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Sexually Explicit Websites and Sexual Initiation: Reciprocal Relationships and the
Moderating Role of Pubertal Status

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Abstract

A two-wave panel study was conducted among adolescents (*Mean age* = 14.78; *N* = 639) to examine the relationship between using sexually explicit websites and sexual initiation with particular attention to adolescents' pubertal status. Structural equation modeling and logistic regression analysis indicated that frequent users of sexually explicit websites were five times more likely to initiate sexual intercourse than non-users. Pubertal status moderated this relationship: an increased likelihood to initiate sex was found among adolescents in an early pubertal stage who frequently viewed sexually explicit websites. However, a *lower* likelihood to initiate sex was found among adolescents in an advanced pubertal stage. The possibility of a reciprocal relationship was also examined but was not supported.

Keywords: sexually explicit websites, puberty, sexual intercourse

Sexually Explicit Websites and Sexual Initiation: Reciprocal Relationships and the Moderating Role of Pubertal Status

A considerable body of research has argued that adolescents are at risk for harmful effects from using sexual media content (Ward, 2003). The most important reason for assuming adolescents to be an important risk group is the central position of sexual processes in adolescent development. Triggered by a set of essential biological, cognitive, and social changes, sexuality increasingly assumes a greater prominence in the awareness of young people (Tolman & McClelland, 2011) and scholars have argued that these developments may well increase adolescents' susceptibility to effects from exposure to sexually oriented media (e.g., Ward, 2003).

Building on the rich tradition of research on the effects of sexual media, the present study examines whether viewing sexually explicit websites is related to early sexual initiation, and whether this relationship is stronger among adolescents who are in the middle of experiencing fundamental physical changes (Mul, 2004). By examining this particular process, the study aims to address three important shortcomings, thus increasing understanding of how sexual media may influence adolescents' sexual development. The first contribution responds to scholars' call to identify factors that may accelerate sexual initiation (O'Donnell, O'Donnell, & Stueve, 2001; Tolman & McClelland, 2011) and the suggestion that one of these factors may be the use of sexually explicit websites (Brown & L'Engle, 2009). Second, the study explores the possibility of a reciprocal relationship, thus elaborating on initial evidence that relations between the consumption of traditional sexual media, such as television and magazines, and sexual outcomes may go in both directions (Aubrey, 2007; Bleakly, Hennessy, Fishbein, & Jordan 2008). Our third contribution is the testing of the hypothesized moderating role of pubertal status on the connection between visiting sexually explicit websites and early sexual initiation, examining the often mentioned assumption that

linkages between media use and sexual outcomes are stronger among adolescents who are at the onset of puberty (e.g., Eggermont, 2006).

To meet these objectives, a two-wave panel study of 12- to 16-year-old adolescents ($N = 639$) was conducted in the Western European country of Belgium. This particular European context, and its relatively liberal sexual beliefs and values, are undoubtedly of importance in the interpretation of this study's findings (Vandenbosch & Eggermont, 2012). Yet, scholars from the U.S., other Western European countries, and Belgium have reported similar trends regarding the level of exposure to sexually explicit internet content (Vandoninck, D'Haenens, & Donoso, 2010; Wolak, Mitchell, & Finkelhor, 2007), the age of initiation of sexual intercourse (Avery & Lazdane, 2008; Centers for Disease Control and Prevention, 2006) and the effects of sexual media on adolescents (e.g., Eggermont, 2006; Ward, 2003), leading us to assume that the relevance of the findings is not confined to the context of this study.

Sexual Maturation during Adolescence

The onset of early adolescence is characterized by pubertal transformations, which on average start between the ages of 9 and 14 years (Nottelmann et al., 1987; Roelants, Hauspie, & Hoppenbrouwers, 2009). More specifically, one Belgian study reported that boys' genital development starts at an average age of 11.4 years, whereas girls' breast development starts at an average age of 10.7 years (Roelants et al., 2009). Comparable trends have been found among boys and girls from the U.S. (e.g., Nottelmann et al., 1987) and other Western European countries (e.g., Mul et al., 2001). The onset of sexual development has been explained by referring to the activation of hormones, such as sex steroids, which then continue to increase throughout pubertal development (Nottelmann et al., 1987). Towards the end of puberty, hormonal levels are expected to decrease slightly and, more importantly, to remain stable (Buchanan, Eccles, & Becker, 1992).

Physical maturation and the associated changes in hormones are paralleled by the emergence of sexual feelings (Brooks-Gunn & Furstenberg, 1989; Richards & Larson, 1993). In this respect, Brooks-Gunn and Furstenberg (1989) noted that changes in adolescent hormones stimulate sexual behavior by increasing feelings of sexual arousal and/or by changing the social environment due to the physical maturation of secondary sex characteristics. Richards and Larson (1993) added that advanced physical maturation was also associated with increased romantic feelings among American boys and girls. Motivated by these new romantic feelings, but also by sexual arousal and the new experience of being seen as a sexual being, adolescents may begin to explore sexual interactions (Brooks-Gunn & Furstenberg, 1989; Vanwesenbeeck, de Graaf, Meijer, & Poelman, 2006). In Belgium, just as in the U.S., the average age at which adolescents initiate sex is between 17 and 18 years (Avery & Lazdane, 2008; Centers for Disease Control and Prevention, 2006).

