



# Sensation Seeking and Impulsivity Can Increase Exposure to Risky Media and Moderate Its Effects on Adolescent Risk Behaviors

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## Abstract

Media exposure to risky behaviors (e.g., alcohol use, violence) has been associated with adolescent engagement in risk-taking behaviors, but not all adolescents are equally at risk. Here we focus on individual differences in impulsivity and sensation seeking and assess their effects on the relation between media risk exposure and adolescent risk behavior. Survey data from 1990 Black and White US adolescents (mean age =  $15.6 \pm 1.10$  years; 48% female) and content analysis of top-grossing films and popular TV shows were analyzed using linear regression models. High levels of impulsivity and sensation seeking were associated with greater exposure to risky media content, and also operated as moderators, exacerbating the impact of media risk exposure on adolescent risk behaviors. Prevention efforts targeting negative effects of media on adolescent health should prioritize youth with high levels of impulsivity and sensation seeking.

**Keywords** Media effects · Adolescent risk behaviors · Impulsivity · Sensation seeking

Adolescents are spending increasing amounts of time with media (Lenhart 2015; Rideout 2016; Rideout et al. 2010). TV and movie exposure to risk behaviors is prevalent among adolescents and is linked to involvement in risk-taking behaviors (Brown and Bobkowski 2011; Strasburger et al. 2010). These effects have been reported for alcohol use (Hanewinkel and Sargent 2009; Wills et al. 2012), sexual risk-taking (Bleakley et al. 2008b; Brown et al. 2006; Collins et al. 2004; Hennessy et al. 2009), and aggressive behaviors (Bushman and Huesmann 2006). Although past studies have often assumed that the effect of media exposure on risk behaviors operates similarly for all adolescents, some adolescents may be more vulnerable than others (Valkenburg and

Peter 2013). By focusing on individual differences in impulsivity and sensation seeking (SS), this study examines the role of these personality dimensions in better understanding the media exposure–risk behavior relationship in adolescents.

## Impulsivity, Sensation Seeking, and Adolescent Risk-Taking

Impulsivity and SS are robust predictors of adolescent risk behaviors. Impulsivity is typically defined as a tendency to act on the spur of the moment without adequate consideration of the consequences and is assessed using self-report measures such as the Barratt (Patton et al. 1995) or Eysenck (Eysenck et al. 1984) scales. SS on the other hand reflects a propensity toward novel or exciting behaviors that is considered to be evolutionarily adaptive (Spear, 2007) and is commonly assessed using self-report measures such as Zuckerman's sensation seeking scale (Hoyle et al. 2002; Zuckerman 2006). Developmental studies find that SS exhibits a universal peak during mid-late adolescence and declines thereafter (Collado et al. 2014; Khurana et al. 2018). Impulsivity is a complex multidimensional construct (Whiteside & Lynam 2001). Some dimensions of impulsivity, such as the one assessed in this study (i.e., acting without thinking), exhibit a peak during adolescence but only for a sub-group of youth who have an underlying weakness in cognitive control

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(Khurana et al. 2018). These difficulties in impulse control can be identified at younger ages (Iacono et al. 2008) and tend to get exacerbated during adolescence when there is a concomitant rise in reward sensitivity (Bjork and Pardini 2015; Moffitt et al. 2011). Unlike impulsivity, SS does not reflect a lack of top-down control over behavioral urges. Instead, SS tends to be positively related to cognitive control measures like working memory (Khurana et al. 2018) and IQ (Raine et al. 2002). It is therefore not surprising that while SS is linked to experimentation with drugs and sexual behaviors, it is not associated with more adverse forms of risk-taking such as progressive drug use or dependence that reflect a loss of control (Khurana et al. 2015a; Khurana et al. 2017).

Guided by the “Uses and Gratifications” theory (Katz et al. 1974; Rubin 2009), several studies have linked SS and impulsivity to seeking out risky content in the media. Adolescents are not mere passive recipients but instead select media purposefully to gratify their needs. Such needs could be developmental (e.g., identity development) or to validate a particular behavior (e.g., validating aggressive tendencies by engaging with violent media). Studies have found that adolescents high in SS are more likely to be exposed to or seek out sexually explicit media content (Bleakley et al. 2011a; Brown and L’Engle 2009; Kim et al. 2006; Slater 2003). Individuals with high levels of impulsivity also report greater exposure to violent media (Chory and Goodboy 2010; Krcmar and Kean 2005). Thus, adolescents high in SS and impulsivity may be at greater risk for experiencing negative effects of media risk exposure (e.g., involvement in risk-taking behaviors) in part because of their higher exposure to risky content in the media (Anderson and Bushman 2001; Strasburger et al. 2010).

Alternatively, it is also possible that adolescents high in impulsivity and SS are more susceptible to the negative effects of media exposure on risk behaviors. This idea is consistent with the Differential Susceptibility Model (Valkenburg and Peter 2013) which posits that some youth experience greater susceptibility to media effects based on personality characteristics, moods, and cognitions. This model argues that personality dimensions such as impulsivity and SS may operate as moderators (as well as mediators) upon which effects of media would be conditional. Adolescents high in impulsivity and/or SS may be more likely to enact media depictions of risk behaviors in the real-world either due to the rewarding aspect or because of their relative inability to control behavioral urges and evaluate long-term consequences. We hypothesized that the association between media risk exposure and risk behavior would be positive and stronger in magnitude among adolescents high in impulsivity and SS (Gibbons et al. 2016; Slater et al. 2004; Wills et al. 2010).

