Title: Do sensation seeking and aggression traits moderate the association between peer influence and alcohol outcomes among young Swiss men?

Authors: Grazioli V, Gmel G, Mohler-Kuo M, Daeppen J, Bertholet N, Studer J

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Abstract

Peer influence is a strong predictor of drinking behaviors, yet not all young adults respond to its influence in the same way. This study aimed to identify young adults who are more vulnerable to peer influence by prospectively examining whether sensation seeking and aggression traits moderate the associations between peer influence and alcohol use and related consequences among young male drinkers. Participants (N = 4,624 participants) were young Swiss men from the Cohort Study on Substance Use Risk Factors. Measures of peer influence (i.e., descriptive norms and peer pressure to engage in misconduct), sensation seeking, aggression and alcohol use and related consequences were used from the baseline and 15-month follow-up assessments. Findings indicated that neither sensation seeking nor aggression significantly moderated the associations between peer influence and alcohol-related consequences. However, they revealed that sensation seeking and aggression had a moderating effect on the association between peer influence and total drinks per year, such that this association was overall stronger among participants scoring lower on personality traits. These findings suggest that young male drinkers with low scores on sensation seeking and aggression may benefit from stand-alone selective interventions targeting peer influence, whereas those scoring higher on these personality traits may rather benefit from programs that include interventions targeting both peer influence and personality risk factors of drinking behaviors.

Keywords: young adults, drinking, descriptive norms, peer pressure, personality traits, Switzerland

Introduction

More than 69% of young adults (aged 21–25) in the US and 76% in Switzerland are current drinkers, with up to 42% reporting engaging at least once in heavy episodic drinking (HED; consuming 5 or more drinks in a row) in the past month (Gmel, Kuendig, Notari, & Gmel, 2015; Substance Abuse and Mental Health Services Administration, 2014). Research in this population has found males to be at greater risk of unhealthy alcohol use than females (Delgrande Jordan & Notari, 2011; O'Malley & Johnston, 2002). Alarmingly, alcohol use among young adults has been related to a host of negative consequences, ranging in severity from short-term health-related consequences to an increased risk of engaging in risky behaviors, to injuries and even to death (Abbey, 2002; Hingson, 2012; Perkins, 2002).

Whereas literature has established that social (i.e., peer influence) and individual factors (e.g., personality traits) are predictors of drinking behaviors in youth (Ham & Hope, 2003), most research has focused on direct associations among these variables. Person-environment theorizing suggests, however, that personality traits and situations interact, such that traits are likely to influence peer influence's susceptibility (Kenrick & Funder, 1988). Surprisingly, the moderating effect of personality traits on the peer influence-drinking behaviors association has been scarcely examined. In response, this longitudinal study aimed to evaluate the moderating effects of sensation seeking and aggression on the peer influence-alcohol outcomes associations among young male drinkers.

Peer influence is a strong predictor of drinking behaviors in youth, especially among young males (Borsari & Carey, 2001; Neighbors, Lee, Lewis, Fossos, & Larimer, 2007; Prentice & Miller, 1993). According to the Social Learning Theory (Bandura, 1986), peer influence

operates directly and indirectly. Direct peer influence refers to getting someone to engage in a behavior and ranges from polite gestures (e.g., offering a drink) to verbal encouragements and commands to drink (Borsari & Carey, 2001). Perceived peer pressure (e.g., peer pressure to engage in misconduct, PPM), for instance, refers to the pressure to behave in certain peer-prescribed ways (Brown, Lohr, & McClenahan, 1986). Peers also exert indirect influence through their own actions, which shapes behaviors by providing information about what behavior is normative or not (i.e., descriptive norms, DNs; Borsari & Carey, 2003). Both DNs and PPM are predictors of concurrent and future alcohol use among young adults (Bahr, Hoffmann, & Yang, 2005; Bertholet, Gaume, Faouzi, Daeppen, & Gmel, 2011; Borsari & Carey, 2001, 2003; Cullum, Armeli, & Tennen, 2010; Studer et al., 2016). Interestingly, whereas PPM has been related to substance use and related consequences (Wood, Read, Palfai, & Stevenson, 2001), DNs have been mostly associated with alcohol use and to a lesser extent with consequences (Arterberry, Smith, Martens, Cadigan, & Murphy, 2014; Geisner et al., 2015; Jamison & Myers, 2008; Larimer, Turner, Mallett, & Geisner, 2004; Scull, Kupersmidt, Parker, Elmore, & Benson, 2010).