Although sexual exploration is normative and developmentally expected during adolescence (Tolman & McClelland, 2011, p. 242), sexual initiation taking place before the age of 16 years has been described as a risk factor (Dickson, Paul, Herbison, & Silva, 1998; Paul, Fitzjohn, Herbison, & Dickson, 2000). Early sexual initiation has been linked to high-risk sexual activities, such as having multiple sex partners or having sex while being intoxicated (O'Donnell et al., 2001, p. 268), and to physical and mental health risks. Sexually transmitted diseases, teenage pregnancy and negative emotional feelings (such as lower relationship quality) have been shown to occur more often among adolescents who initiated sex at an early age (Dickson et al., 1998; Kotchick, Shaffer, Miller, & Forehand, 2001; O'Donnell et al., 2001). Sexual health educators have explained these risks by referring to young adolescents' limited cognitive capacities and lack of sexual experience (e.g., de Wit, Breeman, & Woertman, 2005; O'Donnell et al., 2001). Sexually inexperienced early adolescents may feel less responsible for their own sexual acts and be less able to resist

sexual desire (de Wit et al., 2005). In this respect, scholars have signaled the importance of sexual socialization agents.

Sexual Socialization of Adolescents: The Role of Sexually Explicit Websites

Sexual socialization agents are responsible for adolescents' acquisition of an awareness of ideas, beliefs and values as well as shared cultural symbols, meanings and codes of conduct (Ward, 2003). According to social cognitive theory, individuals learn by observing the rewarding of behaviors performed by attractive role models (Bandura, 2001). If these role models are frequently shown to be enjoying risky sexual behaviors, such as having sex without contraception or at a young age, adolescents may be more inclined to imitate these behaviors.

One sexual socialization agent that has received recent research attention is sexually explicit internet content, defined as content showing genitals and sexual behavior in unconcealed ways with the aim of arousing the viewer (Peter & Valkenburg, 2006). The majority of Belgian adolescents (61.2%) have indicated that they regularly search for sexually explicit internet content (Vandoninck et al., 2010). Research has reported that adolescents are exposed to sexually explicit websites quite frequently and that they value those websites as a source of both sexual arousal and information (Vanwesenbeeck et al., 2006). However, the entertaining and informative characteristics that adolescents ascribe to pornographic content are in strong contrast to academic literature's qualification of pornography as "a poor, and indeed dangerous, sex educator" (Flood, 2009, p.384). Content analyses of pornographic media have shown that pornography represents explicit sexual actions in a gender-stereotypical way without considering the risks and responsibilities associated with sex (e.g., McKnee, 2005). Learning from such examples is expected to lead to socially undesirable sexual attitudes, such as a sexist attitude towards women, and risky sexual activities, such as early sexual initiation among adolescents (Flood, 2009).

Studies have supported the view of sexually explicit websites as a risky sexual socialization agent. For instance, Peter and Valkenburg (2009b; 2010) reported that adolescents who have been exposed to sexually explicit online material are more likely to view women as sex objects (2009b) and to have more recreational attitudes towards sex (2010). Cross-sectional studies have suggested that visiting sexually explicit websites is associated with sexual risk-taking, such as having more sexual partners (Braun-Courville & Rojas, 2009). One longitudinal study found that viewing sexually explicit media was associated with an earlier initiation of oral sex and sexual intercourse (Brown & L'Engle, 2009). Based on the latter results and prior research on sexual attitudes and behaviors (e.g., Peter & Valkenburg, 2010) as well as social cognitive theory (Bandura, 2001), the first hypothesis of this study is as follows:

H1a: Higher consumption of sexually explicit websites at time point 1 predicts a higher likelihood of having initiated sexual intercourse at time point 2.

When studying the impact of sexually explicit websites on sexual initiation, the possibility of a reverse effect, in which sexual initiation encourages sexually active adolescents to deliberately search for sexually explicit content, has to be taken into account (Brown & L'Engle, 2009, p.149). Prior panel studies have indeed suggested that the relations under scrutiny are more likely to be reciprocal than one-way (Aubrey, 2007; Bleakly et al., 2008). These findings may be explained within several theoretical frameworks, such as the theory of cognitive dissonance (Festinger, 1957) and social learning theory (Bandura, 2001); other explanatory models include the media practice model (Steele, 1999) and Ward's (2003) conceptual model of the media's contribution to sexual socialization. These models predict that: the association between sexual media use and sexual outcomes is circular as adolescents select media content in line with their sexual attitudes and behaviors (thus avoiding cognitive

dissonance); in turn, the selected sexual media content intensifies prior sexual attitudes and stimulates corresponding sexual behaviors (i.e., social learning and interaction).

However, when scholars specifically studied sexually explicit websites, another conclusion emerged. Peter and Valkenburg (2008a, p. 207) reported that visiting sexually explicit websites positively affected sexual preoccupation (i.e., a strong cognitive engagement with sexual issues) one year later, whereas no evidence was found for a reverse effect. Similar conclusions emerged in studies examining instrumental attitudes towards sex (Peter & Valkenburg, 2009a) and sexual uncertainty (Peter & Valkenburg, 2010). So far, only one internet study found a reciprocal relationship between exposure to sexually explicit websites and the view of women as sex objects (Peter & Valkenburg, 2009b, p. 407).

Given the inconsistent evidence for pornographic internet content and the scarcity of research on reciprocal relations between sexual internet use and sexual behavior, the present study aims to further explore this issue. In line with the notion of selective exposure (Festinger, 1957; Steele, 1999; Ward, 2003), the second hypothesis is as follows:

H2a: Sexual initiation at time point 1 predicts higher consumption of sexually explicit websites at time point 2.

