
Perceived flirtatiousness of interaction				0.05 (0.11)	0.06	0.672
Interest in content of message				0.06 (0.10)	0.08	0.548
Interest in used technology				−0.00 (0.07)	−0.00	0.992
Privacy concerns				−0.03 (0.07)	−0.03	0.708
			$F(5,124) = 2.31, p = 0.048,$ Adj. $R^2 = 0.05$			
						$F(11,118) = 2.12,$ $p = 0.024, \text{Adj. } R^2 = 0.09$

TABLE 3 | Hierarchical regression analysis of the computer-mediated humans perceived sexual attractiveness.

	Model 1			Model 2		
	<i>B</i> (<i>SE</i>)	β	<i>p</i>	<i>B</i> (<i>SE</i>)	β	<i>p</i>
Constant	2.37 (0.66)		<0.001	0.68(0.46)		0.137
Age	0.00 (0.01)	0.01	0.944	0.01 (0.00)	0.18	0.014
Relationship status	0.13 (0.18)	0.07	0.488	−0.06 (0.11)	−0.03	0.569
General sexual satisfaction	−0.05 (0.07)	−0.07	0.467	−0.04 (0.04)	−0.05	0.400
Experiences with online sexual activities	0.19 (0.11)	0.18	0.082	0.02 (0.07)	0.02	0.761
Affinity to technology	0.20 (0.09)	0.21	0.031	0.03 (0.06)	0.03	0.686
Social perception/presence				0.41 (0.06)	0.54	<0.001
Perceived flirtatiousness of interaction				0.20 (0.06)	0.31	<0.001
Interest in content of message				0.07 (0.06)	0.10	0.241
Interest in used technology				0.01 (0.04)	0.02	0.740
Privacy concerns				0.01 (0.04)	0.01	0.812
			$F(5,121) = 2.88, p = 0.017,$ Adj. $R^2 = 0.07$			
						$F(10,116) = 27.20,$ $p < 0.001, \text{Adj. } R^2 = 0.68$

Another hierarchical linear regression with the same characteristics of the respondent and communication evaluations was computed to investigate which predictors explain variance in the perception of the voice assistant's sexual attractiveness. The results demonstrated that the first block containing the personal characteristics was non-significant [$F(5,124) = 2.074, p = 0.073; R^2 = 0.077, \text{Adjusted } R^2 = 0.040$]. This was different for the communication evaluations with 67.7% explained variance [$F(5,119) = 28.049, p < 0.001; R^2 = 0.702, \text{Adjusted } R^2 = 0.677$]. The coefficient analysis revealed that the perceived sexual attractiveness of the voice assistant was significantly predicted by Ada's social presence [$\beta = 0.559, t(129) = 6.85, p < 0.001$] and the feeling that the voice assistant was flirting with one [$\beta = 0.294, t(129) = 3.76, p < 0.001$]. **Table 4** displays all other regression coefficients.

Even though the predictors formulated in RQ3c and RQ3d predominately need to be rejected, the large explanatory power of the regressions should be emphasized.

DISCUSSION

The aim of the present study was to investigate how sexual priming and the ontological class of a communication partner (artificial and computer-mediated) affects the willingness to engage in further messages, the attractiveness perception and other message evaluations. Within the following sections, the findings will be discussed.

Effects of Sexual Priming (H1a-d, RQ2)

Literature suggests that sexual arousal might shift the focus on the aim to gain sexual satisfaction and therefore diminish thoughts about potential negative consequences or reflections on sexual norms (Ariely and Loewenstein, 2006). For this reason, potential differences in the reactions toward artificial and computer-mediated interaction partners based on sexual or neutral priming were investigated. Almost all hypotheses needed to be rejected. This is especially surprising as it would have

TABLE 4 | Hierarchical regression analysis of the voice assistants perceived sexual attractiveness.

	Model 1			Model 2		
	<i>B</i> (SE)	β	<i>p</i>	<i>B</i> (SE)	β	<i>p</i>
Constant	1.99 (0.60)		0.001	0.79 (0.39)		0.043
Age	−0.00 (0.01)	−0.08	0.443	0.00 (0.00)	0.05	0.455
Relationship status	−0.32 (0.18)	−0.17	0.077	−0.08 (0.11)	−0.04	0.481
General sexual satisfaction	−0.03 (0.07)	−0.04	0.681	−0.08 (0.04)	−0.11	0.062
Experiences with online sexual activities	0.17 (0.11)	0.15	0.129	0.00 (0.07)	0.00	0.951
Affinity to technology	0.16 (0.10)	0.15	0.091	0.08 (0.06)	0.07	0.180
Social perception/presence				0.43 (0.06)	0.56	<0.001
Perceived flirtatiousness of interaction				0.21 (0.06)	0.29	<0.001
Interest in content of message				0.05 (0.06)	0.07	0.396
Interest in used technology				−0.00 (0.04)	−0.00	0.952
Privacy concerns				0.03 (0.04)	0.04	0.417
	$F(5,124) = 2.07, p = 0.073,$ Adj. $R^2 = 0.04$			$F(10,119) = 28.05,$ $p < 0.001, \text{Adj. } R^2 = 0.68$		

been plausible that participants who were primed sexually also wanted to listen to more messages than those in the neutral condition to explore a potential increase in explicitness, which could have brought them even closer to sexual gratification. Even though participants in the sexual priming condition were significantly more aroused than those in the neutral condition (this is also underlined by large effect sizes) it is comprehensible that the shift of focus/attention to of instant sexual gratification needs a higher level of sexual arousal compared to the arousal evoked by showing sexualized images that (due to experimental considerations) could not be explicit. The experimental studies the hypotheses were based on had stronger manipulations of sexual arousal. Ariely and Loewenstein (2006) evoked sexual arousal by asking the participants to stimulate themselves (masturbate) before confronting them with questions, and Brand et al. (2011) facilitated sexual arousal with pornographic pictures that showed couples during intercourse or persons during masturbation. The missing interaction effects with the ontological class of the communication partner also suggest that the effect would not have worked with, for instance, the more familiar communication partner. In other words, sexual priming could have worked when followed by messages provided by a computer-mediated human in comparison to the voice assistant. This could have been in more accordance with the sexual script of the participants (Simon and Gagnon, 1986) which in the SIIM is one of the aspects summarized as goodness-of-artificial fit, which in turn is conceptualized to affect sexual arousal (Szczyka et al., 2019). Regarding the SIIM where sexual arousal is conceptualized as a driving force, results imply that sexual arousal needs to be redefined (in terms of how strong it needs to be) and empirically reinvestigated. The results of this study imply the need for higher levels of arousal.

Effects of the Communication Partner's Ontological Class (H1a-d, RQ2)

Theoretical considerations (especially in terms of the media equation theory, Reeves and Nass, 1996) suggested that there might not be any differences in the reactions people show

regarding computer-mediated humans and artificial interaction partners, while first empirical results (e.g., Szczuka and Krämer 2017; Banks and van Ouytsel, 2020) suggest differences based on the ontological class. In contrast to the effects of the sexual priming, the analyses suggest the ontological class to play an important role in the evaluation of sexualized messages. The results demonstrated that the computer-mediated human was evaluated to be significantly more sexually attractive and flirtatious, and that the human communication partner evoked more social presence compared to the voice assistant.

