



# Associations of anxiety sensitivity and emotional symptoms with the subjective effects of alcohol, cigarettes, and cannabis in adolescents<sup>☆</sup>

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## ABSTRACT

Maladaptive emotional traits (anxiety sensitivity [AS], fear of anxiety-related sensations and consequences) and symptoms (major depressive disorder [MDD] and generalized anxiety disorder [GAD] symptoms) could play a role in altering sensitivity to the subjective effects of drugs of abuse in adolescents. Data were drawn from a longitudinal study of high school students in Los Angeles, CA, USA who completed surveys and reported past six-month use of alcohol ( $n = 1054$ ), cigarettes ( $n = 297$ ), or cannabis ( $n = 706$ ). At each of the four semi-annual waves during mid-adolescence (14–16 years old), students reported positive and negative subjective drug effects experienced in the prior six-months. Controlling for covariates and the simultaneous covariance across the three domains of emotional dysfunction, AS was associated with more positive and negative cannabis effects ( $\beta_s = 0.09$ – $0.16$ ,  $ps < 0.05$ ), and MDD symptoms were associated with fewer negative cigarette effects ( $\beta = -0.13$ ,  $p = 0.04$ ) and more negative cannabis effects ( $\beta = 0.10$ ,  $p = 0.004$ ). The acceleration of positive alcohol and cannabis effects over time was slower among adolescents with higher baseline MDD (MDD  $\times$  time:  $\beta = -0.04$ ,  $p = 0.044$ ) and GAD (GAD  $\times$  time:  $\beta = -0.05$ ,  $p = 0.03$ ) symptoms, respectively. These findings suggest that emotional dysfunction factors show differential and overlapping effects on subjective drug effects, which may vary across time. Future research should investigate emotional dysfunctions and subjective drug effects in relation to substance use across adolescence and emerging adulthood.

## 1. Introduction

Emotional dysfunction manifests as psychopathological symptoms and maladaptive traits in adolescence. Among domains of emotional dysfunction, anxiety sensitivity (AS – the fear of anxiety symptoms and their consequences), major depressive disorder (MDD) symptoms, and generalized anxiety disorder (GAD) symptoms have each been shown to be related to adolescent substance use (Frojd, Ranta, Kaltiala-Heino, & Marttunen, 2011; Leventhal, Strong, Sussman, et al., 2015; Pang, Farrahi, Glazier, Sussman, & Leventhal, 2014; Wolitzky-Taylor et al., 2015). While AS, MDD, and GAD may be part of a common maladaptive expression of negative affect and are intercorrelated, these three factors of emotional dysfunction also are phenomenologically

distinct from one another, reflecting concerns about anxiety symptoms, sadness/anhedonia/somatic symptoms, and tension/anxiety/diffuse worry, respectively (American Psychiatric Association, 2013; McNally, 1996). There is some evidence that AS, MDD symptoms, and GAD symptoms may have unique, non-redundant associations with substance use (Ameringer & Leventhal, 2010; Wolitzky-Taylor et al., 2015).

Individual differences in subjective drug effects is one mechanism implicated in risk of transitioning from drug use experimentation to regular use (de Wit & Phillips, 2012). Following from positive reinforcement models of substance use risk (MacKillop & de Wit, 2013), individuals who have more positive (e.g., relaxation, pleasant) early experiences with alcohol, cigarettes, and cannabis are more likely to

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continue use of the substance and later develop addiction (Agrawal, Madden, Bucholz, Heath, & Lynskey, 2014; Baggio et al., 2014; Buchmann et al., 2013; Zabor et al., 2013). Theoretically, early negative subjective drug effects should exert a protective effect against continued drug use, but the literature has not found consistent evidence to support this. Negative initial reactions to tobacco and cannabis have been found to increase odds of later tobacco and cannabis abuse/dependence (Agrawal et al., 2014), but other studies found no effect on odds of becoming a regular smoker (Zabor et al., 2013) or future or lifetime use of cannabis (Davidson & Schenk, 1994) or found a negative effect on odds of becoming a regular cannabis user (Baggio et al., 2014). Studies have also found that negative alcohol outcome expectancies increase as alcohol consumption increases (Gadon, Bruce, McConnochie, & Jones, 2004) and may be important for alcohol treatment outcomes (Jones & McMahon, 1994, 1996). Thus, it is also possible that increased negative drug effects may be a consequence of consumption rather than a protective factor against use.

There is reason to hypothesize that adolescents with elevations in emotional dysfunctions may be more sensitive to subjective drug effects. Studies have shown associations between AS and greater accuracy in estimating physiological reactivity among children (Eley, Stirling, Ehlers, Gregory, & Clark, 2004) and young adults (Stewart, Buffett-Jerrott, & Kokaram, 2001). Similarly, studies have shown that GAD (vs. depressed) patients showed greater accuracy in heartbeat perception (Ehlers & Breuer, 1992). Greater interoceptive awareness in AS and GAD could result in increased awareness of internal sensations produced by the acute pharmacological (e.g., stimulation, arousal enhancement) and sensory (e.g., sensations of inhaling smoke or imbibing alcohol) effects of self-administering drugs of abuse, which could in turn alter the profile of subjective drug effects. Although this hypothesis has not been tested, one study in adult regular smokers found that AS was associated with greater subjective positive effects from acute cigarette administration (Wong et al., 2013). Additionally, some work in emerging adults has negatively correlated AS with cannabis use, which could theoretically be due to greater negative subjective effects of cannabis in high-AS individuals (Stewart, Karp, Pihl, & Peterson, 1997; Stewart, Samoluk, & MacDonald, 1999). Thus, it is plausible that AS and GAD symptoms may differentiate subjective drug effects in adolescents, but further empirical testing is needed.