Pubertal Status

Several studies have tried to identify factors that may reinforce or alter the effects that sexual media have on adolescents (Ward, 2003). One of these factors may be pubertal status. More specifically, research on the effects of sexual media has explicitly focused on adolescents because major sexual developments take place during the period between childhood and adulthood (Ward, 2003). Drawing on this context, it is surprising to note that research has rarely tested the possible moderating role of specific developmental characteristics, such as pubertal status (Eggermont, 2006; Ward, 2003). Especially with regard to using sexually explicit websites, pubertal status may be of great relevance.

The role of pubertal status may be explained within Ward's (2003) conceptual model of media's contribution to sexual socialization and Steele's media practice model (1999) that both stress the role of individual differences, such as pubertal status, in interactions with sexual media content. Pubertal transformations, such as the elevation of hormone levels and related physical maturation, tend to increase adolescents' drive for sexual exploration (Brooks-Gunn & Furstenberg, 1989); it has been hypothesized that they interact with adolescents' interest in sexual imagery featured in media (Brown et al., 2005), which may stimulate adolescents' likelihood of having sexual intercourse (Bleakly, Hennessy, Fishbein, & Jordan, 2009). More specifically, hormonal changes and the development of secondary sex characteristics in early puberty make adolescents experience sexual feelings in a way that has not been experienced before (Buchanan et al., 1992). The novelty of these sexual feelings in line with physical changes may cause adolescents to be less critical and more willing to learn from sexual images shown on sexually explicit websites (Bandura, 2001; Buchanan et al., 1992). In contrast, adolescents in an advanced pubertal stage are likely to be more accustomed to feelings of sexual desire (Buchanan et al., 1992) and may therefore be less susceptible to the effects from viewing sexually explicit media.

In line with models from sexuality research, such as the sexual behavior sequence of Byrne (1977), we expect that sexual feelings are triggered by viewing sexually explicit media content and may stimulate sexual behavior. However, the extent to which sexual feelings relate to sexual behavior after sexual media exposure may depend on adolescents' pubertal status. Theoretical arguments (Steele, 1999; Ward, 2003) and empirical research (Bleakly et al., 2009; Brown et al., 2005; Buchanan et al., 1992) have thus suggested that adolescents in an early pubertal stage may be more vulnerable to the effects of viewing sexually explicit media compared with adolescents in an advanced pubertal status. As this assumption has not yet been tested, we propose the following addition to the first hypothesis:

H1b: The longitudinal impact of using sexually explicit websites on sexual initiation will be stronger for adolescents in an early pubertal stage than for adolescents in an advanced pubertal stage.

A similar argument could be applied to the reverse effect of sexual initiation on consuming sexually explicit websites. As research has suggested that sexual behavior and sexually-oriented media use are reciprocally associated (Bleakly et al., 2008) and that adolescents in an early pubertal stage are more likely to be interested in sexually oriented media (Brown et al., 2005), it can be hypothesized that the reverse effect will also be stronger for adolescents in an early pubertal stage. When adolescents in early puberty initiate sexual intercourse, they may develop a stronger motivation to seek sexual arousal, such as the arousal triggered by consuming sexually explicit media contents, or become curious about other sexual activities, thus resulting in a higher consumption of sexually explicit websites. Again, the novelty of sexual feelings in this specific group of adolescents (Buchanan et al., 1992) is expected to reinforce this effect. However, no research has yet examined whether pubertal status moderates the reverse effect of sexual experience on sexual media use. We therefore propose to test the following extension of our second hypothesis:

H2b: The longitudinal impact of sexual initiation on using sexually explicit websites will be stronger for adolescents in an early pubertal stage than for adolescents in an advanced pubertal stage.

Control Variables

Research has suggested that adolescents' country of origin (World Health Organization, 2012), gender (L'Engle, Brown, & Kenneavy, 2006; L'Engle & Jackson, 2008; Oliver & Hyde, 1993), age (L'Engle et al., 2006; L'Engle & Jackson, 2008), social economic status (L'Engle et al., 2006; L'Engle & Jackson, 2008; World Health Organization, 2012), quality of communication with parents (L'Engle et al., 2006; Miller,

Norton, Fan, & Christoferson, 1998), quality of communication with peers (Crockett, Bingham, Chopak, & Vicary, 1996; L'Engle et al., 2006; Ward, 2003) and level of sensation seeking (Peter & Valkenburg, 2008) are related to their sexual behavior. Therefore, these variables were included as control variables.

Method

Sample and Participant Selection

A two-wave panel study with an interval of six months was conducted with 12- to 16-year-old adolescents. Because of the relatively rapid sequence of developmental changes occurring during puberty (Mul, 2004), a six-month interval was established with the expectation that it would allow a fuller understanding of developmental trajectories. The sample was limited to adolescents aged 12 to 16 years as this age range has been described as risky for initiating sexual intercourse (O'Donnell et al., 2001).