It is noticeable that especially being sexually attractive and flirtatious are attributes which, until now, have been used to describe human mating partners and seem not so easily transferable to artificial entities. Because the present study was conducted as a between-subjects design, interferences between the conditions are out of question. Regarding the sexual attractiveness, the findings is in line with other studies in which heterosexual men rated women to be more sexually attractive than artificial entities (here sexualized robots, *Szczuka and Krämer, 2017*).

In the realm of the SIIM (Szczuka et al., 2019) and in accordance with results of an empirical study by Banks and van Ouytsel (2020), the results (especially in terms of attractiveness and flirtatiousness) indicate that the voice assistant achieved no goodness-of-artificial fit, which might be due to constraints such as social and sexual norms (intimate or sexualized interactions are preserved for humans) but also evolutionarily rooted aversions (artificial humans may provide cues that deviate from healthy humans, e.g., voice, which might automatically trigger aversion). As the SIIM is based on the media equation theory, it also needs further research on whether it can be applied in the context of digitalized sexuality. Because the present study focused rather on evaluations than on observable reactions, a more profound understanding of the importance of mindless reactions toward technologies compared to humans is required.

The finding that the computer-mediated human was perceived as more flirtatious compared to the artificial communication

partner tackles the importance of authentic cues within intimate interactions and the lack thereof within digitalized sexuality (discussed by Szczuka and Krämer, 2019). Among humans, flirting can fulfill personal needs (e.g., entertainment or boost of self-esteem) but also the aim to establish a sincere relationship between the involved (Hall et al., 2010). It is imaginable that the artificial interaction partner's missing ability to build a deeper relation contributed to worse ratings in the flirtatiousness. However, the results of RQ3c and RQ3d both demonstrated that perceived flirtatiousness significantly explained variance in the sexual attractiveness ratings within the computer-mediated human and voice assistant. While one may argue that not every flirtatious communication between humans is driven by authentic social and sexual needs (compare telephone sex), implementing a convincing communication suggesting that machines have their own sexual needs and aims to engage in reciprocal communication may pose a difficult task for programmers. Further empirical research is needed to gain a deeper understanding of dyadic aspects of sexualized interactions within digitalized sexuality.

The difference in the social presence based on the communication partner's ontological class is in line with Chérif and Lemoine (2019). This result is plausible as social presence per definition refers to the feeling of being connected with a "real" person (Oh et al., 2018). However, it can be of special interest for intimate interactions as social presence was found to be related to attractiveness (e.g., Fromberger et al., 2015). It is unclear whether the human voice is rated to elicit more attractiveness and social presence because both concepts find their origin in human nature or whether, contrary to this, the unnatural cues in the voice assistant condition broke the potential illusion of an interaction with a "real" person (also compare Szczuka et al., 2019). This result, however, highlights the importance of authenticity of voices in the context of digitalized sexuality, especially because social presence was a strong predictor for the interest in further flirtatious messages and the attractiveness ratings (see next section for discussion). In times of artificial voice systems which use numerous vocal cues to enhance human-likeness (e.g., Google Duplex), social presence could be improved in future technologies of digitalized sexuality.

It is questionable why the significantly higher ratings of attractiveness, flirtatiousness and social presence with the computer-mediated human were not accompanied by higher interest in further flirtatious messages. Instead, participants receiving messages from a voice assistant had significantly more interest in hearing further messages. It is likely that this effect was facilitated by the interest in the mere technology, which was also found to be significantly higher for the voice assistant. It seems plausible that the users wanted to get to know the system's abilities to engage in a sexualized flirt, a style of communication which, until now, has mainly taken place among humans. Comparable effects in which users tested a system by confronting it with statements which, among humans, would cause emotional reactions (ranging from display of affection to insults) could be found for voice assistants (UNESCO, 2019)

but also virtual agents (Kopp et al., 2005). However, it should be noted that the interest in the technology did not serve as a significant predictor for the interest in further messages of both communication partners. The result will be discussed in the following section.

Because research has demonstrated that voice assistants have a bad reputation concerning a lack of transparency on how data is processed and stored (Voorveld and Araujo, 2020), the missing effect of ontological class on the privacy concerns was surprising. However, the companies behind the state-of-the-art voice assistants are also frequently the reasons for mistrust (Lau et al., 2018), which was not the case within this study as the voice assistant was presented as a product of a university research project. The descriptive means show that the privacy concerns were only slightly higher for the participants confronted with the voice assistants, with the means of both ontological classes being over the scale average. It is further imaginable that participants had reservations to engage in an intimate interaction with an unknown person which, analog to the misuse of user data for the voice assistant, could misuse exchanged voice messages. More research is needed to understand the danger systems and companies, but also other users pose to privacy in the context of digitalized sexuality.

Predictors of Consuming Additional Flirtatious Messages (RQ3a and RQ3b)

Another aim of the study was to investigate whether personal characteristics and communication evaluations would serve as predictors for the interest in further messages. The results indicate that for the voice assistant, the interest can clearly be attributed to the evaluation of the messages (explanatory power of about 30%) and, more precisely, to the social presence the sender evokes. Especially because the voice (and the person, respectively) was unknown (also without any further information one would normally get, e.g., on dating sites, such as age or hobbies), it seems plausible that the perceived connection to the computer-mediated human played an important role in the interest in further messages. This would be in line with Jung et al. (2017) who found that within dating sites, social presence (enhanced by more details within the dating profile) is connected with the willingness to meet the dating partner as it is stated to reduce uncertainty. This, however, is not the case for the voice assistant, as social presence did not significantly predict the interest in further messages. Future research should investigate whether cues that might facilitate social presence (e.g., a more human-like voice) also contribute to higher intentions to continue sexualized interactions with artificial entities. This would be in line with the SIIM which postulates that impressions of artificiality might negatively affect arousal and therefore the intention to engage in a sexualized interaction with an artificial entity (Szczuka et al., 2019).

The results concerning the predictors of interest in further messages from the voice assistant were less clear. Not only was the explanatory power of the regression models lower, but the coefficient analysis also revealed no significant predictors. One

variable which still should be discussed as a variable which marginally reached level of significance is experiences with sexual online activities. Even though respondents in the voice assistant condition listened to more messages, the included variables do not seem to sufficiently depict the interest in these. This is especially interesting as interest in the technology was included in the calculation which would have been a plausible predictor considering people's interest in testing artificial interaction partners in social interaction settings (e.g., Kopp et al., 2005). Not only does it reflect on the online experiences people have had with sexual activities but, on another level, how experienced people are with sexualized activities that include an unknown, physically absent counterpart (including the less interactive and personalized medium of pornography but also more interactive and personal forms like webcam sex, compare Shaughnessy et al., 2011; Castro-Calvo et al., 2018). It is therefore plausible that more experienced people in this format have less restrictions to engage in flirtatious messages sent by a computer-mediated human or a voice assistant. In line with the SIIM, this would support the idea that conflicting social and sexual norms can counteract sexual arousal in interactions with artificial entities as people who have engaged in sexual online activities may have a different mindset toward digitalized sexuality.