By focusing on three common adolescent risk behaviors, i.e., alcohol use, sexual risk, and violence, this study addressed the following research questions: (1) Are high levels of SS and impulsivity associated with greater media (TV and

movie) exposure to alcohol use, sexual content, and violence, which in turn is linked to elevated risk for involvement in corresponding risk behaviors? (2) Do individual differences in SS and impulsivity moderate the relationship between media (TV and movie) risk exposure and real-world risk-taking for alcohol use, sexual behaviors and violence? (3) Does adolescent race moderate the pathways of influence described in RQ1 and RQ2, i.e., do the direct, mediated, or moderated effects vary for White and Black adolescents? Alcohol use, sexual risk, and violence were modeled as separate outcomes.

## Methods

This study includes data from a content analysis of popular entertainment media titles and an online survey administered to a sample of 2424 adolescents aged 14–17 years, recruited from online opt-in, volunteer panels through survey company GfK between November 13 and December 14, 2015. Most respondents (76%) were recruited through their parents; remaining were recruited directly. Potential respondents were screened for whether they were a teen aged 14–17, parent of a teen aged 14–17, or not eligible. Parents were asked to consent for their child to participate before being asked to bring their teen to complete the rest of the survey. All teens were given assent information before beginning the survey. The survey procedures were approved by the Institutional Review Board of the sponsoring institution. The survey had a median length of 26 min. Respondents received an incentive for participating (e.g., panel points from survey firm). The purpose of the larger study was to examine Black and White differences in media exposure and its effects on risk behaviors; therefore, Black adolescents were oversampled for a roughly equal sample of Black and White respondents. Given the study design, we selected the non-Hispanic Black ( $n = 1000$ ) and non-Hispanic White ( $n = 990$ ) participants to be included in the current sample (total  $n = 1990$ ; mean age =  $15.6 \pm 1.1$  years; 48.8% female).

## Content Analysis

**Movie Sample** The top 30 grossing movies of 2014 according to *Variety* magazine were selected as representing popular mainstream movies. Of the top 500 movies for 2013 and 2014 (1000 total), according to [www.boxofficemojo.com](http://www.boxofficemojo.com), 33 Black-oriented movies were selected based on following criteria: (1) Black actors comprised half or more of the main characters and/or (2) the movie had a Black-oriented narrative (Allen et al. 1989; Schooler et al. 2004; Sheridan 2006). Top-grossing movies of both 2013 and 2014 were included for Black-oriented movies in order to have a large enough sample for comparison purposes. The final sample included 29 mainstream movies and 34 Black-oriented movies (one film

originally coded with mainstream movies (*Ride Along*) met the criterion for a predominately Black cast).

**TV Show Sample** Nielsen statistics for adolescents aged 14–17 were used to determine the narrative television shows from the 2014 to 2015 season (from September 22, 2014 and June 28, 2015) that would be coded. The lists were separated by Black and non-Black adolescents because Black and non-Black adolescents tend to watch different kinds of shows (Ellithorpe and Bleakley 2016) in that adolescents in general tend to gravitate toward content with more characters from their own groups. Thus, television shows popular with Black adolescents will have more Black characters than shows popular with non-Black adolescents. We created lists of the top 30 shows watched by Black adolescents and the top 30 shows watched by non-Black adolescents (including primarily White viewers but also Hispanic, Asian, and others). Old shows airing repeat episodes and syndicated shows were also included but only when the number of repeats aired were equivalent to at least of one season of that show (Bleakley et al. 2017).

Four shows appeared on both the top 30 for non-Black and top 30 for list for Blacks; thus, 56 shows were coded. Episodes from the 2014–2015 season were coded, with the exception of a handful of shows in syndication or reruns (e.g., *How I Met Your Mother*) in which case the last season produced was coded. Either three or five episodes were randomly selected from each season for coding (Manganello, Franzini, & Jordan, 2008). If a show had ten or fewer episodes in the 2014–2015 season, three episodes were randomly selected ( $n = 5$ , 8.9% of shows). If a show had more than ten episodes that season, five episodes were randomly selected ( $n = 47$ , 83.9% of shows). If a show had a 15-min runtime, six episodes were selected to equate the amount coded to a half-hour show ( $n = 4$ , 7.1% of shows).

**Content Coding Procedures** The television and movie contents were coded by trained coders in 5-min segments using a directed, quantitative, previously validated coding scheme (Bleakley et al. 2012; Bleakley et al. 2014; Jamieson and Romer 2008). After multiple training sessions, the coders achieved inter-coder reliability for identifying the presence of each behavior as calculated by Krippendorff's alpha (Hayes and Krippendorff 2007) using a separately validated test sample of 59 segments. Each segment was coded for the portrayal of alcohol, sex, and/or violence. Alcohol portrayal was defined as a character being directly involved any activity related to alcohol, ranging from handling of alcohol bottles to observed consumption ( $\alpha = 0.94$ ). Sexual behavior was defined as any type of sexual contact, from kissing on the lips to explicit intercourse ( $\alpha = 0.93$ ). Violence was defined as initiated or received intentional acts to inflict injury or harm ( $\alpha = 0.94$ ).