Nevertheless, not all young adults exposed to peer influence engage in drinking behaviors. Past research has thus examined moderators that may either buffer or strengthen the peer influence-drinking behavior association to identify young adults who may be more vulnerable to peer influence (Marschall-Levesque, Castellanos-Ryan, Vitaro, & Seguin, 2014). Personality traits may represent such moderators. According to person-environment theorizing (Kenrick & Funder, 1988), personality traits and situations interact, such that traits are likely to influence behaviors in certain situations, such as settings that are “low in constraint” and “highly prototypical and exemplary” (p. 30, Kenrick & Funder, 1988). Settings in which peer influence

usually occurs (e.g., a parties) typically include these characteristics. Personality traits may impact peer influence susceptibility in two ways. On the one hand, according to the the diathesis-stress model (Belsky & Pluess, 2009), some individuals, due to an individual vulnerability to substance use, are disproportionately affected by an environment stressor such as peer influence. Individuals with certain vulnerabilities may therefore be at greatest risks of being influenced by peers. Accordingly, previous research has found the association between peer influence (i.e., DNs, drug offer) and substance use to be moderated by social anxiety (Neighbors, Fossos, et al., 2007), sociability (Knyazev, 2004) and self-monitoring (Perrine & Aloise-Young, 2004), such that it was stronger among youths scoring higher on these measures.

Sensation seeking (i.e., tendency to seek stimulation, novelty and risk; Zuckerman, 2007) is another personality trait that may exacerbate the effects of peer influence on drinking behaviors. Sensation seekers may be more likely to comply with the norms or act under peer pressure because of the rewarding effects associated with these behaviors. Literature has found positive associations between sensation seeking and concurrent and future alcohol use and problematic drinking (Adams, Kaiser, Lynam, Charnigo, & Milich, 2012; Hittner & Swickert, 2006; Howse & Ghodse, 1997; Stautz & Cooper, 2013). Only a few cross-sectional studies have yet examined peer influence in the context of sensation seeking-related constructs. Findings indicated that the association between peer influence (i.e., DNs, peer alcohol and other drug use and drug offer) and substance use was stronger among adolescents with higher scores on risk-taking tendency (Epstein & Botvin, 2002) and on the behavioral approach system scale (i.e., being sensitive to reinforcement; Carver & White, 1994; Knyazev, 2004). Whereas these results provide preliminary evidence that sensation seeking increases the effect of peer influence on

drinking behaviors, longitudinal studies examining peer influence in the context of sensation seeking are needed to better understand the temporal associations among variables.

On the other hand, according to the resilience model (Fergus & Zimmerman, 2005), some individual predispositions may act as protective factors towards peer influence. Aggression (i.e., tendency to be oppositional, resentful; Hardin & Hilbe, 2003), for example, may dampen the peer influence-drinking behaviors association. Whereas previous research has found positive associations between aggression and concurrent and future alcohol use and problematic drinking (Ali, Ryan, Beck, & Daughters, 2013; Butryn & Zeichner, 1997; Costanzo et al., 2007; McKay, Dempster, & Mello, 2015), literature suggests that it may also act as a buffer against peer influence. Indeed, previous research has shown that most popular adolescents (i.e., the most socially skilled) were the most likely to comply with the norms or act under pressure (e.g., drinking behaviors; Allen, Porter, McFarland, Marsh, & McElhaney, 2005). Conversely, less popular adolescents with poor social skills and high scores on aggression are likely to be the least at risk of being influenced by peers (Perkins, 1997).

To our knowledge, the moderating effect of aggression and sensation seeking on the peer influence-subsequent drinking behaviors association has not been tested. Thus, this study aimed to evaluate the moderating effects of these personality traits on the peer influence-future alcohol outcomes association among young male drinkers. Based on the above-mentioned literature, we expected that PPM, sensation seeking and aggression would be positively related to subsequent alcohol use and related consequences, whereas DNs would be positively associated with future alcohol use, yet not with consequences. Next, we expected the peer influence-alcohol outcomes associations to be stronger among higher sensation seekers and among participants evincing lower levels of aggression.

Methods

Study Design and Participants

This study used data from the Cohort Study on Substance Use Risk Factors (C-SURF), which is an ongoing longitudinal study on substance-related risk and protective factors in young men. Enrollment took place in 3 of the 6 army-recruitment centers in the French and German speaking parts of Switzerland (i.e., covering 21 of the 26 cantons). In Switzerland, all men aged around 19-20 undergo a mandatory army recruitment process to assess their eligibility for military service. Thus, virtually all men of this age in the 21 cantons covered were eligible for study inclusion. Even though participants were enrolled in the study in army recruitment centers, the C-SURF was conducted independently of the army. Enrollment procedures are described in more details elsewhere (Gmel, Akre, et al., 2015).

During the C-SURF enrollment window, i.e., between August 2010 and July 2011, a total of 7,556 participants provided written informed consent to participate in the study. Of these, 5,987 (79.2%) completed the baseline assessment between September 2010 and March 2012, and 5,479 (91.5% of the baseline sample) also filled in the follow-up questionnaire between March 2012 and April 2013. Non-response analysis showed that non-respondents were more likely to be at-risk drinkers than respondents. These differences were commonly small, and significance was due to the large sample size, indicating a small non-response bias (Studer et al., 2013). For instance, non-respondents (9.5%) were more often abstainers than respondents (9.2%) but the difference was not significant (OR = 1.04, 95%CI 0.91, 1.17), whereas non-respondents reported HED at least monthly significantly more often than respondents (49.4% vs 45.1%, OR = 1.19, 95%CI 1.10, 1.28).