Intriguingly, the mere interest in and affinity for technology is not sufficient for intimate interactions with or through it. This brings up the discussion about the lack of predictive power for hearing more messages regarding attractiveness, perception of flirtatiousness and interest in the content of the messages. All of the above could have positively affected the arousal and therefore interest in the intention to continue a sexualized interaction according to the sexual script theory (Simon and Gagnon, 1986) and SIIM (Szczyka et al., 2019). It is imaginable that these variables are less important in a voice only setting compared to, for instance, graphical content. Here, users also had the chance to visualize an attractive person, which then could have contributed to the interest in further messages. This aspect was, however, not included in the present study and more research is needed to understand the importance of fantasy and uncertainty reduction in the context of digitalized sexuality. What was also striking was the missing effect of sexual satisfaction. This, though, is a comparable result to a study by Szczyka and Krämer (2017) who found that a person's loneliness (which is likely to correlate with sexual dissatisfaction) does not automatically positively affect their attractiveness rating of sexualized robots. Needs of humans can therefore not automatically be addressed by digitalized sexuality. More importantly, there are other influencing factors (such as social presence) that explain people's interest in a flirtatious interaction with or through media.

Lastly, privacy concerns did not function as a (negative) predictor either, which was especially likely in the voice assistant condition. As already discussed, claiming that the voice assistant was built for a university research project could have contributed to this as well as the fact that the participants were not asked to reply to the voice messages. More research is needed to understand the role of privacy concerns in digitalized sexuality.

Predictors of the Communication Partner's Sexual Attractiveness (RQ3c and RQ3d)

In contrast to the interest to hear more messages, the results of the regression concerning the communication partner's perceived sexual attractiveness showed a more consistent pattern. The models containing the personal characteristics and the evaluations of the communication partner explained 67% of the variance in the attractiveness ratings for both, the computer-mediated human and the voice assistant. In both cases, the coefficient analysis revealed that social presence was the most important significant predictor, followed by the impression that the communication partner was flirting with one. The result demonstrating that the perception of flirtatiousness also explains variance in both cases points out that the illusion of reciprocal exchange and the users feeling of "being addressed" may play an important role for digitalized sexuality, no matter if the impression is conveyed by a computer-mediated human or an artificial entity. Because flirtatious communication usually occurs among humans who are interested in each other, it is plausible that, comparable to this, respondents perceived the communication partner as more attractive if the feeling was "mutual," i.e., if the respondents also served as an "object of desire." This underlines that artificial interaction partners not only need to convey the illusion of own sexual needs but also need to incorporate dyadic interactions that allow the users to feel addressed. It is interesting that these social aspects, which are based on social behaviors among humans, served as predictors for sexual attractiveness instead of, e.g., the interest in the content of the messages, which underlines the importance of a social connection between the user and the interaction partner. The result moreover implies that the predictors which explain attractiveness ratings between humans can be transferred to artificial communication partner, even though the computer-mediated human was perceived to be significantly more attractive than the voice assistant.

The only difference in the regression analyses was that age served as an additional, positive predictor for the attractiveness evaluation of the computer-mediated human. Older participants might have felt flattered by the computer-mediated human who was spoken by a female who was younger than the mean participant, which resulted in higher attractiveness ratings (compare Hall, 1993). The importance of age is rooted in an evolutionary psychological mechanism which represents the other explanation. Feinberg et al. (2008) demonstrated that high pitched voices, which is an indicator for younger age and fertility, were related to attractiveness ratings. The role of authentic cues and evolutionary psychologically rooted mating mechanisms in digitalized sexuality was already discussed in a work by Szczyka and Krämer (2019), and since age did not serve as a predictor for the attractiveness ratings for the voice assistant, this should be emphasized in future studies.

Limitations and Future Research

Because of the coronavirus pandemic, the study needed to be conducted online which came with two bigger limitations. First, future studies should rely on sexually explicit material to

elicit sexual arousal. Especially because internet pornography had a huge impact on how people assess sexually explicit content, studies that aim to investigate the effects of sexual arousal should rely on comparable stimulus material shown to evoke sexual arousal (e.g., Brand et al., 2011). Secondly, it would be fruitful to investigate how participants reacted if confronted with the actual devices of the voice assistant or the computer-mediated human. In this case, it would have also been possible to investigate whether and if, how participants would have replied.

Especially because empirical research on digitalized sexuality is scarce (compare, e.g., Döring et al., 2020, on sexualized robots), the present study aims to inspire future research questions. The results underlining the importance of social presence and the experiences with online sexual activities shed a light on variables in the context of digitalized sexuality which should be included in future studies. Because social presence was higher for the computer-mediated human and connected to both, interest in further messages and attractiveness ratings, the study provides further evidence that human-like cues could be important in digitalized sexuality. However, too much human-likeness can also be harmful for the perception of artificial entities (compare uncanny valley theory). More research is needed to understand which cues can positively affect the perception of artificial entities in sexualized interactions.

Moreover, the study is the first of its kind to center on voice in the context of digitalized sexuality. Because auditive signals can facilitate sexual fantasies it would be interesting to gain more knowledge about how artificial voices may trigger processes of imagination in which the communication partner is artificial or human. This may also be helpful to get a better understanding of whether sexualized interactions with artificial entities are accepted (Compare SIIM; Szczuka et al., 2019) or whether people rather imagine interactions with interaction partners they are familiar with and which belong to their own species.

It also needs to be mentioned that the included dependent variables predominantly failed to reach the criterion of normality. As already mentioned within the results section, literature (Field, 2013) suggests that the used analyses methods are robust against violations of the criterion of normality, especially because the used sample groups are equally distributed and large enough. It, however, needs to be kept in mind when discussing the results. The fact that the evaluation of the non-human and human speakers' sexual attractiveness was normally distributed is in favor of consistent data. However, the analyses of the histograms demonstrated that variables such as privacy concerns and the evaluated flirtatiousness of the source showed clear tendencies to one side. As in every study in the field of digitalized sexuality it needs to be questioned, whether there might be ceiling effects of social desirability. However, more research is needed to understand whether this is an effect associated with the topic of sexualized messages that are perceived from technological devices.

Lastly, the study raised numerous questions that could be addressed in follow up studies. First and foremost, there are different sample groups that should be considered in future studies, including humans of different gender and sexuality.

Especially because erotic audio stimuli seem to be particularly interesting for female users (compare e.g., Cookney, 2020; Dipsea, 2021; Femtasy, 2021) while empirical research found no consent to how female and male differ in their reactions toward auditive erotic content (compare Chivers et al., 2010) more research (also with an emphasis on the stimuli's ontological class) can help getting a better understanding on gender specific connections between cognitive mechanisms and arousal, in combination with the question of potential differences in reactions to artificial stimuli.

