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The Effects of Alcohol Mixed with Energy Drinks on Risk-Taking Behaviour

Holly Bromfield

A report submitted as a partial requirement for the degree of Bachelor of Psychology with Honours at the University of Tasmania, 2016.

Statement of Sources

I declare that this report is my own original work and that contributions of others have been duly acknowledged.

..…… ……..

Holly Bromfield Date

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The Effects of Alcohol Mixed with Energy Drinks on Risk-Taking Behaviour

Holly Bromfield

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Abstract

The ‘wide-awake drunkenness’ hypothesis proposes that consuming alcohol mixed with energy drinks (AmED) masks the sedative effects of alcohol, causing consumers to misperceive their level of intoxication and consequently engage in more risky behaviours (Peacock & Bruno, 2015). Experimental data suggests a trend towards increased risk-taking following AmED consumption driven predominantly by the ED, with small magnitude effects (Lubman, 2013; Peacock, Bruno, Martin, & Carr, 2013). This study examined AmED effects on risk-taking administering standardised ED and alcohol doses, using a naturalistic multi-dose design to mimic how AmEDs are consumed in the ‘real-world’. In a placebo-controlled, within-subjects, double-blind study, participants (N=27) consumed alcohol with ED (AmED condition) and soda water (Alcohol-only condition). The Automatic Balloon Analogue Risk Task (A-BART) measured risk-taking propensity, while the Determination Task (DT) was administered to measure frustration tolerance. AmED administration did not significantly increase risk-taking propensity as measured by the A-BART, however Reaction Time (RT) on the DT was improved following AmED ingestion, indicating improved cognitive function relative to alcohol-only, whilst accuracy was not significantly affected. Improved cognitive performance may predict underestimation of intoxication as drinkers gauge their level of impairment based on cognitive cues (Celio et al., 2014). Future research should aim to measure risk-taking behaviour in social drinking environments to further improve ecological validity.

The consumption of alcohol mixed with energy drinks (AmED) is a common practice among young Australians aged 18-24 (Pennay & Lubman, 2012). Energy drinks (ED) generally promote increased alertness and 'energy', thus it is widely believed that mixing EDs with alcohol will counteract the sedative effects of alcohol (Peacock, Bruno & Martin, 2013).This is theorised to create a state of 'wide-awake drunkenness', whereby the consumer believes they are less intoxicated relative to consuming the same amount of alcohol without ED. Researchers have speculated that this misperception of intoxication may increase the likelihood of engaging in risk-taking (Peacock & Bruno, 2015). Current research consists mostly of self-report retrospective survey designs (Peacock, Pennay, Droste, Bruno, & Lubman, 2014), precluding direct inferences regarding causality. The few experimental studies support a trend toward increased risk-taking post ED and AmED administration, with small magnitude effects (Lubman, 2013; Peacock et al., 2013). Current experimental research is limited in that AmED dosing protocols used in existing work do not reflect the quantities and speed at which they are typically consumed (Pennay et al., 2015), perhaps explaining the absence of substantive effects. As such, there is a need for research that objectively measures risk-taking whilst implementing naturalistic dosing.

Alcohol

Prevalence and harms. Australian guidelines for minimising acute harm when consuming alcohol recommend no more than 4 standard drinks on a single occasion (National Health and Medical Research Council, 2009). In 2013, 37% of Australians aged 12 years and older exceeded this single occasion risk threshold at least once in the past year. People aged 18 to 24 were the age group most likely to exceed this threshold (National Drug Strategy Household Survey, 2013). Excessive

consumption of alcohol is known to have harmful health, economic and social effects. Tangible costs attributable to alcohol totalled 10.8 billion dollars in the 2004/05 financial year, with labour and health costs constituting the major cost components (Collins & Lapsley, 2008). Alcohol intoxication is among the three most common causes of fatal car crashes in Australia (Bureau of Transport Infrastructure and Regional Economics, 2011) and a review of metropolitan Western Australian Emergency department records indicated that the majority (41%) of all alcohol and drug related presentations over a four week period were caused by alcohol consumption, with injury being the most frequent diagnosis at presentation (Hulse, Robertson & Tait, 2002).

Pharmacokinetics and cognitive effects. Degree of alcohol-related impairment is determined by numerous factors including blood alcohol concentration and the rate at which the body is able to metabolise alcohol. Ethanol (ethyl alcohol) is absorbed through the gastrointestinal tract and is distributed through a majority of the water-containing tissues in the body (Naranjo & Bremner, 1993). Breath alcohol concentration (BrAC) peaks approximately 57 minutes post-consumption for males and 42 minutes for females (Dubowski, 1985). An average 70kg person metabolises one standard drink (10g alcohol) per hour (Baraona et al., 2001). Metabolic rate depends on a variety of situational, physical, biological and psychological factors including alcohol concentration, food intake, sex, weight, body water and patterns of alcohol consumption (Dubowski, 1985).

Ethanol affects the central nervous system (CNS) by acting on receptors in the inhibitory γ-aminobutyric acid (GABA) and excitatory *N*-methyl-D-asparate (NMDA glutamate) pathways, producing sedative effects causing a range of behavioural and psychomotor impairments (Dougherty, Marsh, Moeller, Chokshi, &

Rosen, 2000; Zoethout, Delgado, Ippel, Dahan, & van Gerven, 2011). More specifically, behavioural changes in impulsivity caused by ethanol are impacted by serotonin function (Dougherty et al., 2007; Eckardt et al., 1998). Acute intoxication compromises executive function regulated by the pre-frontal cortex. The orbitofrontal area in particular is affected which is implicated in risk assessment and inhibition of socially inappropriate behaviours (Berlin, Rolls, & Kischka, 2004; Rolls, 2004).

Acute tolerance. Severity of alcohol-induced behavioural and cognitive deficits may change over the BrAC curve, which is a representation of level of intoxication over time (Schweizer & Vogel-Sprott, 2008). The curve consists of two limbs: ascending, representing the period from ingestion to peak intoxication, and descending, representing the post-peak decline (Figure 1). Acute tolerance refers to a specific behaviour or function being differentially impaired on the two limbs (Schweizer & Vogel-Sprott, 2008). For example, participants in Amlung, Morris, and McCarthy's (2014) study were more willing to drive, and judged doing so as less dangerous on the descending limb compared to the ascending limb despite having the same BrAC. Tolerance is thought to result from a temporary adaptation to the physiological effects of alcohol (Peacock, Cash, & Bruno, 2015).

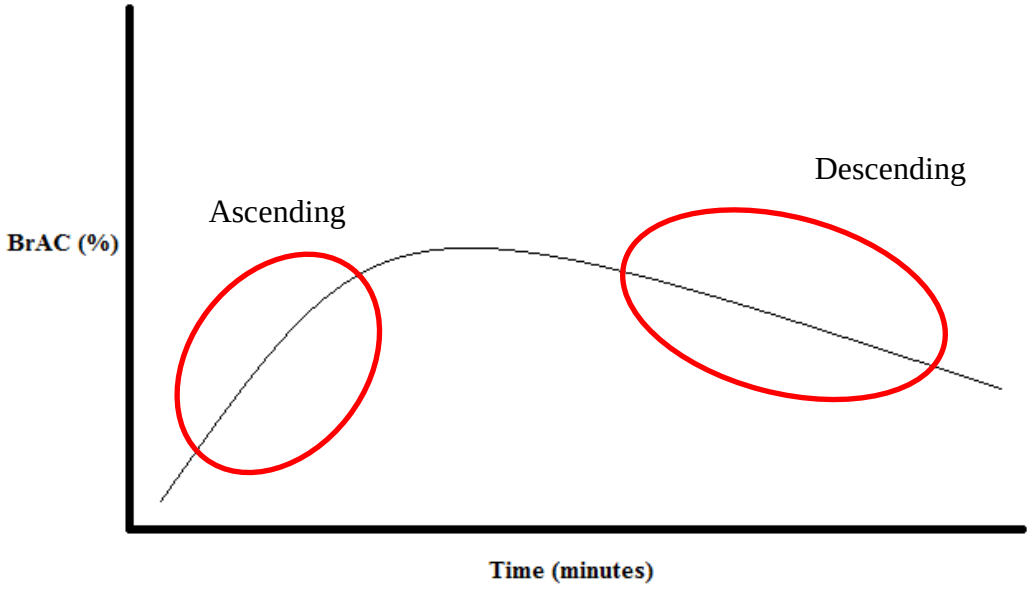

Figure 1. The BrAC curve, in which intoxication level rises sharply to a peak before declining more slowly over time.

