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Are We Losing the Most Relevant Cases First? Selective Dropout in Two Longitudinal Studies of Adolescent Pornography Use

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Abstract

In longitudinal studies of pornography use, selective loss of participants who may be more vulnerable to the effects of pornography than their peers is a serious concern. To explore the potential for such selective dropout, we used data from two independent large-scale panel studies of adolescents' pornography use. Of the three types of attrition—early attrition, later attrition, and gaps in participation—only the first was substantially higher among more vulnerable adolescents, compared with other participants. Panel type (online vs. classroom-based) moderated only the association between vulnerability and participation gaps, which was significant in the classroom-based but not the online panel. Overall, this study's findings point to the importance of delaying selective dropout by developing a comprehensive plan of action, for which we offer some guidelines.

Keywords

Adolescents; pornography use; panel attrition; selective dropout; PROBIOPS

Introduction

Adolescents' access to internet pornography is of particular concern in the digital age. Some suggest that adolescent use of pornographic materials interferes with the development of positive subjective well-being, undermines healthy relationship formation, and contributes to sexual risk taking behavior, as well as sexual violence (Malamuth & Huppin, 2005; Owens et al., 2012; Wright, 2014). Others, however, have noted that research concerning adolescent pornography use is rich with inconsistent findings, methodological shortcomings, and political biases, making it difficult to draw firm conclusions about such effects (Štulhofer et al., in press). Research in this area is particularly hampered by a lack of experimental designs, because implementing such studies with adolescent samples would be unethical and illegal. For this reason, longitudinal research of pornography use is essential, as it has the potential to produce firmer evidence for plausible causal assertions of harm than is possible with cross-sectional designs alone.

When participants are asked to provide data over time, it is inevitable that some will dropout (i.e., fail to take part in all study waves). This can occur for a variety of reasons. Some participants withdraw from such studies between waves or fail to complete questionnaires when contacted; in more extreme cases, some participants die or become infirm (Young et al., 2006). In addition, researchers can have difficulty locating or contacting a subset of participants at follow-up waves (e.g., school drop-outs). Panel attrition can be problematic because it undermines statistical power but also because non-random participant loss challenges the internal and external validity of a study's findings (Cronbach et al., 1981; Hansen et al., 1985). Consequently, various aspects of attrition have been well documented. Extent of attrition, for example, can vary considerably from study to study, but the largest rate of attrition typically occurs in the first 6 months to 1 year of a panel design (Hansen et al.,

1990; Rothman, 2009). This suggests that certain aspects of study design play an important role in attrition (Groves & Peytcheva, 2008).

Beyond the extent of attrition, the key issue is whether or not participants who drop out of a study vary systematically from those that remain in the study, particularly with respect to the characteristics under investigation (Gustavson et al., 2012; Hansen et al., 1985). Past research has found that those that drop out tend to score lower in academic achievement and cognitive performance, and are more likely to be less educated (Fröjd, Kaltiala-Heino, & Marttunen, 2011; Gustavson et al., 2012; Rothman, 2009). They are also more likely to be unemployed and experience more income difficulties (Fröjd et al., 2011; Steer et al., 2009), more likely to smoke and consume alcohol (Hansen et al., 1985; Young et al., 2006), and more likely to exhibit poor mental health and/or problem behaviors (Steer et al., 2009; Young et al., 2006).

Attrition information is also available from recent studies of pornography use among adult though is most often limited to descriptions of follow-up response rates. Pornography research relying on three General Social Survey (GSS) panels, for example, has reported excellent two year retention rates ranging from 76%-78% (Perry & Schleifer, 2018). A six year response rate of 53% has also been reported in pornography research that relied on data from the Portraits of American Life Study (Emerson & Sikkink, 2006; Perry, 2017). However, detailed individual difference attrition analyses relevant to pornography use were not described in either of these reports. In one recent exception, Grubbs and colleagues (2018) reported a one year retention rate of 43% in a sample of first year undergraduate students, and a one month retention rate of 61% in a sample of Mechanical Turk workers. Further attrition analyses were limited to the sample of undergraduates, where no baseline differences in the study's focal variables (e.g., pornography use, perceived pornography addiction, and

religiousness) were found between participants that left and participants that remained in the study.

The case is similar with respect to attrition analyses described by longitudinal analysis of adolescent pornography use. Although such studies have reportedly lost between 5% and 46% of their participants to attrition (Peter & Valkenburg, 2016), systematic attrition analyses are often missing. An older study that focused on the link between male adolescents' sexual activity and testosterone found that participants with higher testosterone levels and those who were sexually active at baseline were less likely to participate in all study waves than their peers (Halpern et al., 1998). More recent and fragmentary evidence is inconsistent with respect to whether gender and age are related to attrition (Peter & Valkenburg, 2008; Vandenbosch, 2015). Little else is currently known about the characteristics of adolescents who are lost in research on pornography use—despite rapidly increasing scholarly interest in the subject (Koletić, 2017; Peter & Valkenburg, 2016).