CONCLUSION

With the rise of possibilities to interact with artificial entities *via* voice, the question arises whether this technology might also be used for sexual gratification. The goal was to get a better understanding of whether humans can be drawn to voice-based artificial entities and of what importance human cues are in voice-based digitalized sexuality. Therefore, this study investigated whether the perception of a communication partners sexual attractiveness and the interest to hear more flirtatious messages are affected by the ontological class of the communication partner (computer-mediated human vs. voice assistant) and whether these effects are influenced by the respondent's sexual arousal. Within the present setting, sexual arousal was not prevailing while the communication partner's ontological class had numerous effects. The computer-mediated human evoked higher levels of sexual attractiveness, social presence, and flirtatiousness, while the voice assistant evoked more interest in the technology and the desire to hear more messages. Taken together, the results introduce social presence and the importance of dyadic interest (perceived flirtatiousness) as important to the context of digitalized sexuality. Referencing this paper's title, data demonstrates that flirting with another human *through* media allows one to form a stronger social connection to the communication partner (in terms of presence and flirtatiousness) which again underlines that humans, in comparison to artificial entities, represent a gold standard of sexuality.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: https://osf.io/df79m/?view_only=356d50cbf6944ae8bf6382b0532bb33a.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the Division of Computer Science and Applied Cognitive Sciences at the Faculty of Engineering of the University of Duisburg-Essen. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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Is Dating Behavior in Digital Contexts Driven by Evolutionary Programs? A Selective Review

Jorge Ponseti*, Katharina Diehl and Aglaja Valentina Stirn

Institute of Sexual Medicine and Forensic Psychiatry, Medical School, Kiel University, Kiel, Germany

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Matthias Brand,
University of Duisburg-Essen,
Germany

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Herman Hay-ming Lo,
Hong Kong Polytechnic University,
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Nicole Krämer,
University of Duisburg-Essen,
Germany

*Correspondence:

Jorge Ponseti
jorge.ponseti@uksh.de

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In recent years, millions of citizens all over the world have used digital dating services. It remains unknown to what extent human sexuality will be changed by this. Based on an evolutionary psychological perspective, we assume that sexual selection shaped behavioural tendencies in men and women that are designed to increase the reproductive fitness. These tendencies are referred to as sexual strategies. Males and females sexual strategies differ according to sex-dimorphic reproductive investments. We assume that this inheritance will affect human sexuality also in a digital future. To evaluate this assumption, we conducted a selective review of studies on digital dating services. Based on sexual selection theory, we derived a number of hypotheses regarding how men and women will use digital dating services typically and how the use of digital dating services might affect sexual wellbeing. Out of an initial data set of 2,568 records, we finally reviewed a set of 13 studies. These studies provided support for the notion that men and women act in the digital dating area according to sex-typical strategies. However, sometimes the circumstances of digital dating affect communication flow, e.g., in that men are even more active in establishing contacts than they are in real world conditions. Overall, women appear to accomplish their sexual goals in digital dating arenas more than men do given a surplus of male demand. Our results suggest that future human sexuality will be impacted by an interaction of both: sex-dimorphic ancient sexual strategies and new technologies.

Keywords: sexual strategies, evolutionary psychology, dating platforms, dating apps, sexual selection, digital sexual services

INTRODUCTION

Digital applications have widely influenced everyday life in most human societies. Moreover, there is good reason to assume that this holds true for the sexual life histories of many citizens in modern societies as well. For example, dating platforms have millions of users. Thirty percent of German adults have used a digital dating service at some point (Statistica, 2020). About 41% of adults in Germany have used digital services to send erotic images of themselves (Döring and Mohseni, 2018). Twelve per cent of all Internet calls in Germany are searches for adult content (Arthur, 2013). In other countries, such as the United States, 46% of singles used online dating to find a new

partner, and 1/3 of all couples who married between 2005 and 2012 in the United States met online (Jung et al., 2019).

It is possible that online sexual activities diverge from offline sexual behaviour. Dating platforms offer highly differentiated services addressing a growing variety of sexual contacts. People engage in long-distance sexual activities like cybersex via webcam, chatting with sex bots or interacting with sex robots. The division between porn users and porn producers has also vanished since platforms that broadcast users' own sexual activities are provided. In light of these new developments, one might argue that digital sexual services will change human sexuality in the future. Some observations, however, call this assumption into question. In modern gender-equal societies, gender-stereotyped personality traits and gender-stereotyped job careers are more frequent in comparison to more traditional gender unequal societies (Stoet and Geary, 2018; Mac Giolla and Kajonius, 2019). These findings suggest that people actualise personality traits that are shaped by evolutionary selection when culture allows them to freely develop their personal aptitudes and personality. With respect to digital sexual services, we therefore expect that men and women use digital dating tools according to gender dimorphic sexual strategies.

In the following, first we will outline some basic ideas of sexual selection theory (Andersson, 2019), and second we will derive hypotheses of how ancient sexual strategies might affect the use of digital sexual services today.

Sexual selection, as one specific case of natural selection, operates on variance in reproductive success. If individuals differ in mating success, traits that aid their reproductive success will find their way to subsequent generations more frequently. Hence, adaptations will follow sexual selection. Traits that aid reproductive success differ between the sexes. Given that the more investing sex, i.e., females in mammals, needs more time for any reproductive act (because of gestation and lactation), sexually receptive females become scarce relative to males. Because of female scarcity, males more than females are selected for their ability of effectively compete for mates. In consequence, in males variability in reproductive success is higher than in females, not only in mammals (Brown et al., 2009; Boyd and Silk, 2020, p. 147) but also in insects (Bateman, 1948). Therefore, sexual selection operates more on males than on females. As sexual selection pressure operates differently between the sexes, the resulting adaptations – in anatomy and behaviour – are sex dimorphic. Traits that help males to increase the number of mates will be favoured by selection. Females in contrast can easily approach the maximum reproductive capacity of their sex (about 15 children in women and many thousands in men), which leads to a lower variability in the number of offspring within the female sex. However, there is more within-sex variability in how many offspring survive. Females cannot increase their reproductive fitness by increasing the number of mates but by increasing the quality of their mates (either in terms of their “genetic quality” and/or in terms of the resources males are able and willing to invest in their partner and offspring). Sexual selection theory predicts choosiness as a typical sexual strategy of females and strategies to increase the number of mates as a typical sexual strategy of males (i.e., stronger competition for mates,

monopolisation of females, preference for young and sexually attractive females, interest in casual sex, short-term mating and sex with low investment). Males can increase their reproductive success not only by mating with numerous females but also by mating with females with a high reproductive capacity, namely young and attractive females.

Numerous studies across various cultures have provided empirical support for the assumption that sexual strategies of men and women follow the predictions of sexual selection theory. Women show a higher preference than men for mates who possess resources and are willing and interested in investing in children; men, in contrast, show a higher preference than women for physically attractive and young mates (Kenrick et al., 1994; Li et al., 2002; Brase, 2006; Roney et al., 2006; Buss and Shackelford, 2008; Conroy-Beam et al., 2015). Same sex competition usually occurs along those dimensions that are sexually preferred by the opposite sex. This allows individuals that own much of the sexually preferred cues to be more choosy and do gain more easily their sexual goals. Hi attractive women were found to be particularly choosy (Buss and Shackelford, 2008) and high status men look more for younger mates than lower status men do (Grammer, 1992). Given that a high number of sexual mates is associated with fitness gains in males more than in females, women are less prone to engage in short-term sex than men are (Clark and Hatfield, 1989; Schmitt, 2005; Voracek et al., 2005; Gueguen, 2011). If women engage in short-term sex, they are particularly attracted by cues of masculinity (i.e., cues for “good genes”) like tallness, physical strength and deep voice pitch (Puts, 2005; Roney et al., 2006). Women are more motivated to engage in short-term sex when there is a possibility to take fitness benefits out of these “good genes,” i.e., when they are in the ovulatory phase of the menstrual cycle (Baker and Bellis, 1995; Pillsworth and Haselton, 2006).