## Online Survey

**Media Exposure to Risk Behaviors** Exposure to media content was calculated for alcohol, sex, and violence using content analysis of movies and TV shows and participants' exposure to film titles and TV shows. Participants were presented with the list of coded films (randomly ordered) in a grid and asked to indicate whether they had never seen the film, seen the film once, or seen the film more than once. Similarly, they were presented with additional grids for the coded television show titles and asked to indicate how often they had watched each show. Content-specific exposure was operationalized by multiplying the proportion of segments for each film containing the risk behavior by each participant's self-reported exposure to the film (indicated on the survey for whether they had seen each film: never (0), once (1), or more than once (2)) or television show (how often they watched each coded television show in the past year, on a scale from 0 = never to 3 = often). Using a previously tested approach (Bleakley et al. 2008a; Bleakley et al. 2011b; Hennessy et al. 2009), these scores were summed across all movie and all television titles, separately, to create a measure of exposure to each risk in movies and in television. The measures were then standardized.

**Impulsivity** We used nine yes/no items adapted from the Junior Eysenck Impulsivity Scale (Eysenck et al. 1984) (e.g., Do you usually do and say things without stopping to think?). Scores were averaged to create a composite index (range = 0–1;  $M = 0.47$ ,  $SD = 0.31$ ,  $\alpha = 0.80$ ).

**Sensation Seeking** We used four items (e.g., "I like to do frightening things") representing each of the four dimensions (i.e., experience seeking, boredom susceptibility, thrill/adventure seeking, and disinhibition) of the Brief Sensation Seeking Scale (Hoyle et al. 2002). Responses were coded on a 5-point scale ranging from strongly disagree to strongly agree and averaged to create a composite score (range = 1–5;  $M = 3.29$ ,  $SD = 1.00$ ,  $\alpha = 0.87$ ).

**Alcohol Use** Drinking frequency was assessed by asking about the number of times the respondent had had at least one drink of alcohol in the past 6 months (Centers for Disease Control and Prevention 2015) (range: never (0) to about every day (5) ( $M = 0.58$ ,  $SD = 1.04$ )).

**Sexual Activity** Progression in sexual activity was measured using an ordered (Guttman) scale of the following dichotomous items assessing activities engaged in the past 6 months: kissed, touched each other over clothes, touched breasts/had breasts touched, touched a partner's private parts, saw a partner naked, was naked with partner, received oral sex, had vaginal sex, and gave oral sex (Hennessy et al. 2008). The items are listed by difficulty: the Loevinger's  $H$  coefficient

was 0.89 (van Schuur 2003) and KR-20 for the scale was 0.94 ( $M = 2.11$ ,  $SD = 3.01$ ).

**Violence** This variable was assessed by asking about involvement in a physical fight in the past 6 months (Centers for Disease Control and Prevention 2015). Response options ranged from 0 times (0) to 12 or more times (7). Given the skewed distribution, the highest three categories with low frequencies were collapsed, with the new variable range of 0 times (0) to 6–7 times or more (4) ( $M = 0.44$ ,  $SD = 0.90$ ).

**Covariates** Age, gender (male = 0, female = 1), perceived parental monitoring, maternal education, and daily TV time were included as covariates because of their relationship to media exposure and/or risk behaviors. In all models, race (White = 0; Black = 1) was examined as a moderator for direct, indirect, and moderated effects. If the moderated effect was non-significant, race was included as a control in the model. Perceived parental monitoring, or the extent to which an adolescent believes his or her parents knows about their whereabouts/activities, was measured by eight items ranging from never (1) to always (5) ( $\alpha = 0.92$ ,  $M = 3.80$ ,  $SD = 0.94$ ) (Kerr et al. 2010). Maternal education was assessed using five categories: 1 (some high school) to 5 (graduate degree). We calculated daily TV time by asking participants how many hours they spent watching television in three time periods the previous day: before noon, between noon and 6 pm, and after 6 pm. In order to have a maximum of 24 h, responses greater than 6 h for the time period between noon and 6 pm ( $n = 41$ , 2.09%) were recoded as 6 h, and responses greater than 9 h were recoded as nine for the other two time periods (before noon  $n = 28$ , 1.42%; after 6 pm  $n = 15$ , 0.08%). Responses were then summed ( $M = 5.50$ ,  $SD = 4.61$ ; median = 4.5).

### Statistical Analysis

Descriptive analyses were conducted using *t* tests or chi-square as appropriate, and correlations among the model variables were assessed. Separate linear regression models were used for the three behavioral outcomes, with robust estimation procedures to account for any violations of normality. Alcohol use was included as an additional control in models predicting sexual activity and violence. Descriptive analyses were conducted in STATA 14.0. Final models were estimated in *Mplus* v8, with mediated and moderated effects tested in the same model. Moderation effects were tested as two-way and three-way interactions by using product terms with mean centered variables (Jaccard and Turrissi 2003). The interaction effects were tested individually, including main effects of predictor variables and covariates in the same model. The data presented here are unweighted.

## Results

Correlations and means (SD) of study variables are presented in Table 1. The media exposure–risk behavior association was significant in case of sexual risk, alcohol use, and violence, for both TV and movie exposure. Impulsivity and SS were positively associated with TV and movie exposure to sex, alcohol use, and violence with involvement in all three risk behavior outcomes, with impulsivity having stronger associations than SS.