Current Study

In longitudinal research on sensitive issues, such as pornography use, losing particular types of participants over the course of the study is a serious concern. If attrition is related to the characteristics that moderate the link between pornography use and adverse outcomes, it becomes more difficult to identify moderating effects when analyses are conducted. Furthermore, if such attrition is extreme, it may severely diminish, or inflate, the link between pornography use and the adverse outcome of interest. Given that the same characteristics which are suspected to make some adolescents more vulnerable to adverse media outcomes—such as difficult family environment and problematic parenting, deviant peer group, impulsivity, difficulties with concentration and inability to delay gratification (Valkenburg & Peter, 2013)—may also make them more likely to discontinue participation in a panel (Winefield et al., 1990), the risks described above cannot be ignored.

The notion that young people may be especially vulnerable to prolonged pornography exposure is based on a growing body of both scholarly (research and policy-oriented) and non-scholarly (popular and activist) literature. As explicitly (Wright, 2014) or implicitly argued in research (see Owens et al., 2012; Peter & Valkenburg, 2016) and policy-oriented studies (Horvath et al., 2013), pornography-influenced sexual socialization is believed to be more troublesome in young people, due to their sexual inexperience, developmentally-related interest in sex and sexuality, stage of cognitive development, and considerable frequency of pornography use (mostly among male adolescents and young men; Miller et al., 2020). Moral concerns aside (Harden, 2014), a growing number of studies that analyze pornography use among adolescents (Peter & Valkenburg, 2016)—primarily with an aim of exploring potential risks (Dawson et al., 2019; Koletić, 2017; Štulhofer et al., 2019; Vandenbosch, 2015)—reflect contemporary societal concerns about adverse outcomes associated with pornography use and underscore the current study's social relevance.

To explore selective dropout more systematically and make practical recommendations for longitudinal research on adolescents' use of sexualized media, this study analyzed attrition in two independent panel studies of sexualized media use among high-school students over the period of more than two years. Importantly, the panels used different data collection modalities (online vs. classroom-based surveying). We focused on three research questions: RQ1—was attrition substantially different among adolescents who may be particularly vulnerable to pornography use (henceforth, the *vulnerable group*) compared to other participants; and RQ2—did data collection modality moderate associations between attrition and the group membership?

This paper analyzed data from the Prospective Biopsychosocial Study of the Effects of Sexually Explicit Material on Young People's Sexual Socialization and Health (PROBIOPS; https://probiops.ffzg.hr/). PROBIOPS was a 4-year (2014-2018) research project conducted to

systematically analyze associations between the use of sexualized media, pornography in particular, and adolescents' sexuality, reproductive health, and psychosocial well-being. PROBIOPS included two independent panels that enabled a replication of some findings (see Kohut, Landripet, et al., 2020) and a longer observation of the constructs of interest than is typical in the field (Štulhofer et al., 2019). Because the intention was to focus on the transition period between middle and late adolescence— when the initial sexual exploration typically takes place among Croatian adolescents (Landripet et al., 2011)—we sampled a cohort of high-school sophomore students and followed them for 2.5 years, until school completion.

Method

Participants and Procedures

The two panel samples were recruited in the largest Croatian city (the capital, Zagreb) and the third largest city (Rijeka). In Zagreb, the initial survey took place in April 2015 and was repeated five more times with a 6-month period between the waves. The final study wave (T6) was a follow-up carried out after participants had graduated. In Rijeka, baseline surveying was carried out between December 2015-January 2016 and was repeated five times at roughly 6-month intervals. All PROBIOPS procedures were approved in June 2014 by the Ethical Research Committee of the Faculty of Humanities and Social Sciences, University of Zagreb.

Zagreb Panel.

The online Zagreb panel was based on participant recruitment carried out in 59 of 90 high schools in the capital city and the surrounding county. Small private schools, specialized art schools, and several smaller county schools were omitted, whereas ten of the contacted schools refused to take part in the study. The study was advertised by distributing recruitment leaflets among sophomore students during a school period. This strategy, which was adopted from Ladin and colleagues. (2004: 146), minimized disruption of regular school activities and

maximized participant reach. Each leaflet contained information about the study, for both students and their parents[1], a unique registration code, and instructions for online registration. Prospective participants were asked to visit the study webpage and register using their email address or Facebook account. Additional information about the study and participation was provided on the study webpage, delivered as a video conversation between a female and a male who were young professional actors.

To develop the online questionnaire application, we used an open source software tool for online survey management. The questionnaire interface was built in a responsive manner for optimal performance on tablet devices and smartphones, as well as on larger laptop or desktop computer screens. A custom-made registration platform based on Joomla content and user management system enabled sending a personalized survey link to each participant. Email addresses and unique codes (randomly generated alphanumeric strings), which were provided by participants during online registration and used to personalize questionnaires and link them over time, were kept as separate databases. Members of the research team had no access to personal identifiers. At each wave, students who completed the questionnaire—after electronically providing informed consent—were eligible to participate in a lottery with vouchers worth about €13.5/$15. At the beginning of each new study wave (except for T6), research assistants would re-visit the participating schools to remind students about the study.