In natural environments, the operational sex ratio (i.e., the number of males relative to the number of females in a given mating area) influences the sexual strategies of males and females. If there is a surplus of females, sexual competence between women increases and women tend to lower the preconditions for sex. Women engage more in short-term sex when there is a surplus of women – sex becomes cheap. In the opposite case, women's willingness to engage in short-term sex decreases (Barber, 2000; Schmitt, 2005). The impact of the operational sex ratio in how men and women pursue their sexual strategies illustrates the interaction between evolved behavioural tendencies and environmental circumstances. We assume that this interactive mechanism will also affect mating behaviour in digital sexual contexts. Given that there is a variety of digital dating services – some of them advertise rather casual sex, others advertise high quality mates and long-term commitment – possibilities to gain sexual goals for men and women will depend on these factors as well. However, in general we assume that the enhanced interest in many sexual mates in men will put women in digital mating markets in a more powerful position compared to men. In natural dating environments it was found that women send inconspicuously cues to men thereby controlling the “first step” of men's courtship

behaviour (Moore and Butler, 1989). In the absence of female non-verbal steering in online dating markets, we assume that a prevalence of male initiative will be more pronounced in online dating markets than in natural environments. This is also in accordance with notions of many of our students and patients: typically, men lament that their request were rarely responded while women complain about being overwhelmed by request, even without having a portrait of themselves in their account. If such a surplus of male demand is given, this will allow women to control the interaction with their male counterparts more according to their own needs. Therefore, we expect women to be more self-centred and self-oriented when communicating with men in online dating platforms. Furthermore, a surplus of male demand will also allow older women (that are less attractive to males in natural dating environments) to improve their dating chances.

Given the absence of some natural restraints in digital encounters (thereby allowing users to interact simultaneously and anonymously with multiple potential mates) we furthermore expect that using digital dating tools can lead to an amplification of sexual benefits as well as harm. Possible benefits might be an increased probability of finding a good mate in consequence of having access to a wider mating pool. Psychological harm can be the result of sexual conflicts. In evolutionary psychology sexual conflicts refer to those instances in which one individual tries to realise its sexual strategies (i.e., maximise its fitness) at the cost of its partners sexual strategies (respectively the partners fitness) (Buss, 1989a). There are numerous examples of how sexual strategies can interfere when men and women interact: ranging from deception about emotional commitment, deception about sexual fidelity, deception about willingness or ability to provide resources, deception about attractiveness, deception about fatherhood, or strategies to circumvent female choosiness by use of coercion. In natural environments, men and women have evolved contra strategies to protect against the harmful consequences of sexual conflicts. Sometimes women delay first intercourse in order to protect themselves against males that pursue only short-term sex and women developed a commitment scepticism bias. Males developed a sexual over-perception bias in order not to lose any single sexual opportunity. Both sexes have strategies to protect against sexual competition and infidelity (see for references Buss, 2008 p. 322–354). While these strategies often are successful in natural environments, we assume that in anonymous digital contexts deception of a possible mate – wherever in which aspect – is harder to detect given the absence of a common social field (no common friends, sometimes no face-to-face interactions). Digital “beauty-filters” are popular software applications in modern mobiles designed to increase the physical attractiveness in just a few instances. By using these applications, people try to deceive a possible mate about one’s own genetic fitness. Sometimes people even use images of other persons.

In detail we hypothesise that *female mating preferences* will shape the online mating market as follows: (i) a high level of education will be demanded more in men than it is in women; (ii) if there are men of different races, white men will be more eligible than males of colour; (iii) high-status men will look for younger women more than lower status men do; and finally; (iv) men will

show in their personal ads more signs of physical strength than women do. *Men’s mating preferences* for numerous, young and physically attractive women will shape the online mating market as follows; (v) men will use dating platforms, hoping to extend the number of sexual partners, more than women do; and (vi) being of an older age is for women less favourable than for men.

The *interaction of male and female sexual strategies* will have the following consequences in the online dating market; (vii) women will receive more requests than men do, and (viii) will receive more responses to their own requests than men do; (ix) women will be more self-centred in their profiles and communication than men; (x) highly attractive women will give fewer responses to requests than less attractive women; (xi) compared to men, older women will use dating services more frequently than younger women do.

With respect to *increased sexual wellbeing*, we expect that; (xii) couples who meet in online settings will be more satisfied with their relationship than offline couples are (given the higher number of choices). With respect to *sexual conflicts and risks* to sexual wellbeing, we expect that; (xiii) women to be more frequently subjected to sexual deception because men are expected to display more emotional commitment than they actually feel (and a less possibilities for women to detect deception). We furthermore expect that; (xiv) using digital sexual dating services can be associated with or driven by psychological problems, such as feelings of loneliness or low self-esteem and finally; and (xv) that people who use online dating services show risky sexual behaviour more than others, e.g., unprotected sex.

To evaluate these hypotheses, we conducted a selective review of recent studies on digital sexual dating services.

METHODS

We first conducted an extensive literature research. We performed the literature research using the PubMed database. Given that online dating services constitute a rapidly changing market, we limited our literature research to studies with a publication year from 2015 to 2021. The search was restricted to publications written either in English or German. We used the following search terms: online dating (525 hits); infidelity, online (24 hits); sexual risk behaviour, online dating (51 hits); dating applications (1,058 hits); relationship, satisfaction, and online (910 hits). Our search string was as follows: Online Dating OR (Infidelity AND online) OR (sexual risk behaviour AND online Dating) OR Dating applications OR (Relationship AND satisfaction AND online). Every string was searched alone, there were 7 duplicates. In total, we found 2,568 publications in this initial step.

Using several additional selection procedures and excluding criteria, we consecutively reduced the sample (**Figure 1**). First, studies with titles that did not match the topic of the current study were excluded. Duplicates were eliminated. We furthermore excluded studies with clinical samples, non-representative samples and samples with probands from the LGBTQIA* Community. Studies with clinical and non-representative samples had to be excluded to ensure a