In the model predicting sexual activity, we found direct effects of media risk exposure and of SS and impulsivity. Some of the effect of impulsivity and SS on sexual activity was mediated by media exposure to sexual content. (See indirect effect estimates in Table 2). Adolescents with high levels of impulsivity and SS reported greater exposure to media sexual content, which in turn was associated with higher levels of sexual involvement. Impulsivity and SS did not moderate the direct or mediated effects. Further, no racial differences were observed in the direct or mediated effects, with the exception of SS's effect on sexual behaviors which tended to be significant for White youth ( $B$  (SE) = 0.26 (0.09),  $p = 0.003$ ) but not for Black youth ( $B$  (SE) = 0.06 (0.09),  $p = 0.51$ ). However, this moderated effect (i.e., SS  $\times$  race) ( $B$  (SE) = -0.37 (0.13),  $p = 0.004$ ) became non-significant ( $B$  (SE) = -0.20 (0.12),  $p = 0.09$ ), controlling for the effect of alcohol use, and thus was not retained in the final model. The direct effect of TV sex exposure on sexual activity was also not significant at  $p < 0.05$ , possibly due to its strong association with movie sex exposure ( $r = 0.69$ ).

In case of alcohol use, we observed direct positive effects of TV and movie alcohol exposure as well as of impulsivity and SS. Some of the effect of impulsivity and SS was channeled through the association with media exposure to alcohol use. Additionally, SS moderated the effect of TV and movie alcohol exposure on drinking (see Table 2). Specifically, the association between media alcohol exposure and self-reported drinking frequency was significant only at high levels of SS (i.e., values  $\geq 3$ ; variable range = 1–5) (See Fig. 1a, b). There was also a significant interaction between SS and race. SS was significantly positively associated with drinking frequency only in case of White ( $B$  (SE) = 0.20 (0.03),  $p < 0.001$ ) but not Black youth ( $B$  (SE) = 0.03 (0.03),  $p = 0.36$ ). Race did not moderate any of the other direct or mediated effects.

For violence, we observed direct effects of TV and movie violence exposure as well as direct effects of impulsivity and SS. Some of the effects of impulsivity and SS on violence were channeled through their association with media exposure to violence. Both impulsivity and SS also moderated the effects of media violence exposure on violence, such that the association between media violence exposure (TV and movies) on violent behavior outcome was stronger for youth

**Table 1** Correlation matrix of key study variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
1 Sexual risk	1.00																	
2 Alcohol use	0.48	1.00																
3 Violence	0.28	0.32	1.00															
4 TV sex exposure	0.23	0.19	0.22	1.00														
5 Movie sex exposure	0.25	0.20	0.24	0.69	1.00													
6 TV alcohol exposure	0.25	0.21	0.20	0.96	0.64	1.00												
7 Movie alcohol exposure	0.25	0.19	0.23	0.69	0.99	0.64	1.00											
8 TV violence exposure	0.22	0.17	0.23	0.95	0.66	0.91	0.66	1.00										
9 Movie violence exposure	0.18	0.13	0.18	0.60	0.83	0.58	0.83	0.63	1.00									
10 Impulsivity	0.27	0.22	0.25	0.14	0.14	0.15	0.14	0.14	0.12	1.00								
11 Sensation seeking	0.19	0.18	0.07	0.15	0.12	0.15	0.12	0.15	0.14	0.30	1.00							
12 Parental monitoring	-0.17	-0.17	-0.20	-0.01	-0.04	<b>0.004</b>	-0.03	-0.02	0.04	-0.18	-0.09	1.00						
13 Gender (female = 1)	-0.10	-0.05	-0.14	<b>0.002</b>	<b>0.03</b>	-0.07	<b>0.02</b>	-0.06	-0.07	-0.04	-0.01	0.07	1.00					
14 Age	0.20	0.18	<b>0.03</b>	<b>0.02</b>	0.05	<b>0.03</b>	0.05	<b>0.003</b>	-0.02	-0.04	-0.04	-0.12	<b>0.01</b>	1.00				
15 Daily TV time	0.09	0.09	0.05	0.29	0.28	0.27	0.28	0.29	0.27	0.11	0.08	-0.03	<b>0.03</b>	-0.02	1.00			
16 Race (Black = 1)	<b>0.01</b>	-0.11	0.08	0.24	0.31	0.19	0.31	0.25	0.19	<b>0.003</b>	-0.03	-0.22	<b>0.03</b>	-0.002	0.16	1.00		
17 Maternal education	-0.04	-0.05	-0.10	-0.11	-0.08	-0.12	-0.06	-0.12	-0.06	-0.09	<b>0.01</b>	0.13	<b>0.01</b>	-0.01	-0.05	-0.03	1.00	
Range; mean (SD)	0–9; 2.11 (3.01)	0–5; 0.58 (1.04)	0–4; 0.44 (0.90)	0–19,88; 4.21 (3.56)	0–18,44; 3.30 (3.12)	0–27,14; 6.56 (5.24)	0–19,10; 3.45 (3.29)	0–39,07; 8.36 (6.93)	0–38,02; 10.20 (6.89)	0–1; 0.47 (0.31)	1–5; 3.29 (1.00)	1–5; 3.80 (0.94)	0/1 14–17; 15.59 (1.10)	0–24; 5.50 (4.61)	0/1 1–5; 3.12 (1.19)			

Values in bold denote coefficients not significant at  $p < 0.05$ . Mean and SD reported for continuous variables only

**Table 2** Unstandardized regression coefficients and standard errors for models predicting sexual risk, alcohol use, and violence