Alcohol and risk-taking. The body of evidence concerning alcohol intoxication points unequivocally to greater engagement in risk-taking behaviour and consequent experience of harm after consuming alcohol. Indeed, alcohol consumption among young people is associated with behaviours such as risky driving (Greene, Krcmar, Walters, Rubin, & Hale, 2000) and unsafe sex (Coleman & Cater, 2005). For example, drinkers who consume alcohol to the point of experiencing impaired judgement or total loss of control have been found to be more likely to engage in risky sexual activity (Coleman & Cater, 2005). Although these behaviours are regularly referred to as risky, there has been no global consensus as to the definition of risk-taking behaviour. Within the current literature the term-risk taking is often used interchangeably with sensation-seeking and impulsiveness, yet Weafer and Fillmore (2016) argue that they are separate constructs. Impulsivity in itself is multifaceted and broadly considered to comprise the tendency to enter situations or make quick decisions without consideration of the possible negative or

aversive outcomes (Zuckerman, 1994b). Sensation-seeking has been referred to as the seeking of varied, novel, complex and intense sensations and experiences whilst willingly accepting the financial, physical, social and legal consequences of such behaviour (Zuckerman, 1994a).

Risk-taking is seemingly more similar to impulsivity than sensation-seeking, defined by Kahneman and Lovallo (1993) as the adoption of an inside view of problems, which leads individuals to base decisions on readily available cues rather than to consider the consequences of such behaviour. People are heavily biased towards adopting this inside view even when historical information about a situation is available (Kahneman & Lovallo, 1993). Alcohol is known to impair cognitive processes involved in evaluating risk such as information processing, attention (Dry, Burns, Nettelbeck, Farquharson, & White, 2012) and inhibitory control (Field, Wiers, Christiansen, Fillmore, & Verster, 2010), and thus is likely to increase risk-taking behaviour.

Laboratory studies of risk-taking post-alcohol consumption.

Experimental research can identify the causal relationship between alcohol consumption and increased risk-taking by manipulating and controlling variables via objective measures of risk-taking, including measures of gambling and risky driving. A number of studies using driving simulators and willingness to drive indicators to measure risk-taking behaviour (Table 1), have observed increased risk-taking in terms of driving violations under the influence of alcohol relative to placebo administration. Other researchers have taken a more decision-making focused approach, using gambling tasks such as the Balloon Analogue Risk Task (BART) that closely mimic the decision-making processes involved in risk-taking (Lejuez et al., 2002).

The BART is a high stakes risk task in which participants accumulate $0.05 for each pump administered to a virtual balloon. Funds are accrued in a temporary bank and are only transferred to a permanent store when the participant decides not to further inflate the balloon. If the balloon is inflated to the pre-determined explosion point (which the participant is unaware of) and explodes, funds accrued for that balloon are lost and a new balloon (trial) begins; this is repeated over 30 trials. Risk is calculated in terms of the average number of pumps entered on trials in which the balloon does not explode (adjusted average pumps). Higher number of pumps indicates greater risk-taking, as the chances of the balloon exploding increase as the number of pumps increases. Results regarding the effect of alcohol on risk-taking as measured by the BART have been mixed (Table 1). Lejuez et al. (2002) showed that risk-taking on the BART is positively correlated with self-reported risky behaviours, while Reynolds, Richards, and de Wit (2006) found that administering alcohol in an experimental study had no impact on risk-taking relative to placebo.

The BART has been criticised for excluding trials on which participants are riskiest, as the outcome measure is adjusted number of pumps (average number of pumps entered across trials on which the balloon did not explode) (Pleskac, Wallsten, Wang, & Lejuez, 2008). Pleskac et al. (2008) has since devised an automated variation (A-BART) in which the participant types the number of pumps they want to administer rather than clicking the mouse to inflate the balloon, thus meaning all trials can be included in the outcome measure. The A-BART has been determined to be a more accurate measure of risk-taking than the BART, with participants willing to take more risks, as well as improved external validity (Pleskac et al., 2008).

Table 1

Summary of Findings for Alcohol-Induced Impairment on Risk-Taking and Inhibitory Control.

Cognitive function	Study	Design	Alcohol dose	BrAC	Task	Statistically Significant Impairment
Risk-taking	Burian et al. (2002)	Within-subjects, placebo controlled	0.3, 0.5, 0.8 g/kg	0.03, 0.05, 0.09%	Simulated driving	Yes
	Burian et al. (2003)	Between-subjects	0.5 g/kg	0.048%	Simulated driving	Yes**
	Weafer & Fillmore (2012)	Within-subjects, placebo controlled	0.65 g/kg	73.7 mg/100ml	Simulated driving	Yes
	Amlung et al. (2014)	Between-subjects, placebo controlled	0.10g%	0.068%	Willingness to drive	Yes*
	Lane et al. (2004)	Within-subjects, placebo controlled	0.2, 04, 0.8 g/kg	0.02, 0.04, 0.09 %	Risk choice task	Yes^
	Reynolds et al. (2006)	Within-subjects, double-blind, placebo controlled.	0.4, 0.8g/kg	0.03, 0.07%	BART	No
	Rose et al. (2014)	Between-subjects, placebo controlled	0.6 g/kg	0.036%	BART	Yes
Inhibitory control	Weafer & Fillmore (2012)	Within-subjects, placebo controlled	0.65 g/kg	73.7 mg/100ml	Cued go-no-go	Yes*
	Marczinski et al. (2011)	Between-subjects, placebo controlled	0.65 g/kg	0.089%	Cued go-no-go	Yes

NB: * = Acute tolerance, ^ = dose dependent effect, ** = expectancy bias.

Energy Drinks

Prevalence. It is further speculated that increases in risk-taking post-alcohol consumption may be exacerbated by the co-consumption of energy drinks (EDs) (Peacock et al., 2015). EDs are caffeinated beverages marketed to reduce fatigue, increase alertness and improve performance. Australians are one of the largest consumers of EDs globally, with national sales reaching $600 million per annum (Cowie & Bolam, 2015). Young people make up the largest consumer group, with roughly 37% of 18 to 24 year olds reporting consumption within a three-month period (Pennay et al., 2015).

ED Ingredients. Active ingredients in EDs include caffeine, sugar, taurine, glucoronolactone, gurana and B vitamins (Table 2) (Higgins, Tuttle, & Higgins, 2010). Caffeine and sugar are thought to be the primary agents influencing behaviour (Adan & Serra-Grabulosa, 2010).

Table 2

Energy Drink Constituents of Red Bull®

Constituent	**Per 250mL**
Sugars	27.5g
Sodium	100mg
Taurine	1000mg
Caffeine	80mg
Glucoronolactone	60mg
Inositol	50mg
Niacinamide	20mg
Pantothetic Acid	5mg
Vitamin B6	5mg
Vitamin B12	5µg

***Caffeine*.** One 250ml can of the dominant market brand of ED, Red Bull ©, contains 80mg of caffeine, similar to a single cup of instant coffee (Scholey & Kennedy, 2004) and 27g of sugar (glucose), higher than regular soft drinks (e.g,. Coca-Cola®: 26.5g sugar). Australian ED daily intake guidelines recommend a maximum of 500ml (Australian Beverages Council, 2015). Caffeine is the primary driver of cognitive and behavioural change (Childs, 2014). Caffeine acts to block the sleep promoting adenosine receptor sites in the brain, subsequently reducing fatigue and increasing stimulation (Pettenuzzo et al., 2008). Following absorption through the gut caffeine reaches its peak plasma levels between 15 and 30 minutes (Teekachunhatean, Tosri, Rojanasthien, Srichairatanakool, & Sangdee, 2013). Caffeine has been detected in the blood for up to 12 hours post-consumption, but effects typically dissipate after four hours (Teekachunhatean et al., 2013).

Sugar (Glucose). Although caffeine is considered to be the dominant constituent of EDs producing cognitive and behavioural effects, glucose also plays a considerable role (Childs, 2014). Glucose is essential to brain function, providing its major source of energy . Once absorbed into the bloodstream glucose is transported across the blood-brain barrier and stored as glycogen in the CNS. Blood glucose levels peak around 25-30 minutes post-consumption and remain stable for around 2 hours before dissipating (Kennedy & Scholey, 2000). Research regarding the effects of sugar on cognitive control suggest that high consumption of sugary beverages during adolescents may impair neurocognitive processes involved in decision-making (Reichelt, Killcross, Hambly, Morris, & Westbrook, 2015), while combining glucose with caffeine has positive short-term effects for working memory (Giles et al., 2012). Glucose and caffeine are reported to have greater psychoactive effects in combination than alone (Adan & Serra-Grabulosa, 2010).