Eligibility criteria for the current study included having completed the baseline and 15-month assessments (N =5479) and having reported at least one drink in the past year at baseline and 15-month follow-up (N = 5060). Missing values on key variables were listwise deleted. The final sample comprised 4,624 participants (91.4% of baseline and follow-up drinkers). The research protocol was approved by the institutional review board at the home institution.

Measures

Socio-demographic variables. Age, educational attainment, and linguistic region were measured at baseline to describe the sample and served as covariates in the analyses.

Personality traits. Personality traits were measured at baseline and served as moderators in the analyses. Aggression was assessed with a subscale of the French and German versions of the Zuckerman-Kuhlman Personality Questionnaire (Aluja et al., 2006). Participants were asked to indicate whether they endorsed 10 statements (e.g., *When I get mad, I say ugly things*). Previous results showed this scale to have good psychometric properties in French and in German (Aluja et al., 2006). The internal consistency was moderate ($\alpha = 0.61$). Sensation seeking was measured with a French and German version of the Brief Sensation Seeking Scale (Hoyle, Stephenson, Palmgreen, Lorch, & Donohew, 2002). Participants were asked to indicate whether they agreed with 8 statements (e.g., *I would like to try bungee jumping*). Two translators conducted the translation and discrepancies were discussed and resolved in meetings to best fit the original scale. Internal consistency was adequate ($\alpha = 0.80$). Mean scores were computed for both personality traits.

Peer influence. DNs were measured with an item asking participants to estimate the percentage of their peers who drink more than they do, and were computed using data from a

quasi-census conducted during the parent study enrollment process. During the enrollment window, 12,564 recruits were invited to complete a self-administered screening questionnaire regardless of whether they participated in the cohort study or not. Of the 12,564 conscripts, 11,819 (94%) completed the census. Data from this quasi-census were used to determine the proportion of peers who drank more than the participants comprised in the current study did. To do so, the average number of drinks per week reported by participants was compared with the average number of drinks per week reported in the census. Then, the proportions of peers who drank more than the participants were compared with the estimations provided by the participants, resulting in three categories of DNs: overestimating, underestimating and accurately estimating peer alcohol use. Estimation was considered accurate if it fell within the 10% range of the actual proportion (Bertholet, Faouzi, Studer, Daeppen, & Gmel, 2013).

PPM was measured with a short version of the Peer Pressure Inventory that has been validated in French and in German (Baggio, Studer, Daeppen, & Gmel, 2013; Brown, Clasen, & Eicher, 1986). Participants were asked to indicate how strongly they perceived pressure from their friends to engage in certain behaviors by selecting their answer from 5 pairs of statements representing the opposite directions of pressure (e.g., not to get drunk vs. to get drunk or get a "buzz"). A mean score across the five items was computed and used in the analyses. Internal consistency was moderate ($\alpha = 0.64$). DNs and PPM were assessed at baseline and served as predictors in the analyses.

Alcohol outcomes. A quantity-frequency measure was used to assess alcohol use. The average number of drinking days and the number of standard drinks consumed per drinking day over the past year were measured at 15-month follow-up. The average number of drinks per week over the past year was computed by multiplying the number of drinking days by the

number of standard drinks per drinking days (Gmel et al., 2014). Total drinks per week needed to be rounded in the main analyses, resulting in "false" zero values (n = 9.7, %). This variable was thus multiplied by 52 (zero values = 1.1%), resulting in the average number of drinks per year (total drinks per year). The number of alcohol-related consequences over the past year was assessed with 11 items adapted from the College Alcohol Study (Knight et al., 2002; Wechsler, Davenport, Dowdall, Moeykens, & Castillo, 1994). Alcohol outcomes at 15-months served as dependent variables in the analyses.

Statistical Analyses

Descriptive analyses showed non-normal distributions for total drinks per year (skewness [S] = 2.26, kurtosis [K] = 8.77) and alcohol-related consequences (S = 1.35, K = 1.58). For both variables, the distribution was positively skewed approximating a negative binomial distribution with the exception of a large number of zeroes for alcohol-related consequences (36.9%). Akaikes'information criterion (AIC) and Bayesian information criterion (BIC) were used to evaluate the models' goodness of fit. Fits of negative binomial regression model (NB), zero-inflated negative binomial regression model (ZINB), Poisson regression model and zero-inflated Poisson regression model (ZIP) were tested using likelihood ratio (LR) tests (for nested models) and Vuong tests (for non-nested models). Regarding total drinks per year, NB (LR $\chi^2(1)$ = 1767108.8, $p < .001$) and ZIP (Vuong = 4.89, $p < .001$) fitted the data significantly better than Poisson regression model. ZINB regression model also fitted the data better than ZIP (LR $\chi^2(1)$ = 1729531.6, $p < .001$) and ZINB regression model did not significantly fit the data better than NB regression model (Vuong = –0.97, p = .167). AIC and BIC were used to compare Hurdle NB (HNB) regression model with other count models (see Table 1); for the sake of parsimony, NB regression was used to model total drinks per year. Regarding alcohol-related consequences, NB

(LR $\chi^2(1) = 952.43$, $p < .001$) and ZIP (Vuong = 13.91, $p < .001$) fitted the data significantly better than Poisson regression model. ZINB regression model also fitted the data significantly better than ZIP (LR $\chi^2(1) = 261.05$, $p < .001$) and NB (Vuong = 9.83, $p < .001$) regression models. ZINB regression model also had smaller AIC and BIC values than HNB models. Thus, ZINB was used to model alcohol-related consequences.