Following good international practice (Ladin L'Engle et al., 2004; Reitz et al., 2015), in preparing for this online panel we conducted focus groups with high-school students to explore adolescents' perspectives of a number of important methodological issues. The focus group discussions informed our decisions regarding the content of the recruitment leaflet, how

[1] According to the National guidelines for ethical research with minors (Kolesarić & Ajduković, 2003), if participants are aged 14 years or older, their parents need only be informed about the study; informed consent should be obtained from participants.

to keep in contact with participants and the type of incentives offered, assisted in the development of the project's visual identity, and helped to determine the questionnaire length and comprehensibility. The same approach was used to learn more about study attrition. After the second data collection wave, we organized a couple of focus groups with students from a large high school who participated in both study waves and those who participated only at baseline to discuss reasons for (dis)continued participation.

At baseline, the online panel (n = 2,235) included 19% of the city's secondary school sophomore student population. Compared to other students, students from generally less prestigious vocational schools were slightly overrepresented in the sample (66% vs. 63% in the sophomore high-school student population). In addition, the panel oversampled female students (58% vs. 49% in the population).

Rijeka Panel.

High-school sophomores in the Rijeka panel were recruited from 14 of the total of 22 secondary schools. Due to financial limitations, seven small schools were omitted from the sample. In addition, one larger high school was dropped from the sample due to recent arson and a pending investigation. Prior to the baseline survey, all parents received a letter with basic information about the study. Self-administered paper and pencil surveys were used to collect data in classrooms, with 50x50 cm (20x20 inch) portable screens placed between participants to enhance confidentiality. At each survey round, information needed for students' consent was printed at the beginning of the questionnaire and summarized orally by a research assistant in charge of surveying. Questionnaires were linked using a simple 5-digit alphanumeric code. No incentives were provided for participation.

At baseline, the classroom-based panel included 1,287 participants or 62% of the city's high school sophomore population. Again, vocational school students (71% vs. 66% in

the population were somewhat overrepresented in the panel. The panel also oversampled female students (59% vs. 51% in the population).

Measures

Panel Attrition.

The fact that participants could return to the panel after one or more missed waves presented an initial difficulty for the assessment of panel attrition. Thus, in estimating attrition we used full participation history to distinguish (terminal) attrition from temporary discontinued participation.[2] Based on attrition patterns in two panels (see Figure 1), we distinguished three specific outcomes for analytical purposes: early attrition, later attrition, and participation gaps. *Early attrition* was defined as participation that ended after the initial study wave. This single-measurement participation was explored separately because it constituted the most frequent type of attrition and had the most severe analytical consequences (the absence of repeated measurement). *Later attrition* was operationalized as leaving the panel after participating in at least two waves. Finally, for participants who did not leave the study we calculated the number of waves skipped (*participation gaps*).

Vulnerability Indicators.

To identify vulnerable adolescents (see Peter & Valkenburg, 2016; Valkenburg & Peter, 2013), we used the following six indicators administered at baseline:

1. Adverse family situation: Problematic family environment, involving hostile and/or aggressive behaviors among family members, was assessed by three items that asked about physical aggression, intense quarrels, and family members systematically ignoring each other

[2] The final study wave, in which the distinction was logically impossible, served to differentiate between attrition and participation gaps in the previous one. In addition, observations for students who attended a 3-year vocational program (the majority of our participants were enrolled in a 4-year secondary-school program) were right-censored after T3 in the Zagreb panel and T4 in the Rijeka panel.

in the past 12 months. A 5-point scale ranging from 1 = *never* to 5 = *often* was used to anchor answers. The summed scores had acceptable reliability in both panels (Cronbach's α_{Zagreb} = .71 and α_{Rijeka} = .72).

2. Lower academic achievement: This characteristic was measured by asking participants about their final grade at the end of the previous school year. In the Croatian education system, the grades range from 1 to 5, with higher values reflecting higher achievement.

3. Early biological maturation: Following Michaud, Suris and Deppen (2006), early onset of puberty was explored by asking participants about the relative timing of their physical maturation. Participants responded on a 5-point scale ranging from 1 = *much earlier than other peers* to 5 = *much later than other peers*.

4. Lower self-esteem: General self-esteem was assessed by the 4-item Cénat and colleagues (2014) scale (e.g., "In general, I like myself the way I am" and "When I do something, I do it well"). Answers were recorded on a Likert-type scale, ranging from 1 = *it doesn't apply to me at all* to 5 = *it completely applies to me*. The composite indicator had satisfactory reliability (Cronbach's α = .81 and .84).

5. Sexual aggressiveness: Following Ybarra, Mitchell, Hamburger, Diener-West and Leaf (2011), self-reported baseline sexual aggressiveness was measured by asking participants whether they had "kissed, touched, or done anything sexual with another person when that person did not want you to do so." Responses options included 0 = *never*, 1 = *once*, and 2 = *more than once*.

6. Earlier sexual debut: In both panels, sexual experience at baseline was measured by reported sexual intercourse.

Pornography Use.

Baseline frequency of pornography use was assessed by asking participants how often they had used pornography during the last 6 months. Response options ranged from 1 = *not once* to 8 = *several times a day*. Prior to the questions concerning pornography, pornography was defined as: "…any material which openly depicts sexual activity; material which shows naked bodies, but not sexual intercourse or other sexual activity does not belong to pornography as here defined".