EDs and risk-taking. Evaluations of EDs as a whole have demonstrated reduced fatigue (Gershon, Shinar, & Ronen, 2009; Horne & Reyner, 2001), improved physical endurance (Ivy et al., 2009), and improved speed of attention (Scholey & Kennedy, 2004). However, behavioural effects of ED consumption are also of concern given that they are often consumed in excess by young people (Gunja & Brown, 2012). Survey data has shown positive associations between ED use and increased problem behaviours such as sexual risk-taking, cannabis use, fighting, failure to use seatbelts, and cigarette smoking (Miller, 2008). It is yet to be determined that EDs are a causal agent in this behaviour and these findings are interpreted as indicating that ED consumers are typically riskier and more impulsive relative to their non-consumer counterparts

Consuming EDs has been linked with improved cognitive performance in a number of experimental studies, in particular alleviating mental fatigue (Kennedy & Scholey, 2004). Consuming 500ml ED was shown to improve driving performance relative to baseline in drivers who had just five hours sleep the night prior. ED had the greatest effect in the first hour after consumption, an effect that was not observed in the sugar matched caffeine-free placebo condition (Horne & Reyner, 2001). Mets et al. (2011) later replicated these findings when they specifically tested the effect of Red Bull®, concluding that the drink significantly improved driving performance and reduced fatigue. This study was financed by Red Bull®, so results should be treated with caution. Independently funded studies have also provided support for EDs as effective in reducing fatigue for nightshift workers (Jay, Petrilli, Ferguson, Dawson, & Lamond, 2006).

The cued go-no-go task measures response activation and inhibition to a target on valid (80%) and invalid orientation cues (20%). The task is further

complicated by a stop signal which indicates to the participant to inhibit their response; failure to inhibit responses indicates high impulsivity (Marczinski, Fillmore, Bardgett, & Howard, 2011). In a study looking at the effects of ED consumption on performance, three different ED doses (1.8 ml/kg, 3.6ml/kg and 5.4ml/kg) were found to significantly improve response activation relative to placebo or no drinks, however, there was no significant effect on inhibition following valid or invalid cues (Howard & Marczinski, 2010). The cued go-no-go task taps into impulsivity as opposed to risk-taking, therefore, inferring risk-taking from performance on the cued go-no-go task goes against the idea of impulsivity and risk-taking being separate constructs. Experimental research concerning the impact of EDs alone on objective measures of risk-taking is limited, instead focusing on the combination of EDs with alcohol and subsequent risk behaviour.

Alcohol mixed with ED (AmED)

Prevalence and harms. The consumption of alcohol mixed with EDs (AmEDs) is a common practice among young Australians aged 18 to 24, with 4.6% having consumed AmEDs over a 3-month period. AmED consumers report reasons for use such as wakefulness and energy; taste; counteracting the drowsy effects of alcohol; facilitating alcohol intoxication, and social bonding for consuming AmEDs (Pennay & Lubman, 2012). These motives, patterns of consumption and popularity with young people have raised concerns among researchers regarding the safety of AmED consumption (Peacock, Bruno, & Martin, 2012; Peacock, Raimondo, & Martin, 2013). Self-report data indicates that relative to alcohol only sessions, AmED drinking sessions are likely to reduce sedation effects while increasing the likelihood of stimulation effects (Peacock et al., 2012). Further research is needed to establish the risks associated with AmED when consumed at rates as reported above.

Subjective effects. Popular belief is that the caffeine in EDs counteracts the adverse effects of alcohol. Retrospective self-report literature indicates that consuming AmEDs increases stimulation, energy, and alertness while reducing fatigue, clumsiness, confusion and sadness in comparison to when alcohol is consumed alone (Peacock et al., 2014). This is despite the fact that AmED and alcohol have a similar impact on objective intoxication (Loo et al., 2016). In a recent double-blind placebo-controlled study, Loo et al. (2016) reported that sleepiness significantly increased after consuming alcohol only (0.08% BrAC), but remained stable in the AmED (250ml ED) condition, supporting the "wide-awake drunkenness" hypothesis that the stimulative effects of AmED can mask the depressive effects of alcohol. Research indicates that consumers of AmEDs underestimate their true level of intoxication and thus impairment (Ferreira, De Mello, Pompéia, Souza-Formigoni, & Oliveira, 2006), likely due to the masking effect of the ED when mixed with alcohol. This "wide-awake drunkenness" is thought to lead to poor decision-making and thus increased likelihood of engaging in risky behaviour (Arria & O'Brien, 2011).

AmED and Risk-Taking.

Self-report. Between-subjects comparisons of self-report data indicate that trait risk-taking is greater among AmED users compared to alcohol-only consumers (Peacock et al., 2014). This does not necessarily reflect an effect of the beverage though, as the difference may be attributable to a greater tendency towards risk-taking among AmED consumers relative to alcohol only consumers. Comparison of risk-taking within-subjects (i.e. among the same individuals after consuming AmED versus alcohol-only) has showed lower risk taking in AmED versus alcohol-only drinking sessions (Peacock et al., 2014). This design produces more reliable results

in terms of an effect of AmED as individual differences are controlled for by comparing participants against themselves. However, self-report data is limited, in that confounding factors, such as differences in drinking environment for AmED and alcohol sessions and differing frequency of use, cannot be controlled. Indeed, previous studies (Peacock et al., 2014) indicate that there may be differences in the way AmEDs and alcohol only beverages are consumed (i.e., frequency, quantity and environment) that may contribute to this effect.

***Experimental research*.** Experimental studies are able to control for such confounding factors and therefore offer more conclusive data regarding the effects of AmEDs on intoxication and risk-taking. An experimental study which directly assessed risk-taking using a simulated driving task showed that increasing ED dose (1, 2 and 3 250ml cans) mixed with 0.50 and 0.65 g/kg of alcohol did not increase risk-behaviours (i.e., speeding or time spent out of lane), relative to the placebo condition (Lubman, 2013). Lubman (2013) attributed the lack of a significant effect to low sensitivity of the driving simulator as a measure of risk-taking, as a very low overall rate of risk-taking was recorded for all participants across conditions. In contrast, Peacock et al. (2013) reported a small magnitude yet statistically significant effect of ED (3.75ml/kg) on risk-taking as measured by the BART, suggestive of increased risk-taking under ED administration independent of alcohol dose (0.5g/kg).

AmED and BrAC. In addition to proposing increased risk-taking, the wide-awake drunkenness hypothesis also assumes equivalent objective intoxication (BrAC) after AmED consumption relative to the same volume of alcohol. However, there is some evidence to suggest that BrAC is lower when alcohol is consumed with ED compared to when it is consumed with sugar-free mixers. As the quantity

of ED is increased BrAC decreases, even when alcohol content is held constant (Lubman, 2013). Food digestion is known to decrease the rate of gastric emptying which in turn decreases alcohol absorption and thus lowers BrAC (Oneta et al., 1998). It is likely that the glucose in AmEDs causes such a reaction, causing BrAC to be lower in AmED relative to alcohol-only consumers. Empirical support is inconsistent, with other studies not having observed such an effect (Loo et al., 2016; Marczinski et al., 2011; Peacock et al., 2013), although, these studies used low ED doses and thus the difference may not have been of a sufficient magnitude to warrant comment. Further research is required to determine the effect of EDs on objective intoxication and how this might affect risk-taking.

Limitations of current research. Current experimental research is lacking in ecological validity. Doses have been limited to one standard 250mL ED in a majority of studies (Peacock et al., 2013). Yet survey data indicates that consumers are typically drinking 2.4 EDs in a drinking session (Peacock, Raimondo, B & Martin, F. H, 2013). Furthermore, laboratory studies generally administer AmED doses bolus (in one dose at the start of the session), which is unrealistic given that common practice is to pre-load one or two AmEDs in private residences at the beginning of the night before attending licensed venues, then drinking more steadily throughout the night (Pennay & Lubman, 2012). More research is needed that adopts naturalistic dosing protocols which reflect real-world drinking patterns in order to assess the behavioural changes and potential resulting harms caused by consuming alcohol and ED in excess of recommendations. In addition to problems with ecological validity, tasks previously used to measure risk-taking, such as the BART, cued go-no-go task and driving simulators, have been criticised as not necessarily

measuring the construct and being of low sensitivity (Loo et al., 2016; Lubman, 2013; Marczinski et al., 2011; Peacock et al., 2013).