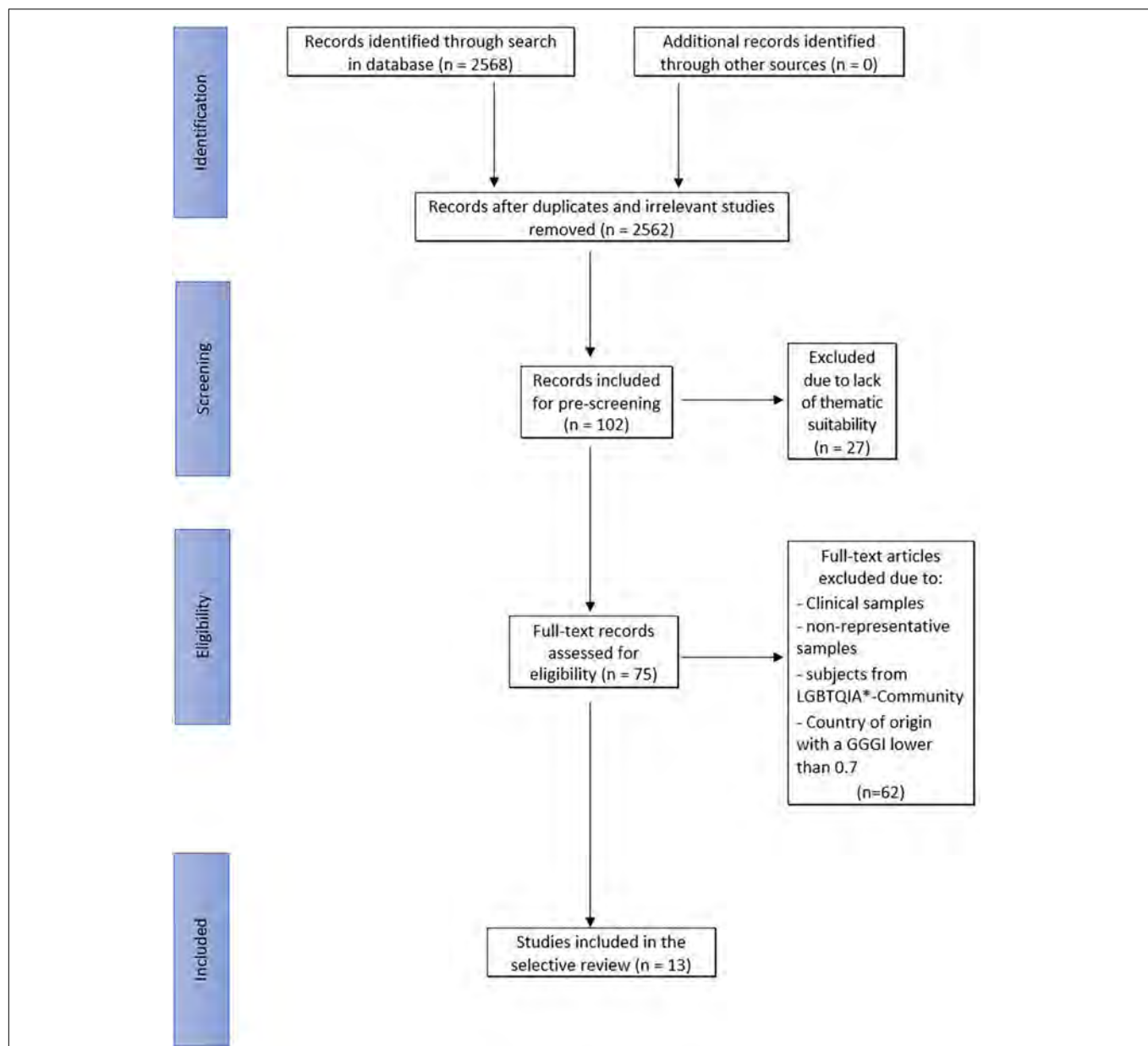


FIGURE 1 | Flow diagram of the selective review according to Page et al. (2021).

generalisation regarding the healthy population of the respective state as far as possible. Sexual selection theory provides no assumptions regarding sexual minorities, like members of the LGBTQIA* community. We therefore excluded studies with these samples. Furthermore, we excluded studies that were published in a country with a global gender gap index (GGGI) under 0.7 (Schwab et al., 2019) from this selective review. For this cut-off value we took the GGGI of Western Europe (0.767) and North America (0.729) into consideration (Schwab et al., 2019). Given the prior assumption that gender inequality restricts “free” dating behaviour (i.e., less driven by society’s constraints), we used this cut-off value to focus our review

on samples from a more liberal dating culture. However, generalisability of our review is thereby limited to the more individualistic cultures of the Western world. On the other hand, this restriction increases comparability between studies included in the review.

Given that our review is focussed on sexual strategies in online dating, articles dealing with sexuality in the context of social media (Instagram, for example) were excluded. Although social media use in many cases leads to sexual interactions, social media are first designed for other purposes, making it more complicated to study sexual strategies in this area. Furthermore, articles that focussed on only one aspect of online dating (like alcohol

abuse) were excluded as well. Furthermore, we were forced to exclude some articles because they were not available online. After applying these selection procedures, 13 articles remained. In a second step, we then reviewed the remaining 13 studies according to our study hypotheses.

RESULTS

All the studies included in the review were exclusively cross-sectional studies. In the following, we report the findings of the reviewed studies with respect to the hypotheses as stated in the introduction (see also **Table 1**).

Findings related to *female mating preferences*:

(i) *A high level of education will be demanded more in men than it is in women.* Applying a detailed network analysis of messaging patterns and demographic variables in a data set of a huge dating platform, Bruch and Newman (2018) found that a high level of education is demanded more in men than it is in women.

(ii) *If there are men of different races, white men will be more eligible than males of colour.* In the same study (Bruch and Newman, 2018), it was found that white men are more eligible than black men.

(iii) *High-status men will look for younger women more than lower status men do.* In a subsequent analysis, the same authors (Bruch and Newman, 2019) found that high-status men look for younger women more than lower status men do.

(iv) *Men will show in their personal ads more signs of physical strength than women do.* One study analysed more than 900 self-portraits ("selfies") that male and female Tinder users chose for their personal profiles (Sedgewick et al., 2017). Basically, they analysed whether males and females differ in the way they orient selfies to manipulate how they want to be perceived by the opposite sex. They found that males more often orient their selfies from below presumable to appear taller and more powerful than the viewer, whereas women were found to orient their selfies more often from an above perspective putative to appear shorter and to flatter the figure. Men manipulate the perspective of the viewer (from below) more often than women (from above), indicating that men guided their self-portrayal more according to female preferences than vice versa.

Findings related to *men's mating preferences*:

(v) *Men will use dating platforms, hoping to extend the number of sexual partners, more than women do.* By means of an online survey with more than 700 participants, it was found that men use dating platforms, hoping to extend the number of sex partners, more than women do; however, they do not succeed in this as much as they expected to Harris and Aboujaoude (2016). Moreover, Martins et al. (2016) found that men more than women use online dating platforms for extradyadic sex.

(vi) *Being of an older age is for women less favourable than for men.* The above-cited network analysis of messaging patterns

revealed in addition that being older is for women less favourable than for men (Bruch and Newman, 2018).

Findings related to *interaction of male and female sexual strategies*:

(vii) *Women will receive more requests than men do.* Two studies that analysed online communication patterns in huge samples reported that women receive more requests than men do (Harris and Aboujaoude, 2016; Bruch and Newman, 2018). In particular, Bruch and Newman (2018) found that more than 80% of first messages were sent from men.

(viii) *Women will receive more responses to their own requests than men do.* This was also reported by the study of Bruch and Newman (2018).

(ix) *Women will be more self-centred in their profiles and communication than men.* The study of Davis and Fingerman analysed 4,000 profiles of two popular websites by means of a linguistic inquiry and word count software. The authors found that women are more self-centred in their profiles than men are (Davis and Fingerman, 2016).

(x) *Highly attractive women will give fewer responses to requests than less attractive women do.* Bruch and Newman (2018) calculated desirability (so called page rank) of individual users in their huge sample and found that highly attractive women respond less often than less attractive women do.

(xi) *Compared to men, older women will use dating services more frequently than younger women do.* Bruch and Newman found in their subsequent analysis that in younger people, more men than women use online dating services; however, in older people this difference decreases (Bruch and Newman, 2019).

Findings related to *sexual wellbeing*:

(xii) *Couples who meet in online settings will be more satisfied with their relationship than offline couples are.* Contrary to our hypothesis Potarca (2021) found in a sample of more than 3,000 partnered individuals (based on an extensive inquiry among the general population of Switzerland) "no differences between couples initiated through dating apps and those initiated elsewhere regarding relationship and life satisfaction."

(xiii) *Women are more frequently subjected to sexual deception than men are.* Similarly, we did not find evidence that women are more at risk of being sexually cheated than men are in digital contexts as revealed by an online survey with more than 600 individuals (Navarro et al., 2020).