Analytical Strategy

In this study, attrition (i.e., total attrition) included three distinct patterns of incomplete participation: (a) early attrition, (b) later attrition, and (c) participation gaps. Each of these patterns of attrition were used as predictors of theorized adolescent vulnerability to pornography. To enable full comparability of the two panel samples, analyses in the classroom-based Rijeka panel (which allowed respondents to join the panel after the initial wave) did not include adolescents who failed to participate in the baseline survey (n = 457).

To identify participants who may be more susceptible to adverse effects of sexualized media (i.e., the *vulnerable group*) than their peers, we used 2-step cluster analysis (Kent et al., 2014) of the hypothesized vulnerability indicators: family environment, academic achievement, biological maturation, self-esteem, sexual aggressiveness, and sexual debut. The analysis, which employed log-likelihood distance measure and did not involve the pre-set treatment of outliers, was carried out by gender, separately for each panel. Based on BIC value comparisons, a model with two clusters was found to best fit the data across gender and panel. Invariably, the smaller cluster represented the vulnerable group (i.e., adolescents with more challenging characteristics). Among female adolescents, the size of the vulnerable group was 16.9% in the Zagreb panel and 19.9% in the Rijeka panel. The proportions were notably higher among male adolescents (28.6% and 24.7%, respectively). According to the silhouette measure of fit (Kaufman & Rousseeuw, 1990), the 2-cluster solution fit was "fair" in all four

cases. Expectedly, adolescents in the vulnerable group were characterized by higher baseline frequency of pornography use ($t_{(748)ZAGREB} = -9.92$, $p < .001$, $d = 0.51$; and $t_{(387)RIJEKA} = -4.87$, $p < .001$, $d = 0.35$).

A more detailed exploration of the two clusters indicated that the core difference between them was earlier sexual debut (in both panels), followed be sexual aggressiveness (only in the online panel). The contribution of other characteristics was minor. However, the validity of including these indicators in the cluster analysis was supported by statistically significant differences in their distribution and mean values between the two groups. The only exceptions were sexual aggressiveness in the classroom-based (Rijeka) panel and self-esteem levels in the online (Zagreb) panel. Due to missing values in one or more indicators, it was not possible to attribute a cluster for 9.0% of adolescent males and 5.8% of adolescent females in classroom-based panel. The proportions in the online panel were 2.0% and 1.2%, respectively.

To explore possible differences in attrition between the two groups, several multivariate logistic regression analyses were carried out using pooled data that controlled for panel type. The binary dependent variable was coded 1 for the vulnerable group and 0 for other participants. Participants' age at baseline and gender were included as controls in all models. Respondent age was missing from 1.9% of classroom-based panel, and those cases were excluded from the analysis. The final research question (the moderating effect of panel type) was addressed by adding relevant interaction terms at the second step. In all analyses, robust standard errors were estimated to account for data nesting in schools.

Results

Baseline sociodemographic characteristics and key measures of sexual behavior in the online Zagreb and classroom-based Rijeka panels are presented in Table 1, separately for adolescents in the vulnerable and non-vulnerable groups. Across groups, 78% of surveyed adolescents in both panels reported living with both parents at baseline. In more than half of

all cases, at least one of the parents completed secondary education. Slightly over a third of parents in both panels had a college/university degree. Religiosity was somewhat higher in the Zagreb panel, where 29.8% of participants attended religious services several times a week or more often, compared to 19.4% in the Rijeka panel. No attendance was reported by 15.7% of adolescents in the Zagreb and 16.3% of adolescents in the Rijeka panel. In both panels, about a fourth of participants had sexual intercourse prior to baseline assessment (20.9% in Zagreb and 22.5% in Rijeka).

TABLE 1 ABOUT HERE

Figure 1 shows the dynamics of participation by wave and panel, as well as attrition. In the Zagreb online panel, high attrition (53%) was observed between baseline and the second wave. From T2 onwards, the attrition rate substantially declined (by T5, 65% of initial participants had left the online panel). The attrition trend was markedly different in the classroom-based Rijeka panel. Only 5% of participants left the panel after the initial wave. Over time, attrition in this class-room based panel was mostly linear, with 19% of participants having left the study by T5. As presented in Figure 1, participants in the online panel were about ten times more prone to early attrition and over three times more likely to have left the panel later on compared to participants in the classroom-based panel. Compared to the online panel, the classroom panel was characterized by substantially lower early and later attrition (both differences significant at $p < .001$), as well as fewer participation gaps ($p < .001$) (see Table 2).

FIGURE 1 AND TABLE 2 ABOUT HERE

As usually observed in longitudinal studies (Müller & Castiglioni, 2017), some participants were characterized by participation gaps. In the online panel, 19% of participants skipped T2 but returned to the panel at a later wave. The percentage of returning participants declined over time (12% at T3, 9% at T4, and 3% at T5). In the classroom-based panel, the

proportion of temporary absentees from T2 to T5 was stable (10-13%) and broadly corresponded to school absenteeism rates caused by truancy, illness, and educational field trips. Consequently, among participants who remained in the panel until the final wave, the average number of participation gaps in the online panel was nearly double that of the classroom-based panel (0.96 vs. 0.54). Figure 2 shows differences in attrition between the vulnerable and non-vulnerable groups by panel. In both panels, attrition was notably higher in the vulnerable group.

