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Combined expectancies of alcohol and e-cigarette use relate to higher alcohol use☆

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HIGHLIGHTS

- Development of the NOSIE-ER (ones perceived likelihood of using e-cigs and alcohol together)
- NOSIE-ER scores related to problematic alcohol use
- E-cig use, compared to no use, related to problematic alcohol use.

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ABSTRACT

Electronic cigarettes (e-cigs) were created to approximate the look, feel, and experience of using a cigarette. Since cigarette and alcohol use co-occur, we hypothesized that e-cig and alcohol use also co-occur, likely due to shared positive drug expectations. Using self-report data from two independent samples of community-dwelling alcohol using adults, the present study: (1) modified the Nicotine and Other Substance Interaction Expectancy Questionnaire (NOSIE) to assess expectancies of combined e-cig and alcohol use (i.e. the individuals perceived likelihood of using e-cigs and alcohol together; NOSIE-ER); and (2) examined the relationships among e-cig use, expectancies, and alcohol use across e-cig use status. In the first sample ($N = 692$, mean age = 32.6, $SD = 9.74$, 50.7% female, 82.2% Caucasian), exploratory factor analysis suggested the presence of two factors: (1) *alcohol use leads to e-cig use* (Scale 1; $\alpha = 0.85$); and (2) *e-cig use leads to alcohol use* (Scale 2; $\alpha = 0.91$). In the second sample ($N = 714$, mean age = 34.1, SD = 10.89, 47.8% female, 75.6% Caucasian), confirmatory factor analysis supported this factor structure ($\chi^2 = 47.00$, $p < 0.01$, df = 19; RMSEA = 0.08, 90% CI = 0.05–0.11; TLI = 0.99; CFI = 0.99). Compared to non e-cig users, e-cig users had significantly higher problematic alcohol use in both samples (b's = 0.09 to 0.14, p's < .05). Expectancies of combined e-cig and alcohol use were significantly related to problematic alcohol use (b's = −0.92 to 0.26, p's < .05). In sum, e-cig use is related to alcohol use and expectancies of combined e-cig and alcohol use; consequently, reshaping of beliefs about needs or desires to co-use could be a prime point of intervention.

1. Introduction

Electronic cigarettes (e-cigs) are electronic nicotine delivery systems that were created to approximate the look and feel of a cigarette (American Cancer Society, 2014). Recent research has found similarities between e-cigs and cigarettes, particularly in increasing blood nicotine levels (Dawkins & Corcoran, 2013) nicotine absorption (Etter & Bullen, 2011a; Dawkins, Turner, Hasna, & Soar, 2012; Nides, Leisschow, Bhatter, & Simmons, 2014), and serum cotinine levels (Flouris et al., 2013; Grana, Benowitz, Stant, & Glantz, 2014). Recently, e-cig use prevalence rates have increased to 6.2% in the general population (King, Alam, Promoff, Arrazola, & Dube, 2013a) and 17% in substance dependent populations (Peters et al., in press), likely as a result of comprehensive smoking bans (Etter & Bullen, 2011b) and perceived health benefits of e-cigs (Grana & Ling, 2014; Huang, Kornfield, Szczypka, & Emery, 2014; Paek, Kim, Hove, & Huh, 2014). However, although research does not currently support the efficacy of e-cigs for smoking cessation or other health benefits (Brown, Beard, Kotz, Michie, & West, 2014; Bullen et al., 2013; Caponnetto et al., 2013; Popova & Ling, 2013; Siegel, Tanwar, & Wood, 2011), many users report using e-cigs to stop traditional cigarette use, to circumvent smoking bans, and because e-cigs are perceived as less harmful than cigarettes (King et al., 2013a). This high prevalence of e-cig use is likely driven by positive expectations about the use of e-cigs. However, this high prevalence is problematic because e-cig liquids contain potentially harmful

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substances such as propylene glycol and nicotine, which can lead to addiction (Czogala, Goniewicz, & Fidelus, 2014; Etter, Zäther, & Svensson, 2013; Food and Drug and Administration, 2014; Benoqitze, 2010).