ZINBs allow modeling two distinct latent classes: one in which the outcome is always absent (participants who never report any consequence); another in which the outcome can be any integer (participants who may or may not report consequences). These models allow to investigate the two dimensions of the distribution simultaneously: the logistic portion tests the likelihood of an excess zero-value; the second portion examines the count portion of the model.

Regression analyses were conducted in 3 steps; step 1 tested main effects only. In step 2, each interaction was tested in a separate model. Then, only significant interactions stemming from step 2 were included in step 3 (Hosmer & Lemeshow, 2000). Significant interactions were followed by an examination of the simple slopes and were graphed by plotting the simple slopes of DNs and PPM at low (one *SD* below the mean), medium (mean) and high (one *SD* above the mean) levels of the moderators (Aiken & West, 1991). All continuous predictors were mean-centered prior to analyses. DNs were used as a categorical variable (with accurately estimating as the reference group). All models were adjusted for age, educational level, linguistic region and alcohol use at baseline. The magnitude of the associations between the covariates and the outcomes were examined with odds ratios (i.e., for the ZINB logistic sub-model) and incident rate ratios (i.e., for ZINB count regression sub-model and the generalized linear models). Odds ratios describe the increase (> 1) or decrease (< 1) in the odds of being an excess zero value, whereas incident rate ratios describe the percentage increase (>1) or decrease (<1) in outcomes

for each unit increase in the covariate (Atkins, Baldwin, Zheng, Gallop, & Neighbors, 2013). The significance level was set at $p = .05$. Analyses were conducted in SPSS 22 and in STATA.

Results

Descriptive Statistics

At baseline, the mean age of participants was 19.94 (*SD* = 1.19). More than half of the sample was French-speaking (*n* = 2,547, 55.1%). Primary school was the most commonly reported highest level of education completed (*n* = 2,261, 48.9%), followed by vocational training (*n* = 1,313, 28.4%) and post-secondary school (*n* = 1050, 22.7%). Descriptive statistics and correlations among key variables are presented in Table 2.

Negative Binomial Generalized Linear Model Examining Peer Influence, Sensation Seeking, Aggression and Total Drinks per Year

Findings yielded in step 3 are presented below. Table 3 displays parameter estimates yielded in steps 1, 2 and 3.

Overestimating peer alcohol use at baseline was significantly associated with total drinks per year at 15-months (*IRR* = 1.15), such that it was related to 15% more drinks on average. The association between underestimating peer alcohol use and total drinks per year was not significant. PPM was significantly related to total drinks per year (*IRR* = 1.23), such that each additional unit increase in PPM was associated with 23% more drinks on average. Findings showed that sensation seeking (*IRR* = 1.21) and aggression (*IRR* = 1.25) were significantly associated with future total drinks per year, indicating that each additional unit increase in sensation seeking and aggression was related to 21% and 25% more drinks, respectively.

Sensation seeking significantly moderated the associations between DNs and total drinks per year. Simple slopes analyses found that overestimating peer alcohol use was not significantly related to total drinks per year in higher sensation seekers (one *SD* above the mean; $b = 0.04$, CIs [-0.06, 0.13]), whereas it was significantly positively related to total drinks per year in lower sensation seekers (one *SD* below the mean; $b = 0.25$, CIs [0.16, 0.35]). Further, simple slopes analyses revealed a significant negative association between undersestimating peer alcohol use and total drinks per year in higher sensation seekers ($b = -0.14$, CIs [-0.26, -0.02]) and a significant positive association in lower ($b = 0.15$, CIs [0.04, 0.27]) sensation seekers. As shown in Figure 1 (panel A), these findings indicated that, among high sensation seekers, those who underestimated peer alcohol use reported a lower number of drinks than those who estimated it accurately; conversely, low sensation seekers who estimated peer alcohol use accurately drank less over a year than those who underestimated it. In other words, the greatest difference between low and high sensation seekers was found when participants estimated peer alcohol use accurately.

Additionally, findings revealed that aggression significantly moderated the PPM-total drinks per year association. Simple slopes analyses revealed significant effects of PPM in participants scoring low ($b = 0.29$, CIs [0.18, 0.40]), and high ($b = 0.12$, CIs [0.03, 0.22]) on aggression. As shown in Figure 1 (panel B), the association between PPM and total drinks per year was stronger among participants scoring lower on aggression than among those scoring higher on this measure.

ZINB Regression Examining Peer Influence, Sensation Seeking, Aggression and Alcohol-Related Consequences

Results of the ZINB regression are presented in Table 4. Because findings revealed no significant interaction, step 3 was not conducted. Findings yielded in step 2 are presented below.

Results of the logistic portion of the model. Results indicated that overestimating and underestimating peer alcohol use and aggression were not significantly related to zero inflation. PPM and sensation seeking were yet negatively associated with zero inflation, indicating that those reporting low scores on PPM and/or sensation seeking were more likely to be in the estimated latent class of excess zeros.