FIGURE 2 ABOUT HERE

RQ1: Was Panel Attrition More Substantial in the Vulnerable Group?

As presented in Table 3, both early and later attrition were significantly higher in the vulnerable group than among the rest of the panel participants. These bivariate findings were only partially supported by multivariate findings shown in Table 4, in which only early attrition was significantly linked to the vulnerable cluster membership (see Model 1; OR = 1.37, $p < .001$). Compared to other participants, members of the vulnerable group were more likely to have left the study earlier than other participants.

TABLE 3 ABOUT HERE

RQ2: Did Data Collection Modality Moderate the Associations between Attrition and the Group Membership?

After the interaction terms were entered into logistic regression (see Models 2 and 4 in Table 4), the analysis demonstrated that panel type moderated the association between vulnerability status and participation gaps (OR = 0.65, $p < .001$). Descriptive information presented in Table 3 is useful for interpreting the interaction. Compared to the online panel, the classroom-based panel was characterized by a lower mean frequency of participation gaps. Nevertheless, a higher number of participation gaps was associated with significantly higher odds of belonging to the vulnerable group only in the classroom-based panel.

TABLE 4 ABOUT HERE

Discussion

Longitudinal studies of sensitive topics may not always be successful in collecting information from the most relevant (i.e., vulnerable) participants. Based on data collected in two independent panel studies of adolescents, the current study focused on whether adolescents who may be more vulnerable to adverse outcomes related to pornography use were more likely to leave the panel before other participants. Summarizing the main findings, we found that: (a) only early attrition was substantially higher among participants who are suspected of being vulnerable to the effects of pornography than their peers; and (b) panel type (online vs. classroom-based repeated surveys) significantly moderated the associations between adolescent vulnerability and participation gaps. Based on these insights, in the concluding section we propose several recommendations for future longitudinal investigations of adolescents' pornography use.

In contrast with previous studies among adolescents (Peter & Valkenburg, 2011; Vandenbosch, 2015) and adults (Hagen et al., 2018; Samueal L. Perry, 2017), we observed significant associations between the frequency of pornography use and panel attrition. However, this information is of limited use, because characteristics other than, but related to, pornography use seem to be considerably more important for predicting both adverse consequences of adolescents' pornography use and attrition. Compatible with general insights about the characteristics of participants who are lost to follow-up (Fröjd et al., 2011; Gustavson et al., 2012; Rothman, 2009), the current study suggests that adolescents who are believed to be under increased risk of adverse outcomes associated with regular pornography use are less likely to complete longitudinal studies about the use of sexualized media, compared to their peers. More precisely, they are more likely to leave the study at an early stage. The consequence of this trend would be the suppression of associations between

pornography use and its associated harms, which may contribute to a "null effects" bias in longitudinal research.

Overall, the pattern of attrition in our two panel studies was markedly different. The online panel witnessed a huge dropout after the initial wave—similar to what was observed in an earlier online panel of Dutch adolescents (Kuyper et al., 2012) that suffered 69.7% dropout following baseline assessment[3]—after which attrition mostly stabilized. From the second wave on, attrition increased minimally and in a linear fashion. This attrition deceleration has been observed in many longitudinal studies. There seems to be general consensus that the highest attrition should be expected in the first 6-12 months of a panel study (Hansen et al., 1990; Rothman, 2009; Winefield et al., 1990). In contrast, attrition in the classroom-based panel was steady, moderate, and mostly linear. Almost two thirds of adolescents who participated at baseline remained in the study until its end (62.2%). This is comparable to the STARS longitudinal study, in which the percentage of participants who completed the study was slightly higher (67.2%; Reitz et al. 2015). It should be noted that Dutch participants were, on average, somewhat younger at baseline than those recruited in the Rijeka panel, which may account for the difference. Different patterns of attrition in the online (Zagreb) and the classroom-based (Rijeka) panels corroborate observations that certain aspects of study design affect attrition more than time passed (Groves & Peytcheva, 2008).

Finally, it should be noted that although we included single-item measures of careful (i.e., attention check; Liu & Wronski, 2018) and honest reporting at T3 in the Zagreb panel and at T4 in the Rijeka panel, marginal proportions of answers indicating lack of attention and dishonest responding precluded their inclusion in our analyses. This precluded testing attention and honesty as potential moderators of the link between selective attrition and

[3] Faced with the unexpectedly high dropout, the authors decided to end the study (personal communication with L. Kuyper).

survey modality or exploring the possibility that one of the two modalities produced less accurate information among more vulnerable participants- However, the distribution of the two indicators indicates the validity of collected information.