(xiv) *Using digital sexual dating services can be associated with or driven by psychological problems, such as feelings of loneliness or low self-esteem.* Performing an online survey on more than 1,000 Tinder users, one study reported a "high level of problematic use" in nearly 1/3 of the sample. In these individuals, using sexual dating services is associated with psychological problems, such as feelings of loneliness or low self-esteem in some cases (Rochat et al., 2019).

(xv) *Users of online dating services show risky sexual behaviour more than others.* There is conflicting evidence concerning whether people who use online dating services show risky

TABLE 1 | Studies included in the selective review.

Authors	Title	Study design	Sample size	Measurements	Main results
Harris and Aboujaoude (2016)	Online friendship, romance and sex: properties and associations of the online relationship initiation scale	Cross-sectional design	713 subjects	Online relationship initiations scale (ORIS)	Men report that they have failed to establish as many romances and sexual relationships as they had expected; people with problems in the offline social context benefit from online services
Lee et al. (2019)	Effects of self- and partner's online disclosure on relationship intimacy and satisfaction	Cross-sectional design	189 subjects	Online self-disclosure scale, self-report measure and perceived relationship quality components; social media profiles	Greater online disclosure was associated with lower intimacy and relationship satisfaction. Offline disclosure is associated with the contrary.
Martins et al. (2016)	Infidelity in dating relationships: gender-specific correlates of face-to-face and online extradyadic involvement	Cross-sectional study	783 subjects	Questionnaire regarding social demographics and information about relationships, Extradyadic Behaviors Inventory (EBI), Attitudes toward infidelity scale und Investment model scale	Different factors such as previous infidelity, dissatisfaction in the current relationship, positive attitudes toward infidelity and high quality of alternatives (exclusively in women) are associated with emotional and sexual EDI online.
Navarro et al. (2020)	Psychological correlates of ghosting and breadcrumbing experiences: A preliminary study among adults	Cross-sectional study	626 subjects	Self-report questionnaire	People who experienced breadcrumbing or combined forms reported less life satisfaction, more helplessness & self-perceived loneliness. Regression model shows that experiencing breadcrumbing significantly increases the likelihood of experiencing less satisfaction in life and of feeling lonelier and more helpless. No significant relation was found between ghosting and any of the given psychological correlates.
Potarca (2021)	The demography of swiping right. An overview of couples who met through dating apps in Switzerland	Cross-sectional study	3245 subjects	Questionnaire	Online couples have a stronger need to move in together; women who met their partner online have a stronger desire to have a child in the next 3 years compared to women who met their partner offline; online couples who do not live together are significantly more satisfied than offline couples who do not live together; exogamy is more likely among dating app users in terms of education level; online couples travel significantly more distance to see each other.
Rochat et al. (2019)	The psychology of "swiping": A cluster analysis of the mobile dating app Tinder	Cross-sectional design	1159 Tinder users	Problematic Tinder Use Scale (PTUS), Questionnaire assessing the pattern of Tinder Use, Short Happiness und Depression Scale (SDHS), Cybersex Motives Questionnaire (CMQ), Sexual Desire Inventory (SDI), Experiences in Close Relationships- Revised (ECR-R), Short UPPS-P Impulsivity Behavior Scale, Single-Item Self-Esteem Scale (SISE)	Identified were the following four reliable clusters: Regulated, regulated with sexual desire (both low level of problematic use), unregulated-avoidants (intermediate problematic use), unregulated-highly motivated (high level of problematic use). Differences regarding gender, marital status, depressive mood and use patterns between the clusters.
Sedgewick et al. (2017)	Presenting your best self(ie): the influence of gender on vertical orientation of selfies on Tinder	Cross-sectional study	665 Tinder profile pictures	Objective rater estimated the vertical orientation of profile pictures, analysis via Welch's ANOVA	Men are taking pictures more likely from below, women more likely from above.

(Continued)

TABLE 1 | Continued

Authors	Title	Study design	Sample size	Measurements	Main results
Tsai et al. (2019)	Is online partner-seeking associated with increased risk of condomless sex and sexually transmitted infections among individuals who engage in heterosexual sex? A systematic narrative review	Systematic narrative review	25 Studies	Review using Google Scholar, PubMed, PsycInfo, Web of Science und Ovid Medline	58% of the studies show that online dating is associated with condomless sex or inconsistent condom use. 16% show that online dating is a protective factor. A 50% of the studies found no association between online dating and positive STI status, 36% found a positive association, 7% showed a negative association and 7% showed no clear results.
Whyte et al. (2018)	Do men and women know what they want? Sex differences in online dater's educational preferences	Cross-sectional study	41.936 RSVP Accounts from which data were collected		Women were more likely to have specified education level as desirable in a potential partner; women show higher minimum standards for education compared to men.
Bruch and Newman (2019)	Structure of online dating markets in United States cities	Quantitative study	Dating website with more than 4 Mio. active users	Network analysis (Newman, 2018). Community detection (Fortunato, 2010)	Women respond to messages from men at a lower rate; women receive more responses from men when they contact men in older submarkets
Bruch and Newman (2018)	Aspirational pursuit of mates in online dating markets	Quantitative study	No details given	Estimation of "desirability" via communication patterns	Women are receiving more messages; desirability varies depending on age (stronger in women); education is more strongly associated with desirability in men; men responding to a women's message is more likely than vice versa
Coor et al. (2019)	Sexually transmitted disease, human immunodeficiency virus and pregnancy testing behaviors among internet and mobile dating application users and nonusers	Cross-sectional study	Data from two market research datasets	Self-reports of the participants from the market research data sets	Higher rates of HIV and STD testing among users. Among 18–24 year olds, testing is significantly lower than among non-users; dating app users are more likely to have taken pregnancy tests in the last year.
Davis and Fingerman (2016)	Digital dating: online profile content of older and younger adults	Cross-sectional study	4000 online dating profiles	Quantitative content analysis of online dating profiles using LIWC software	Younger people are more likely to use 1st pers. singular pronouns and words from the categories: work, achievements, and negative emotion; men are more likely to use 1st pers. plural pronouns and words from the category work.

sexual behaviour more than others. Whereas Harris and Aboujaoude (2016) found a willingness to engage in infidelity or unprotected sex more in online dating users

(particularly in men) than in controls, Tsai et al. (2019) in their systematic review of 25 studies found no systematic association between condom use, sexually transmitted disease and engagement in online digital dating services.

DISCUSSION

This selective review evaluated a total of 13 cross-sectional studies on digital dating services. Evolutionary psychological reasoning and some hypotheses, which we drew from this, drove our analysis. Taken together, our selective review supports the notion that human sexuality is not going to change fundamentally on account of the rising popularity of digital dating services. The hypotheses that led our review covered four broader topics: (a) female mating preferences, (b) male mating preferences, (c) interactions between male and female mating preferences and finally, and (d) sexual wellbeing. The reviewed studies provided supporting evidence particular to hypotheses regarding mating preferences (a–c), which were derived from evolutionary psychological reasoning. Our hypotheses regarding sexual wellbeing received only partial support.

