Perception of intoxication in a field study of the night-time economy: Blood alcohol concentration, patron characteristics, and event-level predictors

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HIGHLIGHTS

- Large, random in-situ sample of nightlife patrons: BAC levels and event-level contexts unfeasible in lab settings
- Male and female subjective intoxication show equally low sensitivity to increases in BAC.
- Polynomial model: at higher BAC, sensitivity worsens until subjective intoxication non-responsive to differences in BAC
- Main effects: late hour, pre-drinking, and young age systematically biased intoxication upward regardless of actual BAC
- Interactions: energy drinks and stimulants compress subjective intoxication responses, leading to even worse sensitivity

ARTICLE INFO

ABSTRACT

Objective: Determine the relationship of subjective intoxication to blood alcohol concentration (BAC) and examine whether patron and event-level characteristics modify the relationship of BAC to subjective intoxication.
Methods: An in-situ systematic random sample of alcohol consumers attending night-time entertainment districts between 10 pm and 3 am on Friday and Saturday nights in five Australian cities completed a brief interview (n = 4628). Participants reported age, sex, and pre-drinking, energy drink, tobacco, illicit stimulant and other illicit drug use that night, and their subjective intoxication and BAC were assessed.
Results: Male and female drinkers displayed equally low sensitivity to the impact of alcohol consumption when self-assessing their intoxication (BAC only explained 19% of variance). The marginal effect of BAC was not constant. At low BAC, participants were somewhat sensitive to increases in alcohol consumption, but at higher BAC levels that modest sensitivity dissipated (actual BAC had less impact on self-assessed intoxication). The slope ultimately leveled out to be non-responsive to additional alcohol intake. Staying out late, pre-drinking, and being young introduced biases resulting in higher self-assessed intoxication regardless of actual BAC. Further, both energy drinks and stimulant use modified the association between BAC and perceived intoxication, resulting in more compressed changes in self-assessment as BAC varies up or down, indicating less ability to perceive differences in BAC level.
Conclusions: The ability of intoxicated patrons to detect further intoxication is impaired. Co-consumption of energy drinks and/or stimulant drugs is associated with impaired intoxication judgment, creating an additional challenge for the responsible service and consumption of alcohol.

1. Introduction

The dose-dependent relationship between alcohol intake and risk of injury to self or others is well-established (Phillips & Brewer, 2011; Taylor & Rehm, 2012), and experimental evidence shows increased cognitive impairment with increased objective intoxication (Zoethout,

Delgado, Ippel, Dahan, & van Gerven, 2011). Subjective awareness of intoxication informs decision-making about further alcohol consumption and engagement in other risk behavior. Ecological momentary assessment studies have shown that subjective intoxication predicts experience of negative outcomes at an event-level (Quinn & Fromme, 2011b). For example, greater blood-alcohol concentration (BAC)

underestimation error predicted greater risk-taking in a driving simulator task, even after controlling for objective BAC (Laude & Fillmore, 2016). Thus, it is critical that consumers evidence relatively accurate subjective perception of intoxication to inform decision-making. Yet, we are still discovering what factors influence the subjective experience of intoxication at the environmental, individual, and drinking event levels.

Subjective reporting of intoxication involves judging interoceptive cues and behavioral changes in comparison to beliefs and norms about how it feels to be intoxicated (Klima, Skinner, Haggerty, Crutchfield, & Catalano, 2014). Ideally, this process would result in self-assessments that proportionately reflected increased objective intoxication. However, the relationship between objective and subjective intoxication is not linear. For example, field-based research has shown that university student patrons exiting licensed venues with a low BAC (≤ 0.080) overestimated their objective intoxication, while those with a moderate BAC (0.081 to 0.160) and high BAC (≥ 0.161) underestimated their objective intoxication (Grant, LaBrie, Hummer, & Lac, 2012). The relationship between objective and subjective experiences of intoxication may also be influenced by individual characteristics, the drinking episode, and the environment (e.g., age, sex, alcohol expectancies, event duration, pre-drinking, whether intoxication is rising or falling, presence of others, and distractions in the environment) (Clapp et al., 2009; Cromer, Cromer, Maruff, & Snyder, 2010; Grant et al., 2012; Martin & Earleywine, 1990; O'Malley & Maisto, 1984; Quinn & Fromme, 2011a; Sher, 1985). However, studies of predictors of subjective intoxication predominantly employ experimental laboratory research or field-based studies limited to specific sub-populations such as university students, and generally focus on a narrow range of potential predictors of intoxication.