The results of the current analysis indicate the importance of caution when interpreting the results of pornography research and add to a growing body of methodological critiques of this area (Campbell & Kohut, 2017; Fisher & Kohut, 2020; Kohut, Balzarini, et al., 2020; Peter & Valkenburg, 2016). One of the most pressing issues in pornography research concerns the common use of idiosyncratic and unvalidated measures of self-reported pornography use that are untethered to a common conceptual definition of this behavior (Kohut, Balzarini, et al., 2020; Marshall & Miller, 2019; Short et al., 2012). Indeed, the measure of pornography use employed in the current study, which focused on the use of materials that clearly depict sexual behavior but omitted the use of materials that display explicit nudity in the absence of sexual behavior, is at odds with some recommendations of best practice (see Kohut et al., 2020). It should be noted, however, that the primary analyses in the current study—the identification of "vulnerable groups" and the patterns of attrition among these groups—did not rely on this measure of pornography use. With that in mind, it is unclear if pornography use would be found to be higher among particular vulnerable samples if other measures of pornography use were employed.

Research Recommendations

The substantive selective panel attrition noted in the two panels of Croatian high-school students points to the importance of taking attrition into account when drawing conclusions about research findings, but also of taking steps to minimize the problem in future studies of adolescents' pornography use and sexualized behaviors in general. Based on our findings, a few recommendations can be made and/or reiterated. First, when deciding about the modality of a longitudinal study, the choice should be made based on resources (*how*

large a sample can we start with?) and anticipated (general) attrition, rather than on considerations about selective dropout. In our experience, an online panel is convenient for participants (anonymity and privacy are maximized) and logistically easy to maintain—provided an efficient system of alerting participants to new data collection waves is in place. However, overall attrition will most likely be substantially higher than in a classroom-based panel study. Given that incentives seem necessary to keep panel participants motivated (Fidler Mis et al., 2018; Seymour, 2012) and that for many adolescents any extra-curricular event that takes place in the classroom and interrupts or postpones regular educational activity is welcomed, in the long run, online panels are likely to be more expensive than the alternative (Laurie & Lynn, 2009). Commercial online panels, managed by market research agencies, have also been used in the field (Peter & Valkenburg, 2008). The 3-wave Dutch panel used by Peter and Valkenburg (2008) was characterized by a lower attrition rate (46%) than was observed in our online panel. It should be noted that the representativeness of commercial panels should always be established by researchers, independently from the agency claims.

Secondly, the obvious significance of the issue calls for systematic preparations for attrition. This would include making decisions about the initial size of panel based on a combination of statistical power calculations and anticipated dropout, as well as careful consideration of issues known to impact attrition (Laurie, 2008; Lynn, 2018). These entail keeping the survey as short as possible (e.g., by the use of skip patterns and the use of planned missing data strategies; Graham, Taylor, Olchowski, & Cumsille, 2006; Rhemtulla & Hancock, 2016) so that the time required to complete the questionnaire does not exceed adolescent capacity for concentration, using desirable incentives, choosing an appropriate visual identity for the project and all related materials, keeping in touch with participants[4], etc.

[4] The PROBIOPS study created a Facebook group to maintain contact with participants, mainly by periodically posting infographics with (non-central) study findings.

Focus groups with adolescents may be particularly useful during the period of planning and preparing for the study to determine visual identity, the type and level of incentives, questionnaire comprehension, as well as to address possible obstacles to participation.

Thirdly, special attention should be paid to delaying selective dropout, as it appears that a later attrition carries a substantially lower risk of selectivity. This is particularly, but not exclusively, relevant for online panels. A comprehensive plan should be developed before launching the study, with measures and activities intended to decrease costs and increase benefits of participation for participants who have been identified as particularly vulnerable. To an extent, this is related to efforts to curb early attrition in general. For example, the dynamics of notifying participants about an upcoming study wave and communicating simple but interesting findings to participants (including a suitable feedback on the study progress) to keep them engaged need not be stable across waves, but can be particularly frequent and intensive between the first and the second data collection waves. Similarly, incentives aimed to motivate participants to remain in the study can be enhanced in an early phase—for example by handing out additional incentives (e.g., by offering a special gift along with the voucher or by offering a choice among several types of gift/incentive). More vulnerable participants, who are often coming from less privileged family background, may be especially attracted to these additional tokens of appreciation. To avoid raising expectations (to be followed by disappointment) that the same or similar reward levels will be provided throughout the study, the enhanced incentives should be advertised as one-time only. Alternatively, bonus incentives tied to the number of waves completed may be offered to participants. Another approach would be to seed the panel with specially incentivized (and committed) peer leaders, selected among more vulnerable youth, whose task would be to promote and encourage study participation among their friends and social network contacts.

In general, selective dropout should always be examined by identifying the most relevant group of participants and then comparing their pattern of attrition with the one characterizing the rest of panel participants. This general practice is likely to add some important caveats to study conclusions. Importantly, the current study also suggests that adolescents who have been theorized to be the most vulnerable to the effects of pornography are more likely to exit longitudinal studies early. Loss of such participants is likely to affect conclusions concerning pornography use, and future longitudinal research in this area should make additional efforts to retain such participants.