Results of the count portion of the model. Results revealed that neither overestimating nor underestimating peer alcohol use were significantly associated with consequences. By contrast, PPM was significantly related to consequences (*IRR* = 1.37), indicating that each additional unit increase in PPM was associated with 37% more consequences on average. Sensation seeking and aggression were significantly associated with consequences (*IRR* = 1.19 and 2.08, respectively), such that each additional unit increase in sensation seeking was related to 19% more consequences and that participants scoring higher on aggression were likely to experience over twice as many consequences on average. Finally, results indicated that the PPM/DNs-consequences associations were not significantly moderated by sensation seeking and aggression.

Discussion

This study examined the moderating effect of sensation seeking and aggression on the longitudinal associations between peer influence and alcohol outcomes among young male drinkers. Main findings revealed that sensation seeking and aggression had significant moderating effects on the associations of peer influence with alcohol use—yet not with related

consequences—, such that the associations were stronger among participants scoring lower on the moderators.

Consistent with past research reviewed in the introduction, findings showed that that PPM, sensation seeking and aggression were positively related to subsequent alcohol use and related consequences, whereas DNs were positively related to alcohol use but not with consequences. These findings are in line with hypothesis and imply that prevention programs aiming to decrease alcohol use and related consequences should target young adults scoring high on indirect and direct peer influences, and/or on sensation seeking and aggression.

Additionally, findings showed that sensation seeking and aggression significantly moderated the prospective association of peer influence with alcohol use; first, aggression was found to moderate the association between PPM and future alcohol use. In line with expectations, findings indicated that this association was stronger among participants scoring low on aggression. Findings suggested a crossover interaction, such that participants with lower scores on aggression evinced lower rates of alcohol use than those with higher scores on aggression when scoring low on PPM; this pattern was yet reversed when scoring high on PPM, such that participants with lower scores on aggression reported more alcohol use than those scoring higher on this measure. Although these findings need replication, they suggest that young male drinkers scoring low on aggression might benefit more from stand-alone interventions targeting peer influence than those scoring high on this personality trait. The latter might rather benefit from interventions targeting personality traits or both peer influence and personality traits.

Findings also revealed that sensation seeking had significant moderating effects on the association between DNs and future alcohol use. Findings suggested that the greatest difference between lower and higher sensation seekers was found among young male drinkers who accurately estimated peer alcohol use; specifically, with high sensation seekers reporting drinking more than low sensation seekers. Past research has established that overestimating peer alcohol use is positively associated with alcohol use (Lewis & Neighbors, 2004; Neighbors, Lee, et al., 2007). It may thus be that estimating peer alcohol use accurately impacts young males' alcohol use to a lesser extent than overestimating does and approaches the actual difference between higher and lower sensation seekers regardless of indirect peer influence.

Nevertheless, findings suggested that, whereas lower sensation seekers reported drinking less than higher sensation seekers when accurately estimating peer alcohol use, they reported close levels of drinking when overestimating peer alcohol use. These findings suggest that lower sensation seekers are more vulnerable to DNs than higher sensation seekers are. These results diverge from expectations and previous research that has found stronger associations between peer influence and participants' substance use among adolescents scoring higher on sensation-seeking-related constructs (Epstein & Botvin, 2002; Knyazev, 2004; Wills, Pokhrel, Morehouse, & Fenster, 2011). The inconsistency of these findings may pertain to differences in study design and context. On the one hand, these three studies were conducted among adolescents, tested construct related to sensation seeking (yet not sensation seeking per se), and two of the latter studies targeted illegal behaviors (e.g., drug use, alcohol use for a subset of participants; Knyazev, 2004; Wills et al., 2011). On the other hand, the present study included young adult male drinkers, tested a measure of sensation seeking and targeted legal behaviors (alcohol use). Previous findings have demonstrated that distinct traits of impulsivity (including sensation

seeking-related traits) related differently to outcomes, such as substance use and deviance (Lynam & Miller, 2004). Furthermore, it is likely that sensation seeking affects the peer influence-substance use association differently depending on the legal status of the target behaviors; legal status is likely to impact behaviors in youths scoring lower on sensation seeking, yet less so in those scoring higher on this measure. Low sensation seekers may be more influenced by their peers in engaging in a legal behavior than in an illegal behavior. By contrast, given that sensation seeking is characterized by the propensity to seek high stimulations and taking risks, the illegality of the behavior may not impact high sensation seekers' decision to engage in it or not. In fact, past studies have found positive associations between sensation seeking and illegal behaviors (e.g., illegal drug use, shoplifting; Hansen Sandseter & Breivik, 2001; Low & Gendaszek, 2002). Future research testing the moderating effect of sensation seeking on the association between peer influence and an illegal behavior among young male may help elucidate this question.