Experimental lab evidence suggests that energy drink (ED) co-ingestion with alcohol results in higher stimulation ratings than when either substance is taken alone; there is conflicting evidence as to changes in perceived intoxication, impairment, and sedation (Peacock, Bruno, Martin, & Carr, 2013). However, a field study found that bar patrons who have consumed caffeinated energy drinks (EDs) with alcohol have a higher BAC and are more likely to report intention to drive home that night (Thombs et al., 2010). Co-administration of alcohol with other simulants such as ecstasy (MDMA) and methamphetamine have been shown to increase stimulation and decrease sedation (Hernández-López et al., 2002) and reduce feelings of alcohol-specific intoxication (Kirkpatrick, Gunderson, Levin, Foltin, & Hart, 2012) relative to use of alcohol alone in laboratory settings. In contrast, other studies have found stimulants such as cocaine (Perez-Reyes & Jeffcoat, 1992) and amphetamines (Perez-Reyes, White, McDonald, & Hicks, 1992) did not reduce subjective ratings of alcohol intoxication. Generally, such studies on the interaction of stimulants and alcohol asked participants to rate the effect of *alcohol* intoxication separately from subjective drug effects, so it is unclear how the interaction might affect *overall* feelings of intoxication when participants are not asked to tease apart alcohol effects from drug effects. Furthermore, the potential effects of depressant drugs are relatively unexplored. Field-based assessment of the general night-time economy patron population is a necessary next step to explore a broad range of other psychoactive substance use on subjective intoxication over a natural dosage range of alcohol.

The aim of the present study was to answer the following questions using a large, random, and naturalistic sample of patrons from the Australian night-time economy:

Q1. To what extent is BAC associated with self-assessed level of intoxication?

Q2. Does the relationship between BAC-measured intoxication and self-assessed intoxication change at different BAC levels?

Q3. What factors other than BAC-measured intoxication are associated with a person's self-assessment of intoxication? For example, do sex, age, time of night, energy drinks, pre-drinking, tobacco use, or other drug use predict self-assessed intoxication?

Q4. Do these other factors *modify* the association between BAC-measured intoxication and self-assessed intoxication?

2. Methods

2.1. Study design and procedure

We used a systematic random sample (selecting every third person) of people attending night-time entertainment districts in five major Australian cities: Sydney, Melbourne, Wollongong, Geelong, and Perth (Sydney, Melbourne, Wollongong, Geelong, and Perth; Miller, Pennay, Droste et al., 2013; Miller, Pennay, Jenkinson et al., 2013). Teams of 6–10 trained interviewers conducted patron interviews in busy thoroughfares and areas where patrons were entering or leaving venues (up to six venues each night). Locations chosen were the busiest hotspots and entertainment precincts across the sites that included a diverse range of patronage.

Data collection occurred approximately every two weeks in each city on a Friday or Saturday night during Australia's warmer months (November 2011–June 2012). Interviews lasted approximately 3–15 min and were normally conducted between 10 pm and 3 am, but sometimes commenced as early as 8 pm or concluded as late as 5 am. Questions were developed using Tap Forms software and stored on iPod Touch© or iPhone© devices. Following the interview, participants' BAC was assessed, and every fifth person was asked to undertake a drug swab.

2.2. Measures

2.2.1. Self-assessed intoxication

Patrons were asked about overall feelings of intoxication: "Can you rate how intoxicated you feel from your alcohol and other drug consumption tonight (on a scale of 0 to 10, 10 being seriously affected)?" When queried on the end anchors, interviewers were instructed to explain: "0 means not intoxicated at all, and 10 means the most intoxicated that you've ever been."

2.2.2. BAC

BAC was assessed using calibrated Andatech Alcosense® Prodigy breathalyzer units, which is certified to Australian Standards and provides accurate readings ranging from 0.00 to 0.40 g/100 ml of ethanol in the blood with a 0.02 g/100 ml margin of error when calibrated.

2.2.3. Individual and event-level correlates of self-assessed intoxication

The interview included information about respondent's sex (male or female) and age (categorized as 18 to 20 years old versus > 20 years), and details about their current night out. Participants were asked to report whether tonight they had: engaged in pre-drinking (consuming alcohol before attending licensed venues/'going out'), used tobacco, consumed three or more energy drinks (based on Australia's recommended daily limit (Peacock et al., 2016)), used illegal stimulants (defined as ecstasy, cocaine, methamphetamine, pharmaceutical stimulants, or mephedrone), or used other illegal drugs (defined as cannabis, LSD, ketamine, GHB/GBL/1.4B, benzodiazepines, opiates/heroin, or other drugs). Time of interview was recorded (< 11 am, 11:00–12:59, 1:00–1:59, 2:00 onwards).

2.3. Analysis

This study aimed to determine how drinkers self-assess their own level of intoxication compared to a biomarker. Therefore, we examined data from the 4628 participants who said they had consumed alcohol that evening, gave a self-rated intoxication estimate, took a breath test, and did not receive a zero on the breath test.

Descriptive bivariate comparisons of self-assessed intoxication and BAC were illustrated graphically. We examined how well BAC predicts