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Table 1

Participants' Baseline Sociodemographic and Sociosexual Characteristics by Potential Vulnerability to Pornography Use and Panel

	Zagreb (online) panel		Rijeka (classroom-based) panel	
	Vulnerable group	Non-vulnerable group	Vulnerable group	Non-vulnerable group
	n (%)	*n* (%)	*n* (%)	*n* (%)
Gender				
Male	268 (55.0)	649 (37.9)	119 (45.3)	358 (38.4)
Female	219 (45.0)	1064 (62.1)	144 (54.8)	575 (61.6)
Living with				
Both parents	352 (72.3)	1366 (79.7)	184 (70.0)	741 (79.4)
One parent or other	135 (27.7)	352 (20.3)	79 (30.4)	192 (20.6)
Mother's education				
Primary	36 (7.4)	111 (6.5)	15 (5.7)	32 (3.5)
Secondary	272 (55.9)	919 (53.8)	162 (61.8)	529 (57.1)
Tertiary	179 (36.8)	678 (39.7)	85 (32.4)	366 (39.5)
Father's education				
Primary	31 (6.4)	83 (4.9)	19 (7.4)	22 (2.4)
Secondary	280 (58.2)	985 (58.3)	162 (63.3)	552 (60.5)
Tertiary	170 (35.3)	623 (36.8)	75 (29.3)	338 (37.1)
Sexual debut				
No	29 (6.0)	1703 (99.4)	0 (0.0)	933 (100.0)
Yes	458 (94.0)	10 (0.6)	263 (100.0)	0 (0.0)
Freq. of pornography use				
Never	26 (6.8)	98 (10.6)	67 (27.2)	357 (43.0)
Up to once a month	80 (29.9)	245 (26.4)	56 (22.8)	179 (21.5)
Up to several times a week	162 (42.3)	391 (42.1)	89 (36.2)	212 (25.5)
Daily or almost daily	115 (30.0)	195 (21.0)	34 (13.8)	83 (10.0)
	M (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
Age	15.82 (0.61)	15.89 (0.42)	16.03 (0.56)	15.77 (0.48)
Academic achievement	3.63 (0.57)	3.90 (0.57)	3.33 (0.56)	3.69 (0.59)
Age at first contact with pornography	11.46 (1.65)	12.17 (1.75)	11.87 (1.62)	12.28 (1.65)

Note. Percentages do not always add up due to rounding.

Table 2

Attrition and Characteristics of Reporting by Panel Type

	Early attrition	Later attrition	Participation gaps
	%	%	*M*
	95% CI	95% CI	95% CI
Rijeka (classroom-based) panel	5.1	11.5	0.48
	[3.9, 6.5]	[9.7, 13.5]	[0.44, 0.53]
Zagreb (online) panel	52.5	25.2	1.00
	[50.4, 54.7]	[22.6, 27.9]	[0.93, 1.07]
Fisher's exact test (*p*)	<.001	<.001	<.001

Note. Confidence intervals (CI) based on assumptions of binomial exact distribution (for proportions) and Poisson distribution (for count data).

Table 3

Attrition and Characteristics of Reporting in the Vulnerable and Non-Vulnerable Groups of Participants

	Early attrition		Later attrition		Participation gaps	
	%	95% CI	%	95% CI	*M*	95% CI
Total						
Non-vulnerable group	33.6	[31.8, 35.5]	17.3	[15.6, 19.2]	0.69	[0.65, 0.74]
Vulnerable group	44.7	[41.1, 48.4]	21.5	[17.6, 25.8]	0.78	[0.69, 0.88]
Fisher's exact test (*p*)		<.001		<.001		.078
Rijeka (classroom-based) panel						
Non-vulnerable group	4.0	[2.8, 5.5]	10.0	[7.1, 12.3]	0.45	[0.40, 0.49]
Vulnerable group	9.1	[5.9, 13.3]	17.4	[12.7, 22.9]	0.65	[0.54, 0.77]
Fisher's exact test (*p*)		<.001		<.001		.002
Zagreb (online) panel						
Non-vulnerable group	49.5	[47.1, 51.9]	24.9	[22.0, 27.9]	1.00	[0.92, 1.08]
Vulnerable group	63.2	[58.8, 67.5]	26.8	[20.5, 33.9]	0.98	[0.88, 1.16]
Fisher's exact test (*p*)		<.001		<.001		.957

Note. Confidence intervals (CI) based on assumptions of binomial exact distribution (for proportions) and Poisson distribution (for count data).