Approval for the survey was granted by the institutional review board of the host university. As is customary in Belgium, consent for the research was obtained from the school head as a stand-in for parents/guardians. In March 2010, a quantitative survey was conducted in eleven schools selected from among those who agreed to participate from different parts of Flanders (the Dutch-speaking part of Belgium), different schooling levels and different ages. All students who were present during the researchers' school visits completed paper surveys. Students were told that the goal of the study was to investigate their leisure habits. To increase confidentiality, the researchers ensured that students were unable to discuss or see each others' answers. Additionally, confidentiality was ensured by asking students to write their identification data on separate forms and by guaranteeing that survey answers would be processed separately. In September 2010, a second quantitative survey was conducted in the eleven schools that had participated in March. Based on the identification forms from waves 1 and 2, the respondents were tracked over time. Afterwards, each

respondent was assigned a unique code so that identification data could be deleted before the data was processed.

A total of 1061 students completed the questionnaire at baseline and 819 students completed the questionnaires for both waves. However, of these 819 students, 95 students were unable to estimate their pubertal growth and another 85 had missing values on other key variables (response rate: 60.23%). The analytical sample thus consisted of 639 students (373 boys and 266 girls) with a mean age of 14.78 years ($SD = 1.18$; range 12-16). The age distribution for boys was 12 years (0.8%), 13 years (17.8%), 14 years (25.4%), 15 years (21.0%), and 16 years (35.0%); for girls, it was 13 years (25.7%), 14 years (6.7%), 15 years (24.5%), and 16 years (44.2%). Most respondents (95.3%) was born in Belgium. Nearly two thirds (65.7%) were following a general educational program, which is representative of the overall Belgian school population (62.6%; Department of Education, 2011).

A set of χ^2 -tests explored whether there were significant differences between the adolescents participating in one wave or adolescents excluded for missing data ($N = 422$) and those fully participating in both waves ($N = 639$). The results revealed first that there were no significant differences with regard to pubertal status and visiting sexually explicit websites ($p > .05$). However, the subjects participating in the first wave (16.1%) were significantly more likely to have initiated sexual intercourse than those who completed both questionnaires (8.6%), $\chi^2(1) = 13.74$, $p < .001$.

Measures

The survey included questions on the control variables, pubertal status, sexual initiation and the use of sexually explicit websites. The questions were based on instruments whose validity and reliability have been established in prior research involving English- and Dutch-speaking adolescents (Armsden & Greenberg, 1987; Eggermont, 2006; Peter & Valkenburg, 2008; Stephenson, Hoyle, Palmgreen, & Slater, 2003; Vandenbosch &

Eggermont, 2012). Instruments that had not yet been translated into Dutch were evaluated and approved by a panel of fellow researchers at the host university and pretested using a small sample of adolescents.

Control variables. Participants reported their gender, age, country of origin (*Belgium or another country*) and educational level. The last variable was based on the academic track in which each pupil was enrolled. The secondary school system in Belgium is divided into three levels: the highest level (*General education*) prepares teenagers for post-secondary education, the middle level (*Technical education*) teaches primarily technical skills, and the third level (*Vocational education*) prepares students for specific professions, such as baking or masonry.

Communication with peers was measured using items from Armsden and Greenberg's (1987) Inventory of Peer Attachment. The nine items with the highest factor loadings on the Communication factor in the original study were selected. However, the item "My friends accept me as I am" was replaced by the item "My friends understand me", as the latter item explicitly refers to communication quality. Using a five-point scale from *never true* (1) to *always true* (5), respondents indicated their agreement with items such as "My friends understand me." An average score was calculated by summing the item scores and dividing by the number of items ($\alpha = .92$).

Similarly, communication with parents was measured using 9 items from the Communication subscale in Armsden and Greenberg's (1987) Inventory of Parent Attachment. First, the 7 items with the highest factor loadings in the original study were selected (the item "I feel it's no use letting my feelings show" was excluded because the item did not directly refer to parents). We also included the items "My parents understand me" and "When we discuss things, my parents consider my point of view." Items were rated using the same response scale as the peer items and an average score calculated ($\alpha = .87$).

The Brief Sensation Seeking Scale-4 (BSSS-4) was used to measure sensation seeking (Stephenson et al., 2003). Using a five-point scale from *never true* (1) to *always true* (5), respondents indicated their agreement with four items, including “I like new and exciting experiences, even if I have to break the rules” ($\alpha = .68$). An average score for sensation seeking was calculated.

Pubertal status. In accordance with prior research (McCabe, Ricciardelli, & Finemore, 2002), pubertal status was measured using two items ($r = .51, p < .001$) from the Pubertal Development Scale (Petersen, Crockett, Richards, & Boxer, 1988): “Describe the level of body hair growth” and “Describe the development of breasts” (girls) or “Describe the development of voice change” (boys). Respondents could answer these items with *not yet started* (1), *just started* (2), *is still going on* (3), or *seems complete* (4). Respondents ($N = 95$) who answered “*I don’t know*” or did not answer the items were coded as having a “missing value” on pubertal status.

This variable was recoded to create a new variable, which consisted of two categories. The first category, *adolescents in an early pubertal stage* (0), included adolescents whose pubertal development had not yet started, had just started or was still going on ($N = 420$). We chose to include 25 adolescents (3.9% of the sample) whose pubertal development had not yet started because the research predicts that their pubertal development will start soon and that they are likely already experiencing hormonal changes (Mul et al., 2004). The second category, *adolescents in an advanced pubertal stage* (1), included adolescents whose pubertal development seemed complete for at least one of the two items ($N = 219$).

Sexual initiation. Respondents indicated whether they had ever had sexual intercourse (*no* = 0; *yes* = 1).