Female Mating Preferences

Some of the reviewed studies provided findings that are in accord with evolutionary psychological reasoning. These studies report that women in the digital mating market appreciate men of higher education and of white colour. Both attributes are associated with higher socio-economic status in many countries. High-status men in turn look for younger women, as one study reported. This indicates that high-status men in digital mating markets are aware of female mating preferences. Both findings (preference for high-status males and pursuit of younger women by high-status men) have previously been found in non-digital mating markets (Buss, 1989b; Grammer, 1992; Buss and Shackelford, 2008; Iredale et al., 2008; Vohs et al., 2014; Ponseti et al., 2018). One of the reviewed studies concluded that men try to look taller and more powerful as they orient their selfies more often from below (Sedgewick et al., 2017). In fact, women prefer males who are physically more powerful and taller (particularly in a short-term mating context). Again, this has been found already in the non-digital mating market before (Frederick and Haselton, 2007). Obviously, men act according to female preferences for physical dominance and display as much as possible of this trait. This in turn is sexually rewarded: physically powerful men report more sexual partners than less powerful men do (Frederick and Haselton, 2007).

We assume that female mating preferences (like male mating preferences as well) are shaped by sexual selection and modulated by culture and actual conditions of the mating market (in terms of demand and supply). The findings discussed so far indicate that humans act according to female mating preferences

in (sometimes anonymous) digital dating arenas more or less similar to real-world encounters.

Male Mating Preferences

According to sexual selection theory, males have more fitness benefits from having numerous sexual partners than females do. Therefore, males are predicted to pursue more sexual partners than females. In humans, this is particularly evident when looking at gender differences regarding interest in short-term sex (Clark and Hatfield, 1989; Voracek et al., 2005; Gueguen, 2011). This has been found outside the digital market area previously and appears to be true in the digital dating market in the same manner (Harris and Aboujaoude, 2016; Martins et al., 2016). Male fitness benefits from high numbers of sex partners and from having young sex partners given that the reproductive capacity of a young female is higher than that of an older female. Therefore, men appreciate youthfulness in their female partners much more than vice versa (Buss, 2008, S. 114). Again, what has been found in real-world mating with respect to male mating preferences is mirrored in the digital mating market (Bruch and Newman, 2018).

Interaction of Male and Female Sexual Strategies

A striking gender difference was reported by the study of Bruch and Newman in that 80% of first messages were sent by men (Bruch and Newman, 2018). Given that in the study of Bruch and Newman the numbers of male and female participants were roughly similar, the reported difference cannot be due to a limited female supply. It rather suggests that males are much more active, if not impatient, in establishing contacts. This male over-activity might be the result of both, (i) the possibility to anonymously interact with several women at the same time (driven by the strategy to find as many mates as possible and the lack of social control) and (ii) the lack of concealed signals from women that help men to focus on those mates with prospect of success. Male over-activity in turn puts females in a more comfortable position, allowing them to define the rules of the game more according to their own needs. One possible consequence of this is that women are more self-centred in their profiles and communication (Davis and Fingerman, 2016). A pattern that is pronounced in high attractive women. These women respond even less to male requests than less attractive women (Bruch and Newman, 2018). These findings are in accord with sexual selection theory predicting the higher investing sex to be choosier and the lower investing sex to be more competitive in its efforts to sexually access the higher investing sex. We predicted the respective findings for the digital mating arena because similar observations have been made in real-world scenarios previously – and, of course, because of our overall hypothesis that important variances in human mating strategies have been shaped in ancient times. However, interactions between male and female mating strategies are complicated and require a closer look, even though the data of our selective review on this was scarce. In real-world scenarios, the supply of males is an importance factor that modulates the female inclination to

engage in short-term sex. If there are fewer males than females in a given mating market, females tend to be more willing to engage in short-term sex; “sex becomes cheap” (Barber, 2000; Schmitt, 2005; Xing et al., 2016). Conversely, “sex becomes expensive” when there is more male demand. Possibly, the observed self-centredness of women in digital dating markets is caused by the dynamic between supply and demand. As noted above, a surplus of male demand can be experienced in a mating market even if absolute numbers of males and females are equal simply because one sex is more impatient in its efforts to establish contacts.

However, it is not self-evident that a surplus of male demand in the digital (as well as in the real-world) market is only driven by male’s (ancient) strategy to find as quickly as possible as many mates as possible. In a seminal review, Baumeister and Twenge (2002) showed convincing evidence that women work together to restrict male’s sexual access to females (in order to get as much as possible in exchange for sex). One strategy is to hide, respectively, to obscure a female’s own sexual interest. Women are influenced by other women (mothers, sisters, girlfriends, etc.) which makes them feel uncomfortable when openly showing their own sexual needs. This cultural force, in addition to adaptations shaped by sexual selection and the specific conditions of anonymous digital dating, might be one further reason why 80% of first messages were sent by men.

Effects of Digital Dating Services on Sexual Wellbeing

Contrary to our expectations, we found no studies that reported high numbers of persons being victims of sexual deception (as described above). However, we found no study that investigated this topic from an evolutionary psychology viewpoint directly. Taken together, the reviewed studies provided mixed information about whether using digital dating services might lead to increased sexual wellbeing or not. In Tinder users, feelings of loneliness or low self-esteem were found quite often (Rochat et al., 2019); others reported a willingness to engage in infidelity or unprotected sex, particularly in male users of some other data bases (Harris and Aboujaoude, 2016); however, Tsai et al. (2019) found no evidence for this in their systematic review. Moreover, a systematic comparison of couples who have met online vs. offline based on a large representative sample reported no difference regarding the quality of the relationship. That is, differences concerning sexual wellbeing between the online and offline dating world might not be as big as they were sometimes assumed, maybe with the exception that some individuals with specific problems might be attracted by particular dating services. We propose that the specific interactions between personality characteristics and characteristics of certain dating services that may lead to problems of sexual wellbeing should be investigated in future research. It is possible that the benefits of digital dating services are underestimated as well. It was found that online couples are not better off than offline couples. However, it is possible that many people are in a stable relationship or experience sexual intimacy thanks to the use of digital dating.

General Limitations

The findings of this selective review are limited by the fact that the studies included in our review were not designed to test evolutionary psychological hypotheses. This has led to a type of methodological cherry-picking in the sense that we just looked at the reviewed studies for evidence that seemed to match with (or contradict) our expectations. One problem with this approach is that the samples of the reviewed studies were of quite different origins. Some studies were based on representative samples of the general population, whereas others focussed on particular individuals, e.g., Tinder users or individuals in committed relationships. Moreover, our review covers different types of dating services; some of them offer opportunities for short-term dating, whereas others focus on long-term dating. These aspects also influence the operational sex ratio. There is ample evidence in evolutionary psychology that people experience different sexual preferences and apply different strategies depending on whether they are looking for a short-term mate or a long-term mate and depending on whether there is a surplus of males or females in a given mating arena. This leads to some limitation in the reported findings given that our hypotheses were found to be proved sometimes in one sample type but not in another sample, and vice versa. In most cases this was influenced by the fact that not all studies we reviewed provided information regarding all our hypotheses.

Closing Remarks and Recommendation for Future Research

Digital sexual services go far beyond pure dating platforms: cybersex via webcam, chatting with sex bots, sex robots and self-broadcasted sexual content are recent developments in a fast-developing digital market. In the light of the findings reviewed here so far, we assume that these developments and future digital sex services will be driven by both, new technologies and ancient sexual strategies of men and women; however, it is hard to predict how both factors will interact in future. It should be subject of an ongoing research. To circumvent the limitations of the present selective review we recommend that future studies should directly test hypotheses that are derived from evolutionary psychology in samples that engage in different types of digital sexual services.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

JP, KD, and AS contributed to conception and design of the study and wrote sections of the manuscript. KD and JP organised the database. JP wrote the first draft of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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