That being said, a recent longitudinal study testing the moderating effect of sensation seeking on the association between environmental risk factors (i.e., exposure to R-rated films) and future alcohol use among adolescents (Stoolmiller, Gerrard, Sargent, Worth, & Gibbons, 2010) yielded similar findings. Results showed a significant moderating effect of sensation seeking, such that exposure to R-rated films was related to a stronger increase in alcohol use among lower sensation seekers than among higher sensation seekers. Research has shown positive associations between sensation seeking and deviant behaviors (Hansen Sandseter & Breivik, 2001; Low & Gendaszek, 2002). It is thus possible that high sensation seekers are less influenced by their peers because they are drawn by these behaviors regardless of whether their peers engage in them or not. By contrast, peer behaviors may be more important for low

sensation seekers who do not share the same predisposition and need therefore peer influence to engage in these behaviors.

Interestingly, no significant interaction was found with alcohol-related consequences as the dependent variable, suggesting that, contrary to alcohol use, the association between peer influence and alcohol-related consequences does not depend on aggression and/or sensation seeking levels. Although preliminary, taken together, these findings suggest that stand-alone selective prevention programs targeting peer influence and/or social norms (e.g., training resistance to PP, providing personalized normative feedbacks ; Donaldson, Graham, Piccinin, & Hansen, 1995; Hansen & Graham, 1991; Walters, Roudsari, Vader, & Harris, 2007) may help decrease alcohol use among young male drinkers with low levels of sensation seeking and/or aggression.

It is important to note the preliminary nature of these findings; research is needed to further confirm them. Additionally, other personality traits, such as impulsivity or neuroticism, have been positively related to drinking behaviors (Littlefield, Sher, & Wood, 2010; Malouff, Thorsteinsson, Rooke, & Schutte, 2007; Rush, Becker, & Curry, 2009; Trull & Sher, 1994). Avenues for future research include the examination of these personality traits in the context of peer influence, thereby elucidating whether young adults scoring high on these personality traits are likely to be more or less susceptible to peer influence.

Limitations

This study is not without limitations. First, the sample was limited to young men, which precludes the generalization of findings to young females or to other age groups. Second, the study relied on responses to self-report questionnaires, which can be subject to inaccuracies

resulting from social desirability (Davis, Thake, & Vilhena, 2010; Schell, Chan, & Morral, 2006). Further, the subscale of the short Zuckerman-Kuhlman Personality Questionnaire and the PPM's measure yielded suboptimal reliability. Thus, a risk of measurement error cannot be ruled out, raising concerns regarding findings' validity and accuracy. Future research using measures with better psychometric properties (e.g., the long version of the Zuckerman-Kuhlman Questionnaire to improve the results' reliability; Zuckerman, 2002) is therefore necessary to further confirm current findings.

Conclusions

Despite these limitations, we believe that this study makes an interesting contribution to the literature by documenting that the prospective association between peer influence and alcohol use was moderated by sensation seeking and aggression, such that it was overall stronger among participants scoring lower on the moderators. Although future research is needed to confirm these findings, they suggest that young male drinkers scoring lower on sensation seeking and/or aggression may benefit from stand-alone selective prevention programs targeting social norms and peer influence (Donaldson et al., 1995; Hansen & Graham, 1991; Walters et al., 2007), whereas those scoring higher on these measures may rather benefit from broader programs that include interventions targeting both peer influence and personality traits (Conrod et al., 2013).

Declaration of Interest

The authors report no conflicts of interest.

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Table 1

Fit Statistics for the Different Models Tested

Fit statistics	P	NB	ZIP	ZINB	Hurdle NB
Total drinks per year				-	
Loglikelihood value	-916152.6	-32598.2	-897334.7	-32568.9	-32569.6
AIC	1832325.3	65218.4	1794709.5	65179.7	65181.2
BIC	1832389.6	65289.2	1794838.2	65315.0	65316.4
Alcohol-related consequences					
Loglikelihood value	-8212.7	-7736.5	-7688.6	-7553.1	-7595.4
AIC	16447.4	15496.9	15411.2	15152.2	15236.8
BIC	16518.2	15574.2	15552.9	15300.3	15384.9

Note. AIC = Akaikes'information criterion. BIC = Bayesian information criterion. P = Poisson regression.

NB = negative binomial regression. ZIP: zero-inflated Poisson regression.

ZINB = zero-inflated negative binomial regression.

Table 2.

Descriptive Statistics and Bivariate Correlations among Study Variables

Variable	M/%	SD	Correlation[a]							
			1	2	3	4	5	6	7	8
Peer influence										
1. DNs[b]			-							
Overestimators	50.20									
Underestimators	18.00									
Accurate estim.	31.80									
2. PPM[c]	0.37	0.42	0.03	-						
Personality traits										
3. Sensation seeking[d]	3.08	0.85	0.05**	0.16***	-					
4. Aggression[e]	0.41	0.22	0.03*	0.10***	0.19***	-				
Alcohol outcomes baseline[f]										
5. Total drinks/year	463.34	524.39	0.16***	0.21***	0.25***	0.19***	-			
6. Consequences	1.76	2.00	0.03	0.31***	0.31***	0.27***	0.47***	-		
Alcohol outcomes 15-months[f]										
7. Total drinks/year	453.89	492.58	0.12***	0.20***	0.20***	0.16***	0.61***	0.36***	-	
8. Consequences	1.70	1.95	0.05***	0.27***	0.25***	0.22***	0.39***	0.57***	0.44***	-