Use of sexually explicit websites. Respondents indicated on a 7-point scale (*never* = 1 through *several times a day* = 7) how often during the last six months they had intentionally

exposed themselves to (a) pictures with clearly exposed genitals, (b) videos with clearly exposed genitals, (c) pictures in which people are having sex, (d) or videos in which people are having sex (Peter & Valkenburg, 2008, p.585) ($\alpha = .91$). In line with the method used by Peter and Valkenburg (2008), these four questions were introduced by referring to the use of online pornographic websites. By summing the four item scores and dividing the sum by the total of items, an average score for use of sexually explicit websites was produced. This variable was further recoded to create an additional variable divided into four categories: *non-users* (= 0), *users who visit sexually explicit websites less than once per month* (= 1), *users who visit sexually explicit websites monthly* (= 2) and *users who visit sexually explicit websites weekly to several times a day* (= 3).

Results

Preliminary Analyses

Table 1 presents the descriptive statistics at baseline (for the analytic sample) for all variables. Focusing on the main study variables, 8.6% of the sample had already had sexual intercourse at baseline. Another 6.1% indicated they had initiated sexual intercourse six months later, which is in line with the expected number of transitioning adolescents over a period of six months (Avery & Lazdane, 2008). At baseline, 65.7% of the adolescents indicated they were in an early pubertal stage and 34.3% were in an advanced pubertal stage. Almost half of the adolescents (45.9%) indicated that they had visited sexually explicit websites. More specifically, 24.9% of those adolescents had visited sexually explicit websites less than once per month, 10.5% visited them monthly and 10.5% visited them weekly to daily.

Using Pillai's Trace, a MANOVA analysis revealed significant differences between adolescents in an early pubertal stage and adolescents in an advanced pubertal stage with respect to several control variables (sensation seeking, educational level, communication with

parents, communication with peers, and age) and with frequency of visiting sexually explicit websites ($V = .22$, $F(6, 632) = 29.02$, $p < .001$, $\eta^2 = .22$). Separate univariate ANOVAs on the outcome variables focused on the significant differences revealed by the MANOVA analysis. First, adolescents in an early pubertal stage showed a lower level of communication with peers ($M = 3.28$, $SD = .76$) than adolescents in an advanced pubertal stage [$(M = 3.64$, $SD = .63)$, $F(1, 637) = 37.02$, $p < .001$, $\eta^2 = .063$]. Second, adolescents in an early pubertal stage were also younger ($M = 14.41$, $SD = 1.18$) than adolescents in an advanced pubertal stage [$(M = 15.48$, $SD = .81)$, $F(1, 637) = 144.41$, $p < .001$, $\eta^2 = .188$].

In addition, a set of χ^2 -tests explored possible pubertal status differences with regard to gender, country of origin and sexual initiation. Girls were underrepresented in the group of adolescents in an early pubertal stage (32.6% girls; 67.4% boys), whereas boys were less likely to belong to the group of adolescents in an advanced pubertal stage (58.9% girls; 41.1% boys), $\chi^2(1) = 40.93$, $p < .001$. Adolescents in an early pubertal stage (6.0%) were less likely to have initiated sexual intercourse than adolescents in an advanced pubertal stage (13.7%), $\chi^2(1) = 10.98$, $p < .001$. No significant differences emerged regarding country of origin.

Table 2 presents zero-order correlations between visiting sexually explicit websites, sexual initiation and pubertal status at time points 1 and 2. These correlations present some initial evidence for hypothesis 1a: for visiting sexually explicit websites at baseline small, but significant correlations were found with sexual initiation at baseline ($r = .12$, $p < .01$) and six months later ($r = .13$, $p < .01$). In contrast, regarding hypothesis 2a, sexual initiation at baseline was not related to using sexually explicit websites six months later ($p > .05$).

[Table 1 – Table 2 here]

Main Hypotheses

To test hypotheses 1 and 2 more rigorously, the data were analyzed with structural equation modeling (AMOS). Because pubertal status is expected to moderate the association between using sexually explicit websites and sexual initiation, we estimated separate models for adolescents in an early pubertal stage and adolescents in an advanced pubertal stage. In line with prior research that used structural equation modeling (Baumgartner, Valkenburg, & Peter, 2011), models controlled for baseline values for country of origin, gender, age, educational level, communication with parents, communication with peers and sensation seeking by adding them as predictors for sexual initiation at wave 2 and visiting sexual websites at wave 2 and by allowing them to covary with sexual initiation at wave 1 and visiting sexual websites at wave 1.

As one of the endogenous variables included in the model is dichotomous (sexual initiation), the model was analyzed using Bayesian estimation (Arbuckle, 2010; Byrne, 2010). Both models—adolescents in an early pubertal stage ($N = 420$) and adolescents in an advanced pubertal stage ($N = 219$) met the assumptions of reliability for Bayesian estimation with a convergence statistic of 1.001 and a Bayesian standard error for each parameter estimate that is lower than .02. Figure 1 presents the results for adolescents in both early and advanced pubertal stages. For clarity, the measurement details and control variables are not shown.

With regard to hypothesis 1, the results differed according to pubertal status. The expected impact of visiting sexually explicit websites at baseline on sexual initiation six months later was significant and positive among adolescents in an early pubertal stage (standardized direct effect mean = .37, 95% CI: .17 - .58). However, among adolescents in an advanced pubertal stage, the estimated effect was *negative*: visiting sexually explicit websites at baseline *decreased* the likelihood of initiating sexual intercourse among adolescents in an advanced pubertal stage (direct effect = -.50, 95% CI: -.89 - -.15). Consistent with hypothesis

1, the results suggest that visiting sexually explicit websites especially stimulated adolescents in early puberty to initiate sex. Unexpectedly, the results also showed that adolescents in an advanced pubertal stage were less likely to initiate sexual intercourse when they visited sexually explicit websites frequently.