Pathways of influence	Sexual risk		Alcohol use		Violence	
	<i>B</i> (SE)	<i>p</i> value	<i>B</i> (SE)	<i>p</i> value	<i>B</i> (SE)	<i>p</i> value
<b>Direct effects: predictors</b>						
TV exposure	<b>0.05 (0.03)</b>	<b>0.08</b>	0.02 (0.01)	< 0.001	0.01 (0.004)	= 0.01
Movie exposure	0.10 (0.03)	= 0.001	0.04 (0.01)	< 0.001	0.01 (0.004)	= 0.001
Impulsivity	1.36 (0.21)	< 0.001	0.43 (0.08)	< 0.001	0.58 (0.07)	< 0.001
Sensation seeking	0.16 (0.07)	= 0.02	0.20 (0.03)	< 0.001	<b>0.01 (0.02)</b>	<b>0.72</b>
<b>Direct effects: covariates</b>						
Age	0.36 (0.05)	< 0.001	0.14 (0.02)	< 0.001	− 0.05 (0.02)	= 0.006
Gender (Female = 1)	− 0.61 (0.11)	< 0.001	<b>− 0.05 (0.04)</b>	<b>0.28</b>	− 0.17 (0.04)	< 0.001
Race (Black = 1)	<b>0.003 (0.13)</b>	<b>= 0.98</b>	− 0.39 (0.05)	< 0.001	<b>0.08 (0.04)</b>	<b>= 0.06</b>
Maternal Education	<b>0.02 (0.05)</b>	<b>= 0.66</b>	<b>0.002 (0.02)</b>	<b>0.91</b>	− 0.04 (0.02)	= 0.04
Parental Monitoring	− 0.17 (0.07)	= 0.02	− 0.15 (0.02)	< 0.001	− 0.08 (0.03)	= 0.001
TV time	<b>0.01 (0.02)</b>	<b>0.38</b>	<b>0.01 (0.01)</b>	<b>0.13</b>	<b>0.001 (0.01)</b>	<b>0.84</b>
Alcohol use	1.05 (0.07)	< 0.001			0.19 (0.03)	< 0.001
<b>Indirect effects</b>						
Impulsivity	0.10 (0.04)	= 0.007	0.06 (0.02)	< 0.001	0.13 (0.03)	< 0.001
Sensation seeking	0.05 (0.01)	= 0.001	0.03 (0.01)	< 0.001	0.05 (0.01)	< 0.001
<b>Moderated effects</b>						
Impulsivity × TV exposure	–	–	–	–	0.04 (0.01)	< 0.001
Impulsivity × movie exposure	–	–	–	–	0.04 (0.01)	< 0.001
Sensation seeking × TV exposure	–	–	0.01 (0.004)	0.01	0.01 (0.003)	= 0.05
Sensation seeking × movie exposure	–	–	0.01 (0.01)	= 0.05	0.01 (0.003)	= 0.03
Race × sensation seeking	–	–	− 0.17 (0.04)	< 0.001	–	–

Interaction effects were retained in the model only when significant. Indirect effects of impulsivity and sensation seeking reflect the total indirect effect, involving mediated pathways through TV exposure and movie exposure. In the moderation models, the interactions of TV exposure and movie exposure with impulsivity and sensation seeking were tested in separate models. Data rendered in bold represent effects are non-significant at  $p < 0.05$

with high levels of impulsivity and SS as compared to those with lower levels. Specifically, the relation between media (TV and movie) exposure to violence and involvement in physical fights was significant only at high levels of impulsivity (i.e., values  $\geq 0.4$ ; variable range = 0–1) and SS (i.e., values  $\geq 3$ ; variable range = 1–5). (See Figs. 2 and 3). No race differences were observed.