There is also reason to believe that MDD symptoms may increase positive subjective effects. Depressed vs. non-depressed smokers show greater smoking reward (Audrain-McGovern, Wileyto, Ashare, Cuevas, & Strasser, 2014) and rate the positive aspects of smoking higher (Spring, Pingitore, & McChargue, 2003). Additionally, there is evidence showing an association between depressive symptoms and the use of alcohol (Thornton et al., 2012) and cigarettes (Audrain-McGovern et al., 2014) to increase pleasure. Lastly, somatic symptoms are a troublesome factor in MDD (Harshaw, 2015; Tylee & Gandhi, 2005), which may be related to greater negative subjective drug effects.

In the current report, data were drawn from an ongoing longitudinal cohort study involving 4 semi-annual data collections spanning mid-adolescence (Leventhal, Strong, Kirkpatrick, et al., 2015). We examined AS, MDD symptoms, and GAD symptoms measured at baseline in relation to reports of positive and negative subjective effects of alcohol, cigarettes, and cannabis in the prior six-month period across the 4 semi-annual assessments. We hypothesized that emotional dysfunction would associate with stronger positive and negative subjective effects averaged across all time points. Given evidence suggesting that subjective drug effects may change over time (Schuckit & Smith, 2013) and that drug use during adolescence may alter neural systems involved in emotional processing (Lydon, Wilson, Child, & Geier, 2014), we also investigated whether emotional dysfunction interacted with time to predict changes in subjective effects. However, due to the paucity of extant theory or data on changes in subjective drug effects over time in relation to emotional dysfunction, we did not have a priori hypotheses regarding these interactive effects. Additionally, there is

some evidence that females compared to males may show stronger associations of emotional symptoms and AS with substance use outcomes (Dahne, Hoffman, & MacPherson, 2015; Stewart et al., 1997). Thus, supplemental analyses investigated gender as a moderator of associations between emotional dysfunction and subjective drug effects.

## 2. Method

### 2.1. Participants

This study comes from an ongoing multi-wave longitudinal school-based study on the association between personality, psychopathology, and substance use. Participants recruited for this study were 9th grade students attending one of 10 Los Angeles area high schools chosen because of their diverse demographic characteristics and proximity. Leventhal, Strong, Kirkpatrick (2015) report characteristics of the 10 schools and other Los Angeles County schools. All 9th grade students at each school were eligible to participate with the exception of those in special education and English as a second language. Of the 4100 eligible participants, 3396 (82.8%) provided parental consent and student assent and were enrolled in the study. Participants remained in the study unless they verbally stated they no longer wished to participate ( $n = 9$ ).

Only participants who have used a particular substance in the past 6 months complete measures of subjective drug effects and participants with data available on AS, MDD symptoms, GAD symptoms and subjective drug effects were included in analytic samples for subjective effects of alcohol (1993 data points from 1054 participants), cigarettes (451 data points from 297 participants) and cannabis (1324 data points from 706 participants).

### 2.2. Procedure

Students completed paper-and-pencil surveys during 40-min class periods in Fall 2013 ( $N = 3383$ ), Spring 2014 ( $N = 3293$ ), Fall 2014 ( $N = 3282$ ), and Spring 2015 ( $N = 3262$ ; retention rate by final wave = 96.05%). However, some of the measures included experiences occurring in the 6 months preceding Fall 2013 (see below). Students were told they could skip questions they did not want to answer and that responses would be confidential. The University of Southern California Institutional Review Board approved the study.

### 2.3. Key measures

The **Childhood Anxiety Sensitivity Index (CASI)** (Reiss, Peterson, Gursky, & McNally, 1986; Silverman, Fleisig, Rabian, & Peterson, 1991) was administered at the first assessment and measured fearfulness that anxiety symptoms may lead to embarrassment (e.g., I don't want other people to know when I feel afraid), mental incapacitation (e.g., When I am afraid, I worry that I might be crazy), and physical illness (e.g., It scares me when my heart beats fast). Responses included "None" (= 1), "Some" (= 2), and "A lot" (= 3). A mean score from all 18-items was computed. The CASI has been shown to possess adequate reliability and predictive validity in relation to panic/anxiety symptoms (Wright et al., 2010) and to have short-term stability (Zavos, Rijdsdijk, & Eley, 2012) in adolescent samples.

The **Revised Children's Anxiety and Depression Scale (RCADS)** (Chorpita, Yim, Moffitt, Umemoto, & Francis, 2000) was administered at the first assessment. The 6-item generalized anxiety disorder (GAD; e.g., I worry about things) and 10-item major depressive disorder (MDD; e.g., I feel sad or empty) subscales were used. Participants rated how often symptoms occurred from "never" (= 0) to "always" (= 3) and a mean score for each subscale was computed. This measure has been shown to have good reliability, internal consistency, and convergent and discriminant validity in adolescents (Kosters, Chinapaw, Zwaanswijk, van der Wal, & Koot, 2015), and short-term stability in

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