With regard to hypothesis 2, the estimated reverse effect of sexual initiation at baseline on frequency of visiting sexually explicit websites was not significant for adolescents either in an early pubertal stage (direct effect = $-.01$, 95% CI: $-.47 - .45$) or an advanced pubertal stage (direct effect = $-.06$, 95% CI: $-.49 - .39$). Hypothesis 2 was thus not supported.

[Figure 1 here]

Longitudinal Analyses of Time 1 Virgins

A logistic regression analysis was used to further test the association between viewing sexually explicit websites and sexual initiation six months later. This analysis allowed us to examine adolescents at risk for early sexual initiation in more detail because frequent visitors of sexually explicit websites can be distinguished from occasional, infrequent and non-users. The analysis was performed with the respondents who had not yet been sexually active at baseline ($N = 584$) and controlled for baseline values on country of origin, gender, age, educational level, communication with parents and peers, and sensation seeking. The categorical variables of pubertal status and viewing of sexually explicit websites, and the two-way interaction effect of these variables, were added as predictors.

Results (see Table 3) indicated that pubertal status and exposure to sexually explicit websites significantly predicted sexual initiation. More specifically, adolescents in an advanced pubertal stage were four times more likely to initiate sex than adolescents in an early pubertal stage (OR: 3.16; 95% CI: 1.09–9.21). Frequent users of sexually explicit

websites five times more likely to initiate sex than non-users of sexually explicit websites (OR: 4.96; 95% CI: 1.34-18.40). Hypothesis 1a was thus further supported by these analyses.

The two-way interaction effect of pubertal status and visiting sexually explicit websites was not significant in the overall sample of Time 1 virgins. However, the subset of adolescents in an advanced pubertal stage who visited sexually explicit websites regularly were *less* likely to initiate sex than adolescents in an early pubertal stage who never visited sexually explicit websites (OR: 0.4; 95% CI: .01-.48; $p < .05$). The odds ratio was lower than 1, suggesting a negative two-way interaction between exposure to sexually explicit websites and pubertal status. These results confirm what was seen in the SEM models: adolescents with a more advanced pubertal status who view sexually explicit websites are less likely to have initiated sexual intercourse.

Finally, as prior research (Ward, 2003) has suggested that gender and age may be important moderators of the effects of sexual media, two additional longitudinal logistic regression analyses to test the interactive effects of gender and age (as a categorical variable; 12-14 year olds vs. 15-16 year olds). These analyses indicated that there were no significant three-way interaction effects of using sexually explicit websites and pubertal status with gender or age (additional information available from the first author).

[Table 3 here]

Discussion

Although research has repeatedly examined associations between using sexually explicit websites and sexual attitudes (e.g., Peter & Valkenburg, 2010), this study is one of the first to examine the longitudinal relationship between such content and early sexual initiation. In addition, our study aimed to explore whether adolescents are more susceptible to sexual effects because of pubertal changes. The findings of our longitudinal study identified adolescents at an early stage of pubertal development to be more susceptible to the effects of

using sexually explicit websites than adolescents in a late pubertal state. The possibility of a reciprocal relationship was also examined but was not supported.

Pubertal status and sexual media effects. This study showed that adolescents in an advanced pubertal stage were, in general, four times more likely to have initiated sex and that frequent users of sexually explicit websites were five times more likely to have initiated sex. Analyses further indicated that the relation between the use of sexually explicit websites and having initiated sex was positive for adolescents in an early pubertal stage but negative for adolescents in an advanced pubertal stage. In other words, the results seem to indicate that although adolescents in early puberty are put at risk for initiating sex by using sexually explicit websites, adolescents in late puberty seem to be “protected” from the harmful effects of such content. These findings have some interesting implications for future research.

First, the findings suggest that pubertal status is important for identifying adolescents who are at risk. After controlling for several important variables, the present study supports that *adolescents in early puberty* are more likely to be affected by sexual media. However, the reasons for their increased susceptibility remain unclear. One reason relates to the biological aspects of this life stage: researchers (e.g., Buchanan et al., 1992, p. 63) have repeatedly highlighted that “the biological changes of puberty are likely to be especially salient in the pre- and early pubertal years because this is when they begin.” Due to these physical and hormonal changes, sexually explicit material may stimulate sexual curiosity and/or provoke new and unknown sexual urges (Brown et al., 2005; Buchanan et al., 1992), causing adolescents in early puberty to be more susceptible to effects from pornography. However, the exact mechanism underlying this exploration remains undefined. Studies linking biological markers to adolescents’ use of and reactions towards sexually explicit material may provide clarification. The use of hormone measures may provide an additional

advantage in this type of research because self-report measurements have been shown to overestimate actual pubertal growth (Shirtcliff, Dahl, & Pollak, 2009).

Another reason relates to the changing social context for young people in early puberty. Changes in social relationships may make adolescents aware for the first time that they have become sexual beings. When pubertal changes start, adolescents' social environment is likely to react to these changes (Brooks-Gunn & Furstenberg, 1989). For instance, peers may start to see them as potential sexual partners and show sexual interest in them. This new (socially stimulated) view of themselves as sexual beings may make teens more attentive when consuming sexual media, perhaps resulting in acceptance of the sexual behaviors that are promoted in such media. Future research may thus focus more extensively on the social aspect of sexuality and explore the suggested process involving puberty, sexual interest of peers, sexual self-concept, media use and sexual behavior.