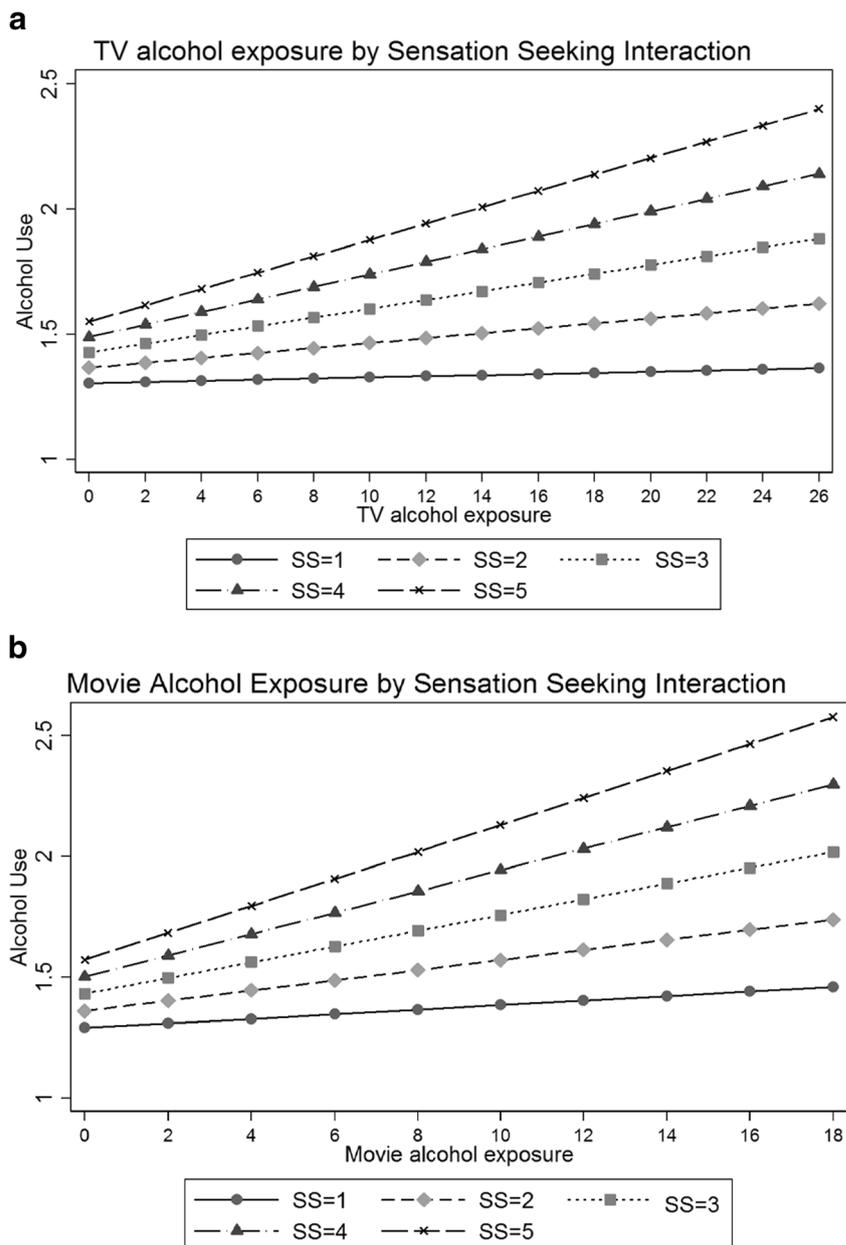
### Discussion

The purpose of this study was to examine the role of individual differences in impulsivity and SS in understanding the association between media risk exposure and adolescent risk behaviors. Specifically, we tested if adolescents high in impulsivity and SS reported greater exposure to TV and movie risk content and whether that in turn was associated with greater involvement in risky behaviors. We found that both impulsivity and SS were positively associated with media risk exposure, which in turn was positively related to real-world risk-taking. We also tested if individual differences in

impulsivity and SS moderated the media exposure–risk behavior link such that the association between media exposure and corresponding risk behavior would be stronger at higher levels of impulsivity and SS than at lower levels. We found evidence for moderation in case of alcohol use (for SS only) and violence (for both impulsivity and SS) but not for sexual behaviors. In terms of race differences, we found that the positive association between SS and alcohol use was significant only in case of White youth and not for Black youth. Race failed to moderate the direct effect of SS on sexual behaviors when controlling for the effect of alcohol use. No other race differences were observed. Overall, our findings suggest that prevention efforts aimed at reducing negative effects of risky media on adolescent risk behaviors could benefit from targeting youth high in impulsivity and SS.

Consistent with past studies (Bleakley et al. 2011a; Brown and L’Engle 2009; Kim et al. 2006; Slater 2003), adolescents high in impulsivity and SS reported greater media risk exposure, which in turn was positively associated with involvement in risk behaviors. The effects of impulsivity on sexual activity and violence were more pronounced than SS. In case