Table 4

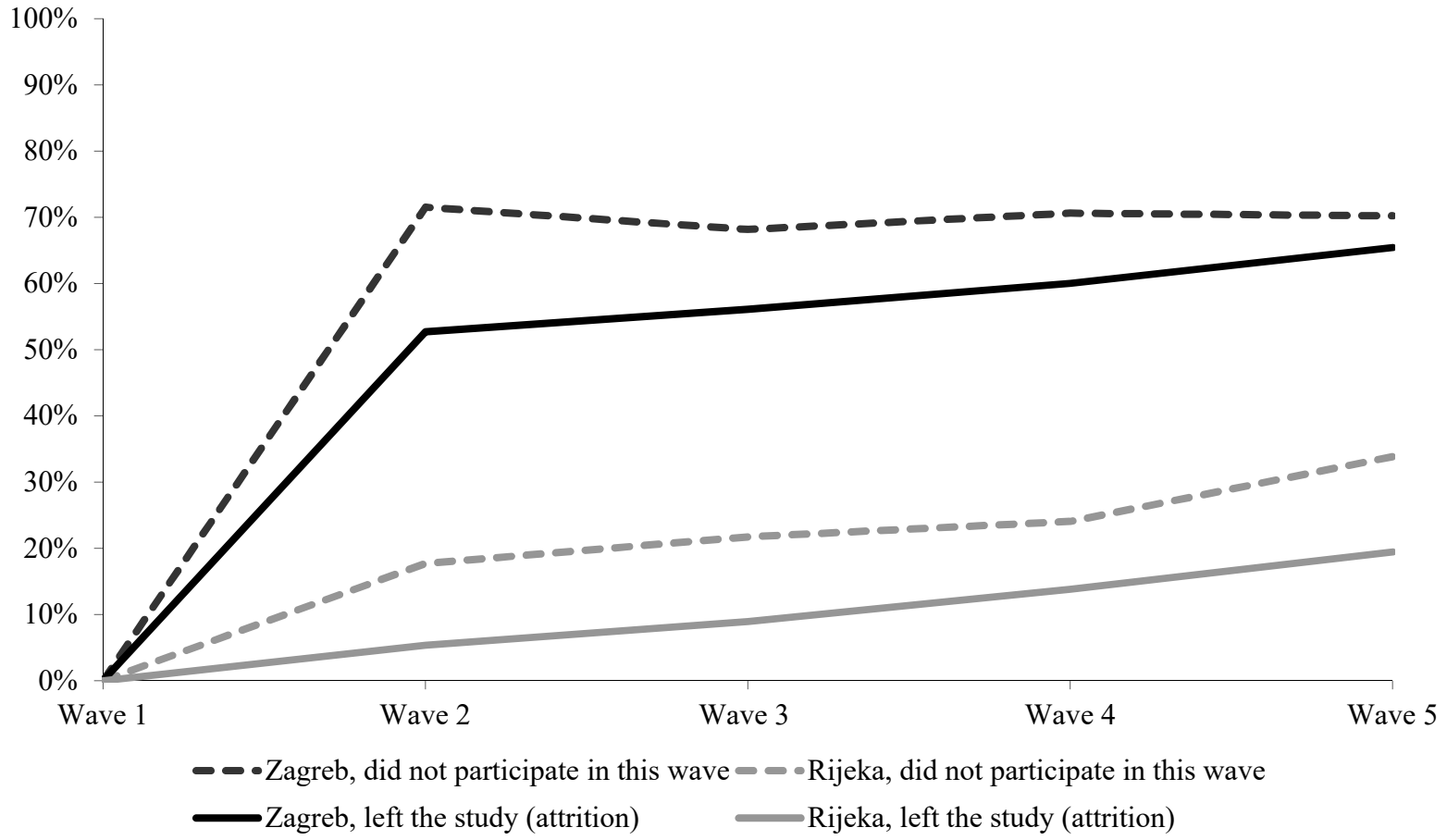
Attrition and Characteristics of Reporting as Predictors of Membership in the Vulnerable (1) vs. Non-Vulnerable (0) Groups

	Model 1	Model 2	Model 3	Model 4
	OR 95% CI	*OR* 95% CI	*OR* 95% CI	*OR* 95% CI
Female gender	0.65***	0.65***	0.69*	0.68*
	[0.54, 0.78]	[0.54, 0.79]	[0.51, 0.94]	[0.50, 0.93]
Age (at baseline)	2.56***	2.54***	2.80***	2.86***
	[2.06, 3.18]	[2.05, 3.16]	[2.08, 3.78]	[2.10, 3.90]
Early attrition	1.37**	1.29		
	[1.08, 1.72]	[0.69, 2.40]		
Later attrition	1.27	1.60		
	[0.95, 1.70]	[0.99, 2.58]		
Online panel (Zagreb)	0.93	1.03	1.01	1.40
	[0.65, 1.36]	[0.67, 1.59]	[0.64, 1.59]	[0.87, 2.23]
Early attrition x online panel		1.19		
		[0.53, 2.68]		
Late attrition x online panel		0.66		
		[0.35, 1.27]		
Participation gaps			1.08	1.41**
			[0.95, 1.23]	[1.15, 1.74]
Participation gaps x online panel				0.65***
				[0.51, 0.83]
n	3373	3373	1766	1766
pseudo R^2	0.055	0.056	0.044	0.050
BIC	3403.05	3417.02	1638.90	1636.29
Log-likelihood	-1677.16	-1676.02	-800.76	-795.72

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

Figure 1

Attrition Patterns in Zagreb (Online) and Rijeka (Classroom-Based) Panels



Note. Attrition rates were calculated as Kaplan-Meier failure function estimates for panel participation per study wave; dashed lines represent both attrition and temporary absence from the study (i.e., gaps in participation).

Figure 2

Attrition Rates, Calculated as Kaplan-Meier failure function estimates, in Vulnerable and Non-Vulnerable Participants by Panel.