Finally, Brown et al. (2005) have suggested that media may function as a kind of sexual super peer for (young) adolescents. When adolescents in early puberty are confused or curious about their new bodies, they may search for information and view the media as a valuable source of information. One study has indicated that after friends (74.9%) and mothers (60.9%), the third most important source of sexual information is the media (57%) (Bleakly et al., 2009). Following this view, content analyses have suggested that the media may teach adolescents which sexual behaviors are acceptable (Ward, 2003). Because our research brings to the foreground the heightened susceptibility of adolescents in early puberty to the effects of sexual media, it is important for future research to further explore the characteristics of adolescents in early puberty and how these characteristics relate to their exposure and reactions to sexually explicit material. Moreover, studies may examine whether adolescents in early puberty also report more positive effects of using sexually explicit websites, such as increased sexual pleasure or sexual communication (see Döring, 2009).

Future research also needs to address *adolescents in later puberty* because they seem to be less likely to initiate sex when viewing sexually explicit websites. This may be explained by the concept of sexual uncertainty. Research has suggested that exposure to sexually explicit websites increases sexual uncertainty, which is defined as the extent to which an individual is uncertain about one's own sexual attitudes, expectations and beliefs (Peter & Valkenburg, 2010). Sexual uncertainty, in turn, may engender a lower perceived sexual self-efficacy (Martino et al., 2005, p.916), leading to a decreased chance of initiating sexual intercourse (Martino et al., 2005). According to this explanation, sexual uncertainty and sexual self-efficacy serve as mediators for the negative association between exposure to internet pornography and sexual initiation.

Although this suggestion deserves further research attention, it does not explain why the negative association only emerges in late puberty. In this respect, it can be argued that adolescents in early puberty may not be "capable" of reacting in another way that is different from the instinctive stimulation of sexual drives after exposure to sexual stimuli. On the one hand, adolescents in early puberty are not familiar with sexual drives (Buchanan et al., 1992) and this lack of experience may cause them to react instinctively. Adolescents in later puberty, on the other hand, are probably more accustomed to sexual stimulation and may thus be more "experienced" in coping with sexual arousal, allowing for other reactions beyond sexual arousal. Furthermore, these adolescents may process the sexual messages promoted in such content more extensively and integrate them into their own sexual attitudes and cognitions, possibly resulting in increased feelings of sexual uncertainty and a lower perceived sexual self-efficacy. Another possible explanation is that adolescents in a more advanced pubertal stage are more comfortable with their own sexual needs and do not feel the urge to seek a sexual partner to satisfy their sexual needs. In this view, one study has suggested that young adults (especially males) masturbate frequently after watching

pornographic media content (Mosher & Maclan, 1994). Future research may thus explore whether the frequency of masturbation is a mediating mechanism between visiting sexually explicit websites and early sexual initiation.

It is noteworthy that we did not find a three-way interaction effect between pubertal status, the use of sexually explicit websites, and either gender or age on sexual initiation. Regarding gender, this finding is in contrast with the results from studies on the use of television (Vandenbosch & Eggermont, 2012) and sexually explicit media in general (Brown & L'Engle, 2009), but it is consistent with research on sexually explicit websites. Peter and Valkenburg (2008a; 2009a; 2009b) have repeatedly reported no gender differences for the longitudinal relationship between using sexually explicit websites and adolescents' sexual development. More research is therefore needed to explore this lack of gender differences. Future research may also consider focusing on pubertal development instead of age when examining early adolescents as our results highlight the importance of pubertal status above age.

Causal direction. Throughout the past five years, scholars have suggested that linkages between media use and sexual development should not just be framed within a media effects perspective, but rather within a broader reciprocal context, acknowledging individual characteristics that may affect media use (Aubrey, 2007; Bleakly et al., 2008). Taking into account this new research approach, this study tested the possibility of a reciprocal relationship between the use of sexually explicit websites and sexual initiation. The results supported media effects theories (e.g., Bandura, 2001), but no evidence was found for selective exposure theory (Festinger, 1957; Steele, 1999).

One possible explanation is that the use of sexually explicit websites depends on factors other than sexual behavior, such as the need for sexual exploration (e.g., Peter & Valkenburg, 2008) or sexual satisfaction (e.g., Peter & Valkenburg, 2009). For instance, one

study by Peter and Valkenburg (2009) showed that lower levels of sexual satisfaction lead to increased use of sexually explicit websites. Lower levels of sexual satisfaction may occur irrespective of whether one has ever had sexual intercourse. Adolescents who have had sexual intercourse may, for example, feel disappointed about their (first) sexual experience as the experience may not have met their expectations, and thus feel sexually dissatisfied. Adolescents who have never had sexual intercourse may interpret their lack of experience as unanswered sexual desire, leading to sexual dissatisfaction. Thus, adolescents who differ with regard to their sexual initiation status can experience sexual dissatisfaction, which is expected to increase their use of sexually explicit websites. Future research may need to explore this explanation and identify which sexual attitudes and cognitions predict a higher use of sexually explicit websites.