Note. [a]Spearman rank-order correlations. [b]Percentage of participants overestimating, underestimating and accurately estimating the number of drinks per week among peers. [c]Participants selected their answer from 5 pairs of statement representing polar opposites of pressure's direction on a 7-point Likert scale ranging from -3 to 3, where -3 = *a lot of pressure not to do* to 3 = *a lot of pressure to do*, and 0 = *no pressure to do*. Following Baggio and colleagues (2013) guidelines, answers ranging from -3 to 0 were collapsed and recoded as 0, resulting in a 4-point Likert scale, where 0 = *pressure not to do or no pressure*, to 3 = *a lot of pressure to do* (Baggio et al., 2013). [d]Participants were asked to indicate whether or not they agreed with 8 statements on a 5-point Likert scale ranging from 1 =

strongly disagree to 5 = *strongly agree*. [e]Participants were asked to indicate whether or not they endorsed 10 statements with a true-false answer. [f]Over the past 12 months. * $p<.05$ ** $p<.01$ *** $p<.001$

Table 3

Generalized Linear Models Testing the Moderating Roles of Sensation Seeking and Aggression in the Associations Between Peer Influence at Baseline and Total Drinks per Year at 15 Months

Predictor	*b*	*SEb*	*95% CI*	*IRR*	$\chi^{2a}/\Delta\chi^2$
Sensation seeking[b]					
Step 1					1748.44***
DNs					
Overestimating	0.14	0.04	0.08, 0.21	1.15***	
Underestimating	0.02	0.04	-0.07, 0.10	1.02	
Peer pressure[c]	0.21	0.04	0.14, 0.28	1.23***	
Sensation seeking	0.11	0.02	0.07, 0.14	1.11***	
Step 2					18.05***
DNs					
Overestimating	0.14	0.03	0.08, 0.21	1.15***	
Underestimating	0.01	0.04	-0.08, 0.09	1.01	
Peer pressure	0.21	0.04	0.13, 0.28	1.23***	
Sensation seeking (SS)	0.20	0.03	0.14, 0.27	1.23***	
DNs x SS					
Overestimating x SS	-0.13	0.04	-0.21, -0.05	0.88**	
underestimating x SS	-0.18	0.05	-0.27, -0.09	0.84***	
Peer pressure x SS	-0.06	0.04	-0.14, 0.02	0.94	
Agression[d]					1729.57***
Step 1					
DNs					
Overestimating	0.14	0.03	0.07, 0.21	1.15***	
Underestimating	0.01	0.04	-0.08, 0.09	1.00	
Peer pressure	0.22	0.04	0.15, 0.30	1.25***	
Agression (AG)	0.28	0.07	0.15, 0.42	1.33***	
Step 2					10.39*
DNs					
Overestimating	0.14	0.04	0.07, 0.21	1.15***	
Underestimating	0.00	0.05	-0.09, 0.10	1.00	
Peer pressure	0.23	0.04	0.16, 0.31	1.26***	
Agression (AG)	0.48	0.14	0.21, 0.74	1.16***	
DNs x AG					
Overestimating x AG	-0.31	0.17	-0.64, 0.14	0.73	
underestimating x AG	-0.20	0.23	-0.65, 0.25	0.82	
Peer pressure x AG	-0.42	0.18	-0.77, -0.07	0.66*	

Predictor	*b*	*SEb*	*95% CI*	*IRR*	$\chi^{2a}/\Delta\chi^2$
Step 3					1779.23***
DNs					
Overestimating	0.14	0.03	0.08, 0.21	1.15***	
Underestimating	0.01	0.04	-0.08, 0.09	1.01	
Peer pressure	0.21	0.04	0.13, 0.28	1.23***	
Sensation seeking (SS)	0.19	0.03	0.13, 0.26	1.21***	
Agression (AG)	0.23	0.07	0.09, 0.36	1.25**	
DNs x SS					
Overestimating x SS	-0.13	0.04	-0.21, -0.05	0.88**	
Underestimating x SS	-0.17	0.05	-0.26, -0.08	0.84***	
Peer pressure x AG	-0.39	0.17	-0.72, -0.06	0.68*	

Note. Generalized linear models using negative binomial distributions with log link. SE: standard errors. IRR: Incidence rate ratios. DNs were used as a categorical variable (i.e., overestimating, underestimating, accurately estimating)—accurately estimating being used as the reference group in the analyses. All models were adjusted for age, linguistic region, highest level of education, and alcohol use. [a]Log-likelihood ratio tests. [b]Participants were asked to indicate whether or not they agreed with 8 statements on a 5-point Likert scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. [c]Participants selected their answer from 5 pairs of statement representing polar opposites of pressure's direction on a 7-point Likert scale ranging from -3 to 3, where -3 = *a lot of pressure not to do* to 3 = *a lot of pressure to do*, and 0 = *no pressure to do*. Following Baggio and colleagues (2013) guidelines, answers ranging from -3 to 0 were collapsed and recoded as 0, resulting in a 4-point Likert scale, where 0 = *pressure not to do or no pressure*, to 3 = *a lot of pressure to do* (Baggio et al., 2013). [d]Participants were asked to indicate whether or not they endorsed 10 statements with a true-false answer. * $p<.05$ ** $p<.01$ *** $p<.001$