Current Study

Aims. The aim of the present study was to expand and develop the existing AmED and risk-taking literature by implementing a multi-dose naturalistic procedure. In order to replicate the real-world rate and quantities of consumption, 2.5 EDs were administered mixed with 5 standard alcoholic drinks (10g) across four doses, the first dose being a double dose, mimicking pre-loading. Previous studies have administered alcohol based on body weight (Marczinski et al., 2011; Peacock et al., 2013). While this is an accurate formula for determining performance at specific BrAC levels, administering standardised drinks to a number of participants provides more detail in terms of how standardised doses affect behaviour. After all, consumption guidelines are in the form of standard drinks (National Health and Medical Research Council, 2009). It is proposed that by administering standard doses in a naturalistic pattern results will be more generalizable and thus reflective of real-world implications of excessive AmED consumption.

Risk-taking will be measured by the Automatic Balloon Analogue Risk Task (A-BART), with higher number of average pumps and percentage of exploded trials indicating risk-taking. The second measure of risk-taking will be the Determination Test (DT) component of the Fitness to Drive Standard (DRIVESTA) test set (Schuhfried GmbH, 2012). The DT was originally designed as part of a driving assessment battery, to measure stress, reactive tolerance. Participants are presented with visual and auditory stimuli and must respond by selecting the corresponding colour and tone keys on a specially designed key pad and stepping on left and right pedals that correspond to icons on the screen. Presentation becomes faster as correct

responses accumulate. The task therefore measures participant's ability to inhibit frustration, as indexed by accuracy (% of correct responses) and reaction time (RT) risk-taking is characterised by faster RT and lower accuracy of correct responses demonstrating inability to inhibit frustration.

Hypotheses. Based on the 'wide-awake drunkenness' premise of increased risk-taking post-AmED consumption, the following three hypotheses have been formulated. In light of Peacock et al. (2013)'s finding that ED administration significantly increased risk-taking on the BART, it was hypothesised that there would be a significant Time*Condition interaction for the outcome measure of average number of pumps on the A-BART, with minimal differences at the ascending limb (35 and 75-minutes), but significantly higher average number of pumps (inferring riskier behaviour) recorded at peak caffeine and alcohol levels (115 and 155-minutes) in the AmED compared with the alcohol-only condition. A significant Time*Condition interaction was hypothesised for median RT on the DT, with minimal differences at the ascending limb (25 and 65-minutes), but significantly faster RT (inferring riskier behaviour) in the AmED compared to alcohol-only condition at peak caffeine and alcohol levels (105 and 145-minutes). Previous research has supported faster RTs following AmED administration relative to alcohol (Marczinski et al., 2011; Peacock et al., 2013). In theory, speed and accuracy are in competition with one-another, thereby, an improvement in one should correspond to a deficit in the other evidenced by a speed accuracy trade-off (SAT) (Bogacz, Wagenmakers, Forstmann, & Nieuwenhuis, 2010). It was therefore hypothesised that there would be a significant Time*Condition interaction for accuracy on the DT, with minimal differences on the ascending limb (25 and 65-minutes), but number of correct responses being significantly lower (inferring riskier

behaviour) at peak caffeine and alcohol levels (105 and 145-minutes) in the AmED compared with alcohol-only condition.

Method

Participants

Ethics approval was obtained from the Human Research Ethics Committee (Appendix A). The current study was a double-blind, placebo-controlled, within-subjects design. Thirty participants (n=15 male) aged 18-35 years (the target ED demographic) (Gunja & Brown, 2012) were recruited through advertisements posted around the University of Tasmania Sandy Bay campus and online (Facebook and Gumtree). Participants attended one 60-minute familiarisation session and two 4 hour experimental sessions in which they consumed 5 standard alcoholic beverages with i) ED and ii) placebo. Testing occurred at baseline and five time points, once after each drink, and then again as BrAC began to descend.

Eligibility was determined by an online screening survey (Appendix C). Inclusion criteria included completion of Year 12 or equivalent, normal sleep patterns, normal or corrected-to-normal vision and normal Body Mass Index (BMI). Participants were regular ED (weekly to monthly); alcohol (≥ 5 standard drinks on one occasion in the past month); and caffeine (≥ 5 standard caffeinated products in the past week) consumers. Exclusion criteria included history of psychiatric or neurological condition, current psychological distress (≥ 30 on the Kessler Psychological Distress Scale (K10) (Kessler et al., 2002), intellectual disorder (< 70 on the Weschler Test of Adult Reading (WTAR) (Wechsler, 2001), alcohol dependence (≥ 16 on the Alcohol Use Disorders Identification Test (AUDIT) (Saunders, Aasland, Babor, De la Fuente, & Grant, 1993), regular tobacco use (≥ weekly), history of drug dependence, illicit drug use (last six months), pregnancy, or

any chronic health issues. First-year Psychology students received course credit or AUD 80.00; other participants received AUD 80.00.

Materials and Apparatuses

Alcolizer HH-2. BrAC was measured using the Alcolizer HH-2 to determine BrAC at the outset of each task. The Alcolizer HH-2 is calibrated to Australian certified standards for breathalysers (Alcolizer Technology, n.d).

Beverage rating scale (BRS). Participants estimated the number of standard alcoholic drinks and standard EDs consumed to ensure they were blind to condition (Peacock et al., 2013).

A-BART. The automatic BART is a computerised risk analysis task in which participants inflate a balloon by typing the amount of pumps, accruing $0.05 per pump in a temporary bank. If the balloon does not explode on the number of pumps entered by the participant, the funds in the temporary bank are transferred to a permanent tally; if the balloon explodes, the funds are lost. The average breakpoint across trials is 64 pumps; the participant is made aware of this explosion point. The current study administered 30 trials at each time point. The A-BART can be administered in 3.5 minutes (Pleskac et al., 2008). Response rates on the A-BART are moderately correlated with the standard BART (r=.62, p <.01). Scores on the BART have been significantly moderately positively correlated with self-reported accounts of risky behaviour including alcohol, and substance use, cigarette use, gambling, sexual risk behaviour and stealing (Lejuez et al., 2002).

Determination Test (DT). Participants are presented with five visual stimuli; two auditory stimuli and two signals corresponding to foot-operated pedals on a screen. The participant must respond as quickly as possible to all signals by selecting the corresponding keys on the response panel and foot pedals. The

outcome measures are number of correct responses and median RT to correct responses. The DT has high internal reliability; construct validity is also high having been found to be significantly positively correlated with driving performance (Schuhfried GmbH, 2012).

Treatment doses. Doses were administered in four beverages, with the first being a double dose. The treatment condition consisted of 5 standard serves (33.8ml) of a/v Smirnoff Red Label No. 21 vodka, served in standard drink portions, and mixed with ED or the equivalent amount of soda water (alcohol-only condition) (Table 3). Conditions were matched for taste using Torani sugar-free syrup; previous research indicates this technique successfully disguises the taste of ED/placebo (Peacock et al., 2013). Alcohol dose was chosen based on drinking habits of young people who typically consume 4.2 AmEDs in a drinking session (Pennay & Lubman, 2012). Based on pilot testing, it was expected that this dose would achieve an average BrAC of 0.05%. Red Bull® was chosen as it is frequently mixed with alcohol (Peacock, Raimondo, B & Martin, F. H, 2013).

Table 3

Dosing Schedule and Treatment Doses

Time	**Estimated BrAC**	**AmED Condition**	**Alcohol Condition**
0 minutes	0.00%	250ml ED; 67.5 ml alcohol	250ml soda water; 67.5 ml alcohol
40 minutes	0.03%	125ml ED; 33.8 ml alcohol	125ml soda water; 33.8 ml alcohol
80 minutes	0.04%	125ml ED; 33.8 ml alcohol	125ml soda water; 33.8 ml alcohol
120 minutes	0.05%	125ml ED; 33.8 ml alcohol	125ml soda water; 33.8ml alcohol

Procedure

Experimental sessions commenced at 9am or 1pm, four to fourteen days apart to ensure familiarisation with tasks was maintained and to limit carry-over effects. Condition order was counterbalanced using a completely balanced Latin-square design. Abstinence requirements prohibited consumption of alcohol and caffeine for 24-hours prior to experimental sessions, and food and exercise for 4 hours, except for a small meal 60-minutes before experimental sessions. Abstinence from tobacco and illicit drugs was required for the duration of the study. Prior to commencement of experimental sessions, a declaration of abstinence (Appendix E) was signed to confirm adherence to pre-session requirements; participants also provided written consent (Appendix D) and height and weight measurements.