**Fig. 1 a, b** Interaction effects of media (TV and movie) exposure and sensation seeking (SS) on alcohol use



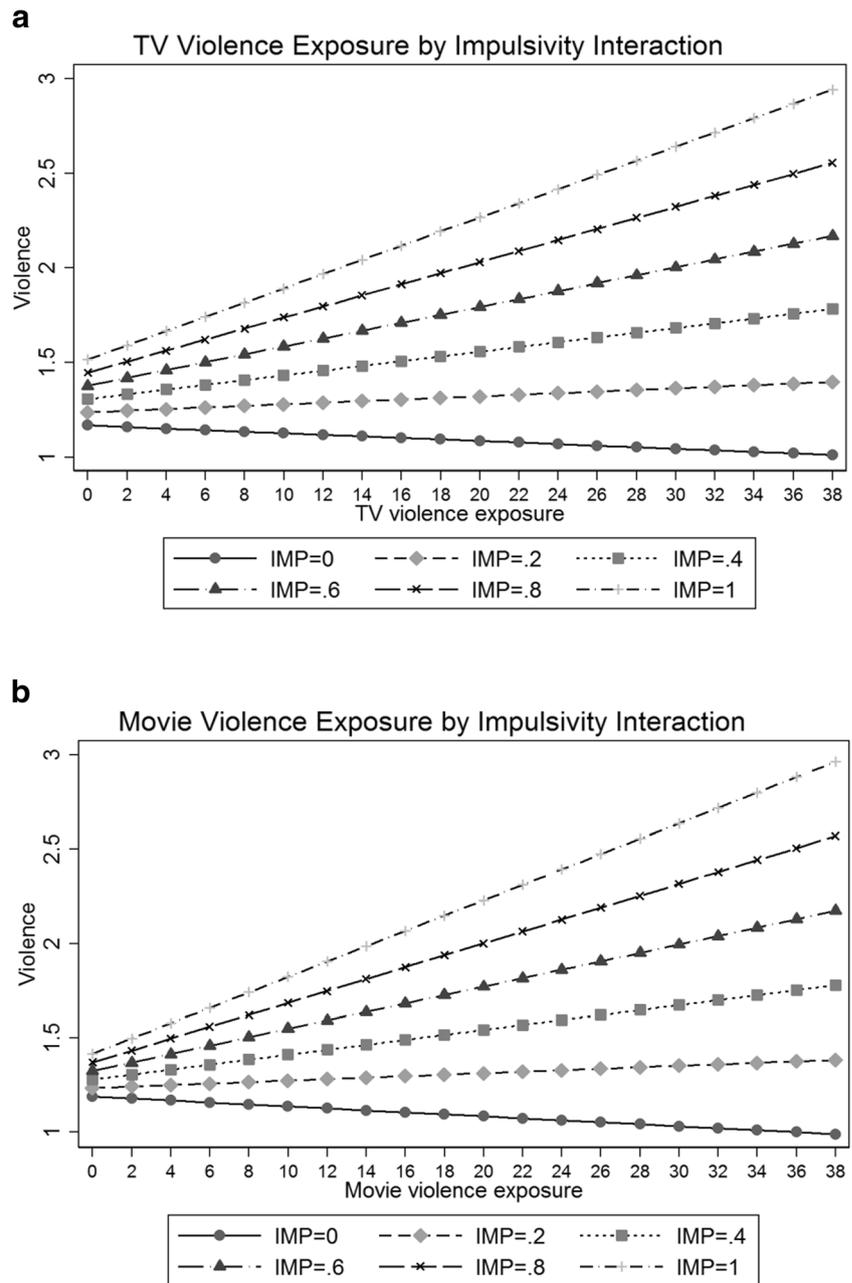
of alcohol use, the direct effects of impulsivity and SS were comparable, likely because experimenting with alcohol use is a more normative type of adolescent risk-taking that is often associated with social rewards (Balsa et al. 2011). For sexual behaviors and violence, lack of impulse control is expected to play a larger role in predicting behavior than SS (Khurana et al. 2012, 2015b).

Both impulsivity and SS moderated the effect of media risk exposure in case of violence. But for alcohol use, only SS moderated the effect of TV alcohol exposure. It is possible that because experimentation with alcohol use is socially accepted and normative, adolescents high in SS may be more strongly influenced by media depictions of drinking behaviors and engage in these behaviors for the rewarding component.

Violent behaviors on the other hand are not as normative and are more likely to be influenced by a lack of self-control (i.e., inability to control aggressive tendencies) and/or a rewarding component (e.g., deviant peer group conformity). Studies find that chronic exposure to violent forms of media (e.g., videogames) is associated with aggressive/violent tendencies, but consistent with our findings, these effects are stronger for individuals with poor impulse control (Kronenberger et al. 2005). Therefore, adolescents with impulse control difficulties and/or strong reward sensitivity may be more likely to act on aggressive tendencies fueled by media violence exposure.

In terms of race differences, the direct effect of SS on alcohol use was significant only in case of White youth. This may be because White youth are more likely to experiment