Although recent research has investigated e-cig perceptions and use in substance dependent populations (Peters et al., in press), little research has examined how e-cigs influence other addictive behaviors in adults, particularly alcohol use. Traditional cigarettes have a well-established relationship with alcohol use (Grant, Hasin, & Chou, 2004; Little, 2000; McKee, Falba, O'Malley, Sindelar, & O'Connor, 2007; Kahler et al., 2008; Wilson, Weerasekera, Kahler, Borland, & Edwards, 2012) and cigarette smokers are at a higher risk for developing an alcohol use disorder (AUD; Grucza & Bierut, 2006). Additionally, nicotine consumption has been linked to alcohol consumption in multiple ways. First, the mesolimbic dopamine system is responsible for the reinforcing effects of substances of abuse (Funk, Marinelli, & Lê, 2006), and might subsequently contribute to the motivation to seek both alcohol and nicotine (Soderpalm, Ericson, & Olausson, 2000; Ericson, Molander, Lof, Engel, & Soderpalm, 2003; Tizabi, Copeland, Louis, & Taylor, 2002); in this way, the dopamine system serves as a plausible mechanism for the high rates of nicotine and alcohol co-use, and could generalize to concurrent alcohol and e-cig use. Second, Rohsenow and colleagues (Rohsenow et al., 1997) propose a "priming hypothesis," in which tobacco serves as a conditioned stimulus for alcohol consumption and vice versa. Such conditioned processes likely contribute to high rates of co-use between alcohol and cigarettes, and may generalize to e-cig and alcohol co-use. Third, nicotine has been found to mitigate the sedative effect of alcohol, as nicotine is alerting in small doses (Perkins, Sanders, D'Amico, & Wilson, 1997). These and other learned expectancies of combined cigarette and alcohol use (e.g., If I drink and smoke, I will be more sociable) are implicated in the relationship between cigarette and alcohol use (Fearnow-Kenny, Wyrick, Hansen, Dyreg, & Beau, 2001; Fromme & D'Amico, 2000; Pabst, Kraus, Piontek, Mueller, & Demmel, 2014). From such beliefs arise combined expectancies, which have previously been measured using the Nicotine and Other Substance Interaction Expectancy Questionnaire (NOSIE; Rohsenow & Colby, 2005), which assesses expectancies of combined smoking and substance use through 29 items that fall onto four scales: a) substance use increases tobacco use urges (e.g., *I need a cigarette while I am drinking or using drugs*); b) smoking increases substance use urges (e.g., *Smoking gives me more desire for alcohol or drugs*); c) smoking to cope with substance urges (e.g., *I have smoked a cigarette in order to try and decrease my urge to drink or use drugs*); and d) openness to quitting smoking during substance use treatment (e.g., *I believe that I should try to quit smoking*).

Given the similarities of e-cigs and cigarettes, expectancies of combined e-cig and alcohol use might also be similarly related to alcohol use behaviors; however, no studies have examined this. Elucidating whether such combined expectancies would lead to increased alcohol consumption can lead to a better understanding of the potential harm of using e-cigs, particularly for those at risk for developing alcohol use disorders and/or for those who are more likely to use e-cigs (Peters et al., in press). The goals of the present studies were: a) to adapt the NOSIE to assess expectancies of combined e-cig and alcohol use (NOSIE-ER), and b) to examine and characterize the relationship between e-cig use, expectancies, and alcohol use across e-cig use status.