Participants completed baseline trials on the A-BART and DT, and were tested to ensure BrAC was 0.00%, before commencing the first treatment dose. Dosing occurred at 40 minute intervals. Each dose was consumed from an opaque bottle over a 10-minute period followed by a 5-minute absorption period. BrAC readings were taken at five minute intervals following consumption coinciding with task administration (Table 4)

Table 4

Timing of Dose and Task Administration

Dose	**DT**	**A-BART**
Baseline/No dose	Baseline	Baseline
0 mins	25 mins	35 mins
40 mins	65 mins	75 mins
80 mins	105 mins	115 mins
120 mins	145 mins	155 mins
No dose	195 mins	205 mins

The DT was administered 15 minutes post consumption, and the BART a further 10 minutes later (25-minutes post-consumption).The BRS was completed at

30 minutes followed immediately by the next dose. After the four doses and subsequent testing, the participant observed a 10-minute break to substitute for the normal dosing time followed by a final round of testing (DT, BART & BRS). Upon completion of testing participants consumed a detoxification meal and were released after two consecutive readings of BrAC ≤ 0.03 within a 15-minute period.

Design and Analysis

Two participants completed only Session 1 (Alcohol-only). One participant completed Session 2 (Alcohol-only) without A-BART testing at Baseline, 35, and 75-minutes; these subjects were retained in the final analysis. One participant's DT Accuracy scores for Session 1 were excluded as an outlier, falling more than 7 standard deviations below the mean.

The present study used a 2 (Condition: ED, Placebo) x 2 (Session: 1, 2) x 2 (Sex: Female, Male x 6 (Time: 0 (baseline), 1, 2, 3, 4, 5) within-subjects design. Five dependent variables (DT mean RT (ms), DT Accuracy and A-BART average number of pumps,average earnings and explosion percentage) were analysed using Mixed Models for Repeated Measures in IBM SPSS Statisitics v.21, with an unstructured covariance matrix. Session, Condition, Time and Sex were entered as fixed effects. BrAC was included as a covariate to control for variation in objective intoxication across time and between treatment conditions. Subject was included as a random effect to account for performance variation between individuals. Condition sequence was determined using a completely balanced Latin-square design based on the anticipated sample size of N =30. Only 27 participants completed the study meaning that condition administration was not completely balanced. As such, session was included as an independent variable to examine the effect of condition order.

As the aim of the study was to examine treatment condition effects over time, pairwise comparisons for Condition x Time interactions were conducted regardless of statistical significance. Pairwise comparisons were also conducted for any other interactions that reached significance. All moderate magnitude effects (Hedge's g >0.40) were considered meaningful and interpreted.

Results

Sample Characteristics

The sample consisted of young adults with high levels of intellectual functioning, with 100% currently completing or having completed post-secondary qualifications. AUDIT scores indicated normal alcohol consumption for a young-adult Australian community sample (7-16) (Bowring, Gouillou, Hellard, & Dietze, 2013). Two participants reported occasional tobacco use (1 fortnightly; 1 monthly). The sample had low levels of psychological distress and normal sleep patterns (Table 5).

Table 5

*Demographic Characteristics (*N *= 27, 14 male)*

Sample Characteristic	**Mean (*SD*)**	**Range**
Age (years)	22.8 (4.2)	18.0-34.0
BMI[a]	23.7 (3.0)	19.0-30.0
Risk for alcohol dependence (AUDIT)[b]	8.8 (4.2)	2.0-20.0
General intellectual functioning (WTAR)[c]	113.3 (9.8)	87.0-127.0
Level of psychological distress (K-10)[d]	12.0 (3.1)	8.0-20.0
Alcohol Sensitivity (ASQ)[e]	7.3 (2.8)	3.3-14.8
Sleep patterns[f] (hours per weeknight)	8.0 (0.9)	7.0-10.0
(hours per weekend night)	8.3 (1.1)	6.0-10.0

[a]The healthy BMI range is 18.5-24.9; scores ≥ 25.0 are considered overweight and ≥ 30.0, obese (World Health Organisation, 2006). [b]The AUDIT measures alcohol dependency. Scores range from 0-40, scores ≥ 16 indicate hazardous drinking (Saunders et al., 1993). [c]WTAR scores <70 indicate below average intelligence; scores are normed based on age (Wecshler, 2001). [d]The K-10 is a measure of psychological distress, scores range from 10-50. Scores ≥ 30 indicate clinical levels of psychological distress (Kessler et al., 2002). [f]Eight hours sleep per-night is considered to be normal (Hor & Tafti, 2009).

Based on their typical intake, 88% of participants exceeded the recommended daily intake for alcohol (>4 standard alcoholic drinks) (National

Health and Medical Research Council, 2009) at least once in the past month, while 11% of participants had exceeded the recommendation for EDs (2 x 250ml EDs/day) at least once in the past month (Table 6).

Table 6

*Self-Report Alcohol, Caffeine and EDs Consumption (*N*=27)*

Consumption Pattern	Mean (SD)	Range
Alcohol (Past Month)		
Average standard alcoholic drinks consumed per drinking day	6.2 (4.9)	1.4-20.0
Maximum standard alcoholic drinks consumed per drinking day	10.3 (6.0)	2.0-20.0
Days alcohol consumed	7.7 (6.1)	1.0-26.0
Days consumed exceeded NHMRC guidelines	2.6 (2.4)	0.0-9.0
ED Past Month and Caffeine		
Typical ED consumed per drinking day	1.5 (1.2)	0.0-4.0
Maximum ED consumed per drinking day	2.0 (1.3)	0.0-4.0
Caffeine intake in the preceding week (mg)	240.0 (181.6)	15.0-673.0

Placebo Manipulation Check

Beverage rating scale (BRS). A mixed models analysis revealed a significant main effect of Condition on perceived alcohol content, F (1, 166) = 35.42, p <.001, with participants rating alcohol content as higher in the Alcohol-only condition (M=3.8, SD=1.1) relative to AmED (M=3.1, SD=1.0), with a moderate magnitude effect (g=0.65). The main effect of Condition on perceived ED content

was non-significant, F (1,142) = .057, p =.812; participants did not rate ED content in the Alcohol-only condition (M 2.01, SD 0.74) as significantly different to AmED (M 2.03, SD 0.72), indicating successful blinding to condition.

Breath Alcohol Content – Automatic-Balloon Analogue Risk Task

Table 7

Main Effects and Interactions for Session, Condition, Time and Sex on BrAC recorded prior to A-BART administration

Effect	**BrAC (A-BART)**
Session	$F_{1, 135} = 19.21$, $p < .001$
Condition	$F_{1, 182} = 57.40$, $p < .001$
Time	$F_{5, 70} = 303.95$, $p < .001$
Sex	$F_{1, 26} = 38.94$, $p < .001$
Condition*Time	$F_{5, 70} = 3.81$, $p = .004$
Condition*Sex	$F_{1, 185} = 2.07$, $p = .152$
Time*Sex	$F_{5, 66} = 34.42$, $p < .001$
Condition*Time*Sex	$F_{5, 68} = 0.65$, $p = .662$

BrAC. Mixed models for repeated measures analysis revealed significant main effects of Session, Condition, Time and Sex for BrAC (%) recorded prior to commencing the A-BART. These were subsumed by significant Condition x Time and Time x Sex interactions. The Condition x Sex and Condition x Time x Sex interactions were non-significant (Table 7). BrAC (%) was significantly higher in Session 1 compared to Session 2 (g=0.28). BrAC (%) was significantly higher for females than males in the Alcohol-only (p <.001, g= 1.87) and the AmED condition (p <.001, g=1.68).

Pairwise comparisons for the Condition x Time interaction showed that BrAC (%) was significantly lower in the AmED relative to the Alcohol-only

condition at 35 to 205-minutes. These effects were significant and moderate in magnitude (*ps*<.004, *gs*>0.56); (Figure 2).