Table 4

Zero-Inflated Models Testing the Moderating Roles of Sensation Seeking and Aggression in the Associations Between Peer Influence at Baseline and Consequences at 15 Months

Predictor	*b*	*SE b*	*95% CI*	*IRR/OR*	$\chi^{2a}/\Delta\chi^2$
Logistic Portion of the Models					
Sensation seeking[b]					
Step 1					410.68***
DNs					
Overestimating	0.14	0.16	-0.18, 0.45	1.15	
Underestimating	-0.16	0.18	-0.52, 0.20	0.85	
Peer pressure[c]	-1.25	0.25	-1.75, -0.75	0.28***	
Sensation seeking	-0.25	0.08	-0.41, -0.08	0.78**	
Step 2					3.01
DNs					
Overestimating	0.12	0.16	-0.20, 0.44	1.13	
Underestimating	-0.14	0.18	-0.50, 0.22	0.87	
Peer pressure	-1.20	0.25	-1.69, -0.71	0.30***	
Sensation seeking	-0.24	0.08	-0.41, -0.08	0.79**	
Agression[d]					
Step 1					419.81***
DNs					
Overestimating	0.14	0.16	-0.18, 0.45	1.15	
Underestimating	-0.17	0.18	-0.52, 0.18	0.84	
Peer pressure	-1.28	0.26	-1.79, -0.78	0.28***	
Agression	-0.56	0.34	-1.22, 0.10	0.57	
Step 2					0.79
DNs					
Overestimating	0.15	0.16	-0.17, 0.47	1.16	
Underestimating	-0.16	0.18	-0.52, 0.19	0.85	
Peer pressure	-1.27	0.26	-1.78, -0.77	0.28***	
Agression	-0.52	0.34	-1.19, 0.15	0.59	
Counts Portion of the Models					
Sensation seeking					
Step 1					
DNs					
Overestimating	-0.04	0.04	-0.12, 0.03	0.96	
Underestimating	0.01	0.05	-0.09, 0.11	1.01	

Predictor	*b*	*SE b*	*95% CI*	*IRR/OR)*
Peer pressure	0.30	0.03	0.23, 0.37	1.35***
Sensation seeking	0.17	0.02	0.13, 0.21	1.19***
Step 2				
DNs				
Overestimating	-0.05	0.04	-0.13, 0.02	0.95
Underestimating	0.01	0.05	-0.09, 0.12	1.01
Peer pressure	0.32	0.04	0.25, 0.39	1.37***
Sensation seeking (SS)	0.17	0.04	0.10, 0.24	1.19***
DNs x SS				
Overestimating x SS	0.02	0.04	-0.06, 0.11	1.02
underestimating x SS	-0.04	0.06	-0.15, 0.07	0.96
Peer pressure x SS	-0.05	0.04	-0.12, 0.02	0.95
Agression				
Step 1				
DNs				
Overestimating	-0.05	0.04	-0.12, 0.02	0.95
Underestimating	0.00	0.05	-0.10, 0.10	1.00
Peer pressure	0.31	0.03	0.24, 0.38	1.36***
Agression (AG)	0.65	0.07	0.50, 0.79	1.91***
Step 2				
DNs				
Overestimating	-0.04	0.04	-0.12, 0.03	0.96
Underestimating	0.01	0.05	-0.10, 0.11	1.01
Peer pressure	0.32	0.04	0.24, 0.39	1.38***
Agression (AG)	0.73	0.13	0.47, 0.99	2.08***
DNs x AG				
Overestimating x AG	-0.11	0.16	-0.42, 0.20	0.90
underestimating x AG	-0.08	0.23	-0.53, 0.37	0.92
Peer pressure x AG	-0.08	0.15	-0.38, 0.21	0.92

Note. Ratio: zero-inflated odds ratios are presented for the logistic portion of the models and negative binomial incidence rate ratios are presented for the counts portion of the models. SE: standard errors. IRR: Incidence rate ratios. DNs were used as a categorical variable (i.e., overestimating, underestimating, accurately estimating)—accurately estimating being used as the reference group in the analyses. All models were adjusted for age, linguistic region, highest level of education, and alcohol use at baseline. [a]Log-likelihood ratio tests. [b]Participants were asked to indicate whether or not they agreed with 8 statements on a 5-point Likert scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. [c]Participants selected their answer from 5 pairs of statement representing polar opposites of pressure's direction on a 7-point Likert scale ranging from -3 to 3, where -3 = *a lot of pressure not to do* to 3 = *a lot of pressure to do*, and 0 = *no*

pressure to do. Following Baggio and colleagues (2013) guidelines, answers ranging from -3 to 0 were collapsed and recoded as 0, resulting in a 4-point Likert scale, where 0 = *pressure not to do or no pressure*, to 3 = *a lot of pressure to do* (Baggio et al., 2013). [d]Participants were asked to indicate whether or not they endorsed 10 statements with a true-false answer. * $p<.05$ ** $p<.01$ *** $p<.001$