**Fig. 2 a, b** Interaction effects of media (TV and movie) exposure and impulsivity (IMP) on violence

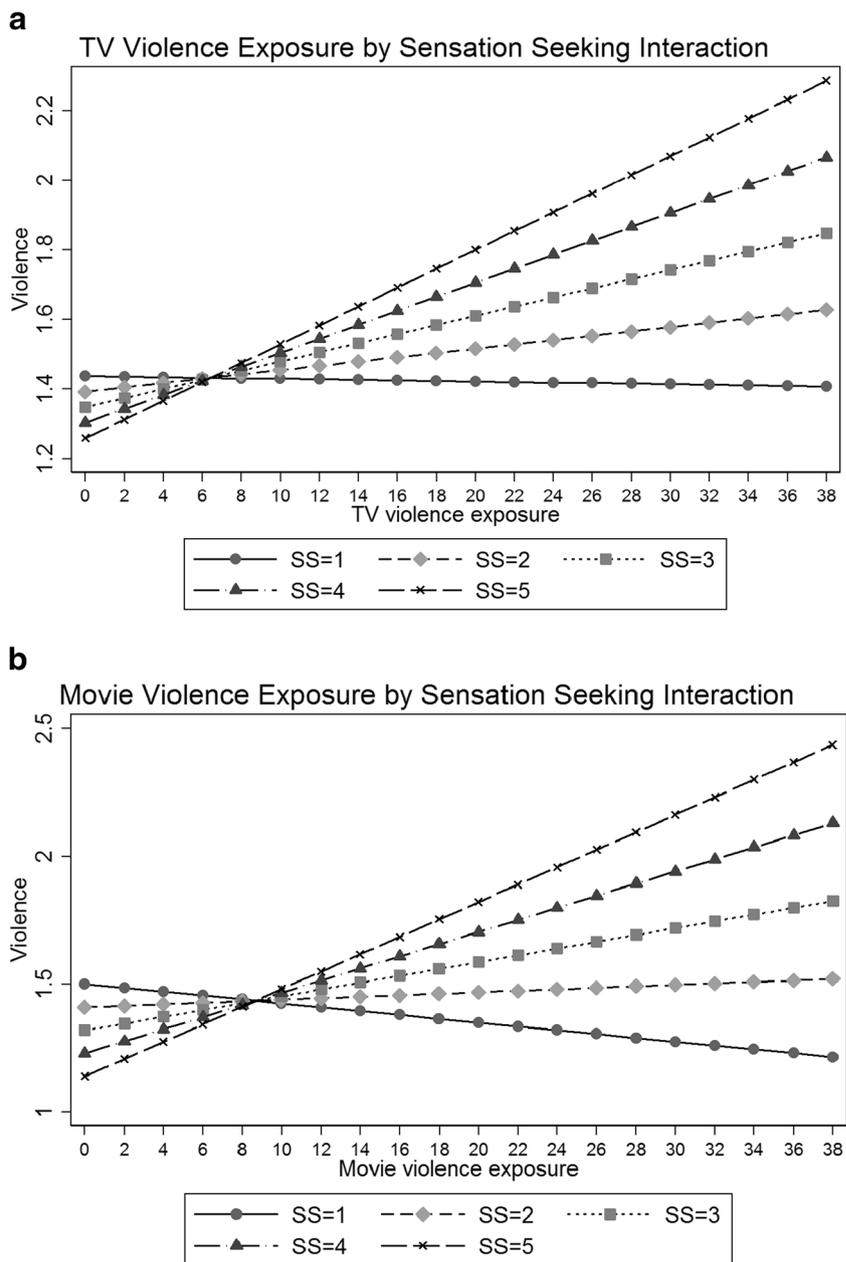


with alcohol and have greater access to alcohol than their Black counterparts (Blum et al. 2000). This finding also highlights the fact that even though SS exhibits a universal peak during adolescence (Khurana et al. 2018), the social contexts of adolescents can play a significant role in determining which behaviors adolescents actually engage in to satisfy their exploratory drives, as well as the health outcomes associated with these behaviors.

Adolescence is a period of rapid brain development, providing a window of plasticity to train weaknesses in impulse control. Several cognitive training interventions have yielded promising results in improving executive functions related to top-down control over behavior

(Jaeggi et al. 2011) and targeted drinking behaviors (Houben et al. 2011); however, no study to date has examined effects of cognitive training on adolescent impulsivity. This is a ripe area for future research, as similar interventions with younger children have reported protective effects of cognitive training on self-control (Diamond and Lee 2011). Other family-based interventions (Dishion and Stormshak 2007) and cognitive behavioral approaches (Heller et al. 2013) have also been used successfully to reduce impulsivity in adolescents. Although these findings need to be replicated, these are promising strategies to support adolescents who may be more vulnerable to the detrimental effects of media.

**Fig. 3 a, b** Interaction effects of media (TV and movies) exposure and sensation seeking (SS) on violence



Parental monitoring of media use and content may be another strategy to protect youth high in impulsivity and SS from being exposed to risky content in the media (Collier et al. 2016). Perceived parental monitoring, which is an indicator of the family climate and parental involvement, operated as a significant protective influence in all our models. Parents could play an important role by communicating with their child about media content and de-glamorizing it, so that youth high in SS and/or impulsivity are less likely to enact these behaviors. Policy-level changes can also help decrease risky media exposure for youth by having stricter and clearer guidelines. For example, a change in ratings systems (from age-based to content-based) could enable parents in reducing exposure to risky media.

**Limitations**

Our findings should be interpreted in light of the following limitations. First, cross-sectional data is not ideal for testing mediational processes that hypothesize specific temporal sequence of events (Maxwell and Cole 2007). Future research should examine temporality of these relations and explore reciprocal effect models. Previous studies have found that SS and impulsivity can predict exposure to risky media, and not the reverse, with the exception of videogaming literature where there is some evidence of excessive exposure to violence resulting in more impulsive behaviors (Bushman and Huesmann 2006). Second, we only examined effects of TV and movie risk exposure; other

forms of interactive media, including videogames, internet, and social media, could not be explored. Their appeal to youth high in impulsivity and SS as well as their effects on risk behaviors can vary as compared to TV and movie risk exposure. Relatedly, the high correlations between the media risk exposure variables (e.g., TV alcohol exposure and TV sex exposure) made it difficult to isolate the unique association of content-specific media risk exposure and the corresponding behavioral outcome. Third, our findings are based on a convenience sample of 14–17 years old U.S. adolescents who were recruited online and cannot be generalized to other populations. Finally, our findings based on self-report data are susceptible to issues of recall bias and single informant bias.

Our results provide support for both uses and gratifications paradigm and differential susceptibility hypothesis (for alcohol and violence). High impulsivity and SS can increase risk for problem behaviors through greater exposure to risky media, and by operating as moderators, although the influence of SS on some forms of risk-taking (e.g., experimentation with alcohol use) seemed to be stronger for White youth than Black youth. Understanding these processes longitudinally and in the context of environmental influences (e.g., parental and peer influences) will be an important direction for future research. Impulsivity and SS are important characteristics to consider when investigating how exposure to specific media content affects corresponding behavior, and they offer a possible point of intervention. For instance, by employing brief screeners for impulsivity and SS, health practitioners and educators could identify youth who may be at greater risk for negative outcomes associated with media risk exposure. This type of preventive approach would facilitate early identification and intervention support for youth most in need.

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## Compliance with Ethical Standards

**Conflict of Interest** The authors declare that they have no conflict of interest.

**Ethical Approval** All procedures involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. All procedures were approved by the University of Pennsylvania Institutional Review Board. This article does not contain any studies with animals performed by any of the authors.

**Informed Consent** Informed consent was obtained from all participants included in the study.

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