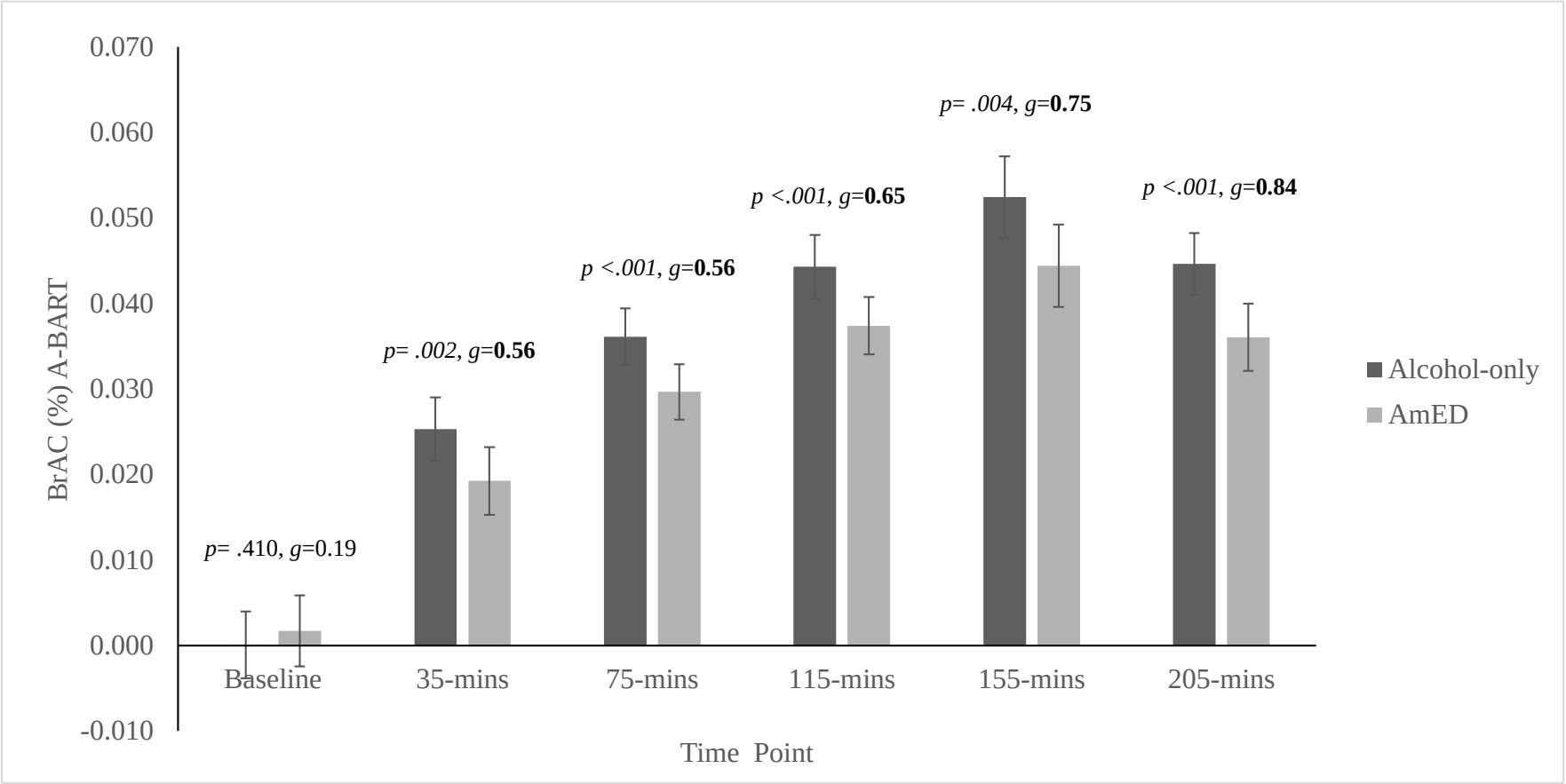

Figure 2. Mean BrAC and 95% confidence intervals (95%CIs) on the Automatic-Balloon Analogue Risk Task for each of the two treatment conditions at six testing time points. NB: *Hedge's gs>0.40 appear in* ***bold****. Ps < .050 appear in* italics

Breath Alcohol Content – Determination Test

Table 8

Main Effects and Interactions for Session, Condition, Time and Sex on BrAC recorded prior to Determination Test administration

Effect	**BrAC (DT)**
Session	$F_{1, 179} = 11.58$, $p = .001$
Condition	$F_{1, 147} = 44.91$, $p < .001$
Time	$F_{5, 48} = 409.48$, $p < .001$
Sex	$F_{1, 9} = 53.00$, $p < .001$
Condition*Time	$F_{5, 49} = 4.50$, $p = .002$
Condition*Sex	$F_{1, 146} = 9.55$, $p = .814$
Time*Sex	$F_{5, 48} = 33.77$, $p < .001$
Condition*Time*Sex	$F_{5, 49} = 0.71$, $p = .621$

BrAC. Mixed models for repeated measures analysis revealed significant main effects of Session, Condition, Time and Sex on BrAC recorded prior to DT administration. Significant Condition x Time and Time x Sex interactions were also present. Condition x Sex and Condition x Time x Sex interactions were non-significant (Table 8). BrAC was significantly higher in Session 1 compared to Session 2 (g=0.56). BrAC was significantly higher for males than females in the Alcohol-only (p<.001, g=2.98) and AmED (p<.001, g=3.55) conditions.

Pairwise comparisons for the Condition x Time interaction showed significant moderate to large magnitude decreases in BrAC in the AmED relative to the Alcohol-only condition at 25 to 195-minutes (ps<.011, gs>0.56; Figure 3).

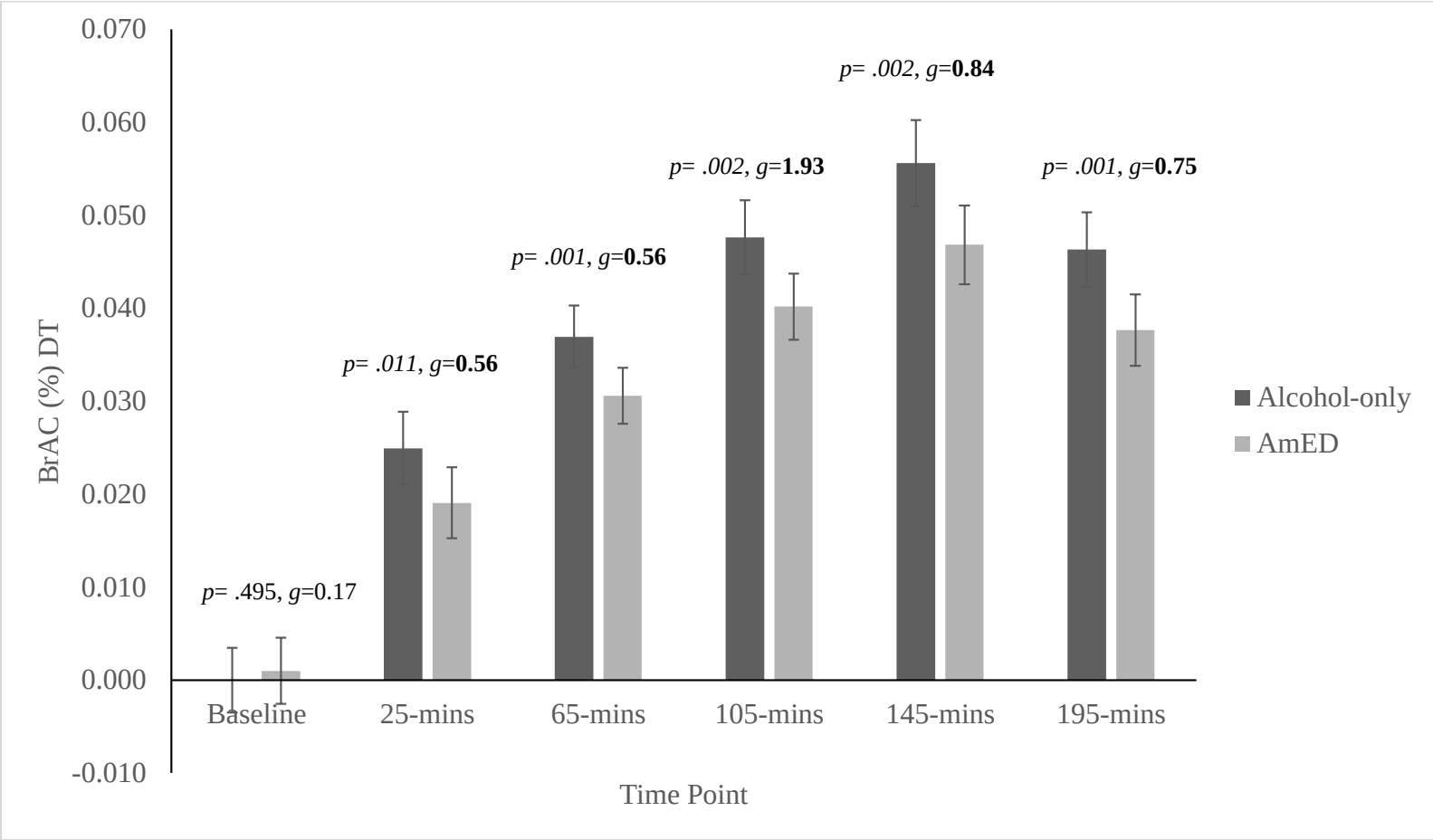

*Figure 3.*Mean BrAC and 95% confidence intervals recorded prior to Determination Test administration for each of the two treatment conditions across six testing time points. NB: *Hedge's gs>0.40 appear in* ***bold****. Ps <.050 appear in* italics