Limitations. The study was limited in some respects. First, although this study was strengthened overall by its specific focus on pubertal development instead of age, it was limited by the self-report method that was used to measure pubertal status. Future research may consider using medical examination reports that can accurately measure pubertal growth (Shirtcliff et al., 2009). Second, the proportion of sexually active adolescents was lower in this sample than in previous research (e.g., Avery & Lazdane, 2008) leading us to question whether the reported relations would have been stronger in a more sexually active sample. Third, this study was limited by the fact that 422 adolescents who participated in wave 1 did not participate in wave 2 or had to be excluded due to missing data. More importantly, those who dropped out of the study were more likely to have initiated sex, suggesting that this study may be underestimating the impact of sexually explicit websites on early sexual initiation and highlighting the need for future research to explore this effect in more detail. Fourth, future research may include younger adolescents (aged 10-12 years) to examine in depth the effects of variability in pubertal status among adolescents who have not yet entered

puberty, adolescents in an early pubertal stage and adolescents in an advanced pubertal stage. Fifth, the study focused on the initiation of sexual intercourse without specifically considering the social context in which sexuality occurs (e.g., Steele, 1999). Future research may therefore focus more extensively on relationships with peers, parents and romantic partners.

Conclusion. The present study examined the longitudinal relation between the use of sexually explicit websites and adolescents' sexual initiation. The study supported that frequent users of sexually explicit websites were more likely to initiate sexual intercourse than non-users, but no support was found for a reciprocal relationship. In line with the importance attached to pubertal status in sexual media literature (Ward, 2003), the present study supports the moderating role of pubertal status and asks for more research on its potential role.

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Table 1

Descriptive Statistics for Study Variables at Baseline

	Mean (<i>SD</i>) or Percent
Country of origin	95.3% Belgium 4.7% Other country
Gender	58.4% Boys 41.6% Girls
Age	14.78 years (1.18)
Student educational level	65.7% General secondary education 27.4% Technical secondary education 6.9% Vocational secondary education
Communication with parents	3.19 (.69)
Communication with peers	3.40 (.74)
Sensation seeking	3.35 (.81)
Pubertal status	65.7% Adolescents in an early pubertal stage 34.3% Adolescents in an advanced pubertal stage
Sexually explicit websites	54.1% Never 24.9% Less than once per month 10.5% Monthly 10.5% Weekly to daily
Sexual initiation	91.4% No 8.6% Yes

Note. $N = 639$

Table 2

Zero-order Correlations between Pubertal Status, Sexual Initiation and Sexually Explicit Websites

	Pubertal status W1	Pubertal status W2	Sexual initiation W1	Sexual initiation W2	Sexually explicit websites W1	Sexually explicit websites W2
Pubertal status W1	1	.73***	.15***	.21***	-.01	-.13**
Pubertal status W2		1	.11***	.21***	.03	-.06
Sexual initiation W1			1	.64***	.12**	.03
Sexual initiation W2				1	.13**	.01
Sexually explicit websites W1					1	.65***
Sexually explicit websites W2						1

Note. $N = 639$; * $p < .05$; ** $p < .01$; *** $p < .001$; Zero-order correlations were calculated with the metric variables of pubertal status

and sexually explicit websites. Binary coded variables were used for sexual initiation (*no* = 0; *yes* = 1).

Table 3

Logistic Regression Analysis of Use of Sexually Explicit Websites and Sexual Initiation among Virgins at Time 1

Sexual Initiation	<i>Regression Coefficient</i>	<i>SE</i>	<i>OR</i>	<i>95% CI</i>	<i>P value</i>
Country of origin (Belgium ref)	1.73	.56	5.64	1.87 - 17.00	.002
Gender (boys ref)	-.55	.52	.58	.21 - 1.60	.290
Age	.55	.21	1.74	1.16 - 2.61	.008
Educational level (ref General secondary education)					.138
Technical secondary education	1.12	.59	3.08	.974 - 9.71	.055
Vocational secondary education	.44	.43	1.55	.67 - 3.59	.305
Communication parents	-.45	.24	.64	.40 - 1.03	.065
Communication peers	.91	.30	2.48	1.38 - 4.45	.002
Sensation seeking	.16	.22	1.17	.76 - 1.82	.481
Pubertal status (ref adolescents in an early pubertal stage)	1.15	.55	3.16	1.09- 9.21	.035
Sexually explicit websites (ref non-users)					.046
Sexually explicit websites less than once per month	-.12	.73	.89	.21 - 3.72	.874
Sexually explicit websites monthly	.62	.74	1.87	.44 - 8.00	.402
Sexually explicit websites weekly to daily	1.60	.67	4.96	1.34 – 18.40	.017
Pubertal status X sexually explicit websites					.077
Pubertal status X sexually explicit websites less than once per month	-.70	.92	.50	.08 - 3.02	.446
Pubertal status X sexually explicit websites monthly	.06	1.01	1.07	.15 - 7.64	.949
Pubertal status X sexually explicit websites weekly to daily	-3.31	1.32	.04	.01 - .48	.012
Model constant	-13.91	3.46	.00		<.001

Note. $N = 584$; Model $\chi^2 (15) = 56.12, p, < .001$

Figure 1. Structural equation model for the relationships between the use of sexually explicit websites and sexual initiation among adolescents in an early pubertal stage ($N = 420$) and adolescents in an advanced pubertal stage ($N = 219$). Values reflect standardized coefficients and all paths (except for dotted line) are significant at $p < .05$. For clarity, error terms, measurements and control variables are not shown.