2. Methods

2.1. Participants

Two independent samples were collected using identical methods and measures. Participants who met study inclusion criteria (21 years or older, able to read and understand questions in English, live in the United States, and drink alcohol), signed up to participate online through Amazon's Mechanical Turk (www.mturk.com; MTurk), which is an online web service that connects researchers with individuals willing to complete tasks for a wage. The MTurk subject pool has recently been used to research an array of psychological constructs, including addiction (Boynton & Richman, 2014), personality (Holden, Dennie, & Hicks, 2013), relationships (Adams, Luevano, & Jonason, 2014), self-injury (Andover, 2014) and grief (Papa, Lancaster, & Kahler, 2014). MTurk samples have shown good test–retest reliability, with less than 2% showing inconsistent responses across one week (Shapiro, Chandler, & Mueller, 2013).

2.2. Measures

2.2.1. E-cig use status

Participants responded to face valid e-cig use ("Do you use electronic-cigarettes currently" with 3 response options — "No", "Yes, I use e-cigarettes regularly [daily]", "Yes, I use e-cigarettes, in social contexts only"), and cigarette use ("Do you smoke cigarettes currently" with 3 response options — "No", "Yes, I smoke cigarettes regularly [daily]", "Yes, I smoke cigarettes, in social contexts only") items. Those reporting daily e-cig use and no cigarette use were designated "regular," those reporting e-cig use in social contexts and no cigarette use were designated "social," those reporting daily e-cig use and any cigarette use were designated "regular dual," and those reporting e-cig use in social contexts and any cigarette use were designated "social dual."

E-cig use frequency was assessed in Sample 1 with one item created for this study ("How often do you use an e-cig?" with 4 response options — "Monthly or less," "Weekly or less," "At least daily," and "10× a day or more"). The purpose of the item was to validate the measure of social versus daily e-cig use. More social users, compared to regular users, reported using e-cigs monthly or less, $\chi^2 = 80.78$, $p < .001$, and weekly or less, $\chi^2 = 16.28$, $p < .001$, while more regular users, compared to social users, reported using e-cigs at least daily, $\chi^2 = 46.10$, $p < .001$, and at least 10 times per day, $\chi^2 = 19.96$, $p < .001$ (Fig. 1). Amount of cigarettes smoked per day was examined using one item created for the study ("How many cigarettes do you smoke per day?" with 4 response options — "10 or less," "11–20", "21 to 30," and "31 or more"). Social dual and regular dual e-cig users did not vary in the amount of cigarettes smoked per day (Fig. 1).

2.2.2. E-cigs and alcohol use expectancies

E-cig using participants completed the Nicotine and Other Substance Interaction Expectancies-E-cig Revised version (NOSIE-ER), which was adapted from the NOSIE to reflect combined expectancies of e-cig use and alcohol consumption (Rohsenow & Colby, 2005). The original NOSIE contains 29 items; only the 8 items on Scale 1 and Scale 2 of the NOSIE were modified for use in the NOSIER-ER as they were the most relevant to measuring combined expectancies. Scores on the NOSIE have shown acceptable to good reliability ($\alpha = 0.69$ to 0.81), and are related to level of nicotine dependence ($r = 0.13$, $p < .05$), number of heavy drinking days ($r = 0.13$, $p < .05$), and drug use ($r = 0.14$, $p < .05$; 39). The adapted NOSIE-ER consists of eight true/false items that assess expectations about e-cig use increasing alcohol consumption and alcohol consumption increasing e-cig use (see Table 1). Total data from the NOSIE-ER had good reliability in both samples ($\alpha = 0.88$ and $\alpha = 0.84$) and data were approximately normally distributed in Sample 1 (mean = 3.24, SD = 2.65, skewness = 0.30, kurtosis = −1.06) and Sample 2 (mean = 3.06, SD = 2.50, skewness = 0.322, kurtosis = −0.90). The NOSIE-ER was related measures of alcohol consumption in the present studies (see Sections 3.2 and 4.2).

2.2.3. Alcohol use

The Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, De la Fuente, & Grant, 1993) is a ten-item scale that assesses hazardous alcohol consumption, abnormal alcohol consumption behavior, and alcohol related problems. Data obtained by the AUDIT allows for discriminating between hazardous and non-hazardous drinkers (Saunders et al., 1993), with AUDIT responses showing