Automatic-Balloon Analogue Risk Task

Table 9

Main Effects and Interactions for Session, Condition, Time and Sex on A-BART Average Pumps, Average Earnings and Explosion Percentage

Effect	**Average Pumps**	**Average Earnings**	**Explosion Percentage**
Session	$F_{1, 211} = 12.21$, $p = .001$	$F_{1, 222} = 0.01$ $p = .923$	$F_{1, 192} = 5.89$, $p = .016$
Condition	$F_{1, 202} = .95$, $p = .331$	$F_{1, 231} = 0.00$, $p = .985$	$F_{1, 187} = 0.02$, $p = .887$
Time	$F_{5, 86} = 2.86$ $p = .020$	$F_{5, 93} = 1.05$, $p = .391$	$F_{4, 80} = 2.29$, $p = .067$
Sex	$F_{1, 28} = 3.26$ $p = .081$	$F_{1, 30} = 1.60$, $p = .214$	$F_{1, 35} = 1.00$, $p = .323$
Condition*Time	$F_{5, 66} = 0.80$, $p = .554$	$F_{5, 81} = 2.17$, $p = .066$	$F_{4, 66} = 2.01$, $p = .104$
Condition*Sex	$F_{1, 202} = 0.62$, $p = .431$	$F_{1, 251} = 4.64$, $p = .032$	$F_{1, 185} = 0.90$, $p = .323$
Time*Sex	$F_{5, 71} = 1.57$, $p = .181$	$F_{5, 92} = 2.02$, $p = .083$	$F_{4, 64} = .1.32$, $p = .272$
Condition*Time*Sex	$F_{5, 61} = 0.72$, $p = .613$	$F_{5, 74} = 2.17$, $p = .067$	$F_{4, 68} = 1.98$ $p = .107$

NB: All analyses controlled for BrAC. Analysis of Explosion Percentage controlled for baseline (Time 0) differences.

Average number of pumps. Mixed models for repeated measures analysis controlling for BrAC recorded prior to the task revealed significant main effects of Session and Time for average number of pumps. Main effects of Condition and Sex were not statistically significant. The Condition x Time, Condition x Sex, Time x Sex and Condition x Time x Sex interactions were also not statistically significant (Table 9). Average number of pumps was significantly higher in Session 2 compared to Session 1, with only a small magnitude effect (g= 0.23).

Pairwise comparisons of the Condition x Time interaction (Figure 4) revealed small magnitude differences which did not reach statistical significance in Average number of pumps between AmED and Alcohol-only conditions at all of the six time points. Pairwise comparisons of the Time x Sex interaction revealed that Average Number of Pumps were higher for males than females at time 3 and 4 (ps≤.040, gs≥0.56).

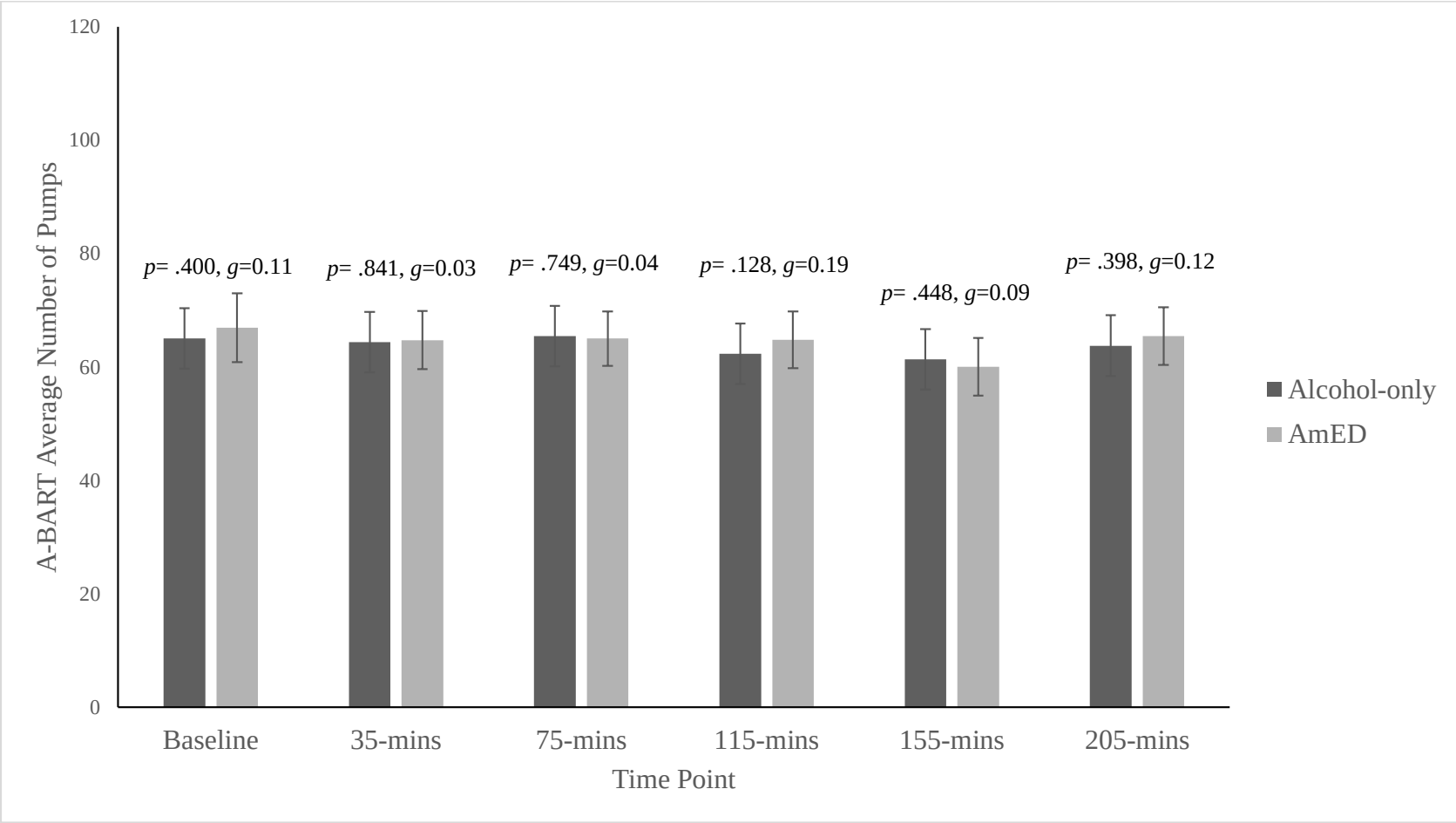

Figure 4. Mean Average Number of Pumps and 95% confidence intervals (95% CI) on the Automatic Balloon Analogue Risk Task for each of the two conditions at six testing time points. NB: *Hedge's gs>0.40 appear in* ***bold****. Ps < .050 appear in* italics

Percentage of exploded trials. Mixed models for repeated measures analysis controlling for BrAC recorded prior to the task and Baseline performance revealed a significant main effect of Session for percentage of explosions. Main effects of Condition, Time and Sex were non-significant. Condition x Time, Condition x Sex, Time x Sex and Condition x Time x Sex interactions were all non-significant (Table 9). Percentage of explosions were higher in Session 2 than Session 1 (g=0.31).

Pairwise comparisons for the Condition x Time interaction revealed that a significant moderate magnitude increase in Percentage of Explosions was significantly higher in the Alcohol-only relative to AmED condition at 75-minutes (Figure 5). No other time points reached significance.

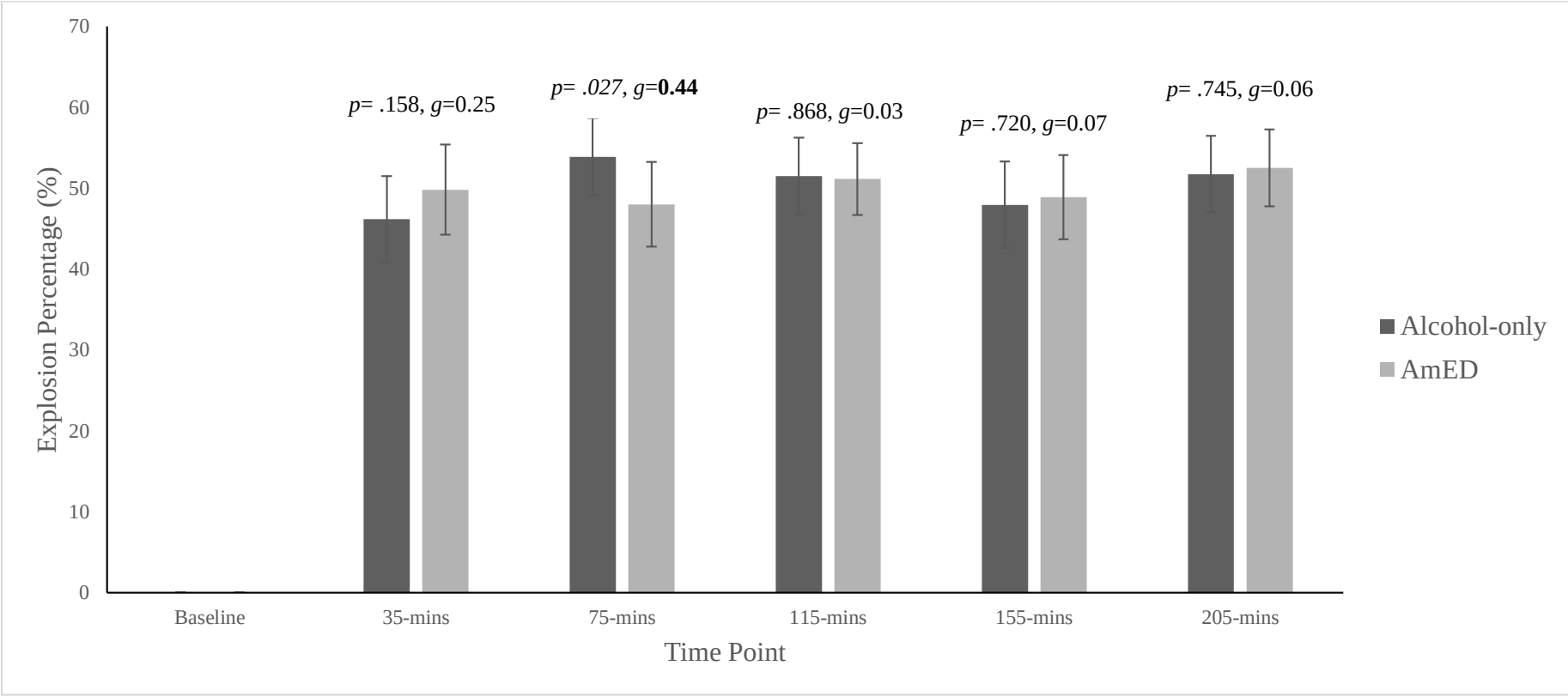

Figure 5. Mean Percentage of Exploded Trials and 95% CI on the Automatic Balloon Analogue Risk Task for each of the two conditions at six testing time points. NB: *Hedge's* gs≥*0.40 appear in* ***bold***, ps≤*.050 appear in* italic

Earnings. Mixed models for repeated measures analysis controlling for BrAC recorded prior to the task revealed non-significant main effects of Session, Condition, Time and Sex on earnings. A significant Condition x Sex interaction was revealed but the Condition x Time, Time x Sex and Condition x Time x Sex interactions were all non-significant (Table 9)

Pairwise comparisons of the Condition x Time interaction revealed a significant moderate magnitude increase in average earnings in the Alcohol-only condition relative to AmED at 35-minutes (Figure 6). Comparisons at all other time points were not statistically significant and of small magnitude. Pairwise comparisons of the Condition x Sex interaction revealed that Average Earnings were significantly higher for males than females in the Alcohol-only condition (p=.035, g=0.61). No significant sex differences were observed in the AmED condition (p=.953, g=0.02).

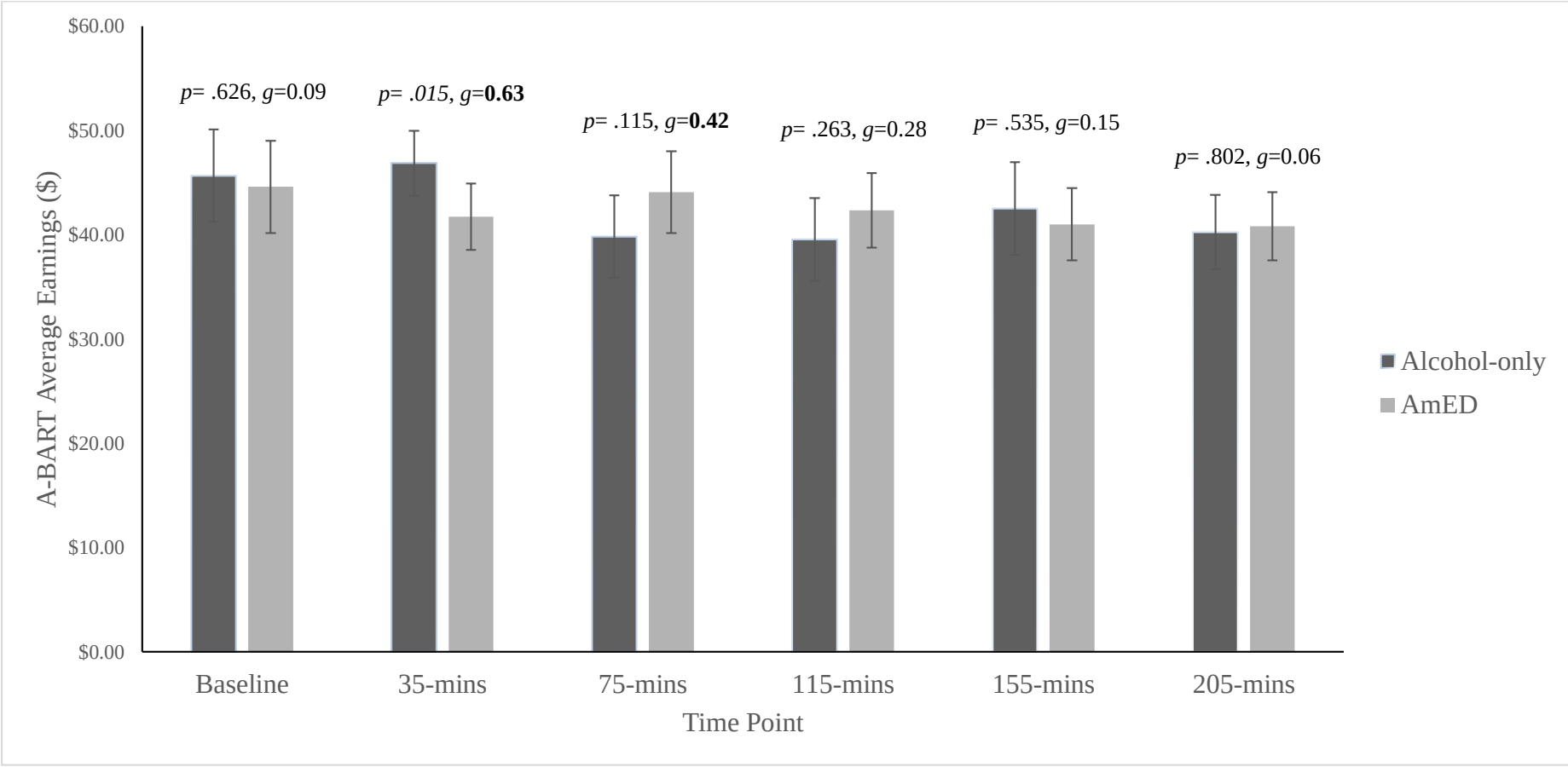

Figure 6. Mean Earnings and 95% confidence intervals on the Automatic-Balloon Analogue Risk Task for each of the two treatment conditions at six testing time points. NB: Hedge's gs>0.40 appear in bold. *Ps <.050 appear in italics*

Determination Test

Table 10

Main Effects and Interactions for Session, Condition, Time and Sex on Determination Test Accuracy and RT

Effect	Accuracy (% correct)	RT (seconds)
Session	$F_{1, 216} = 5.42$, $p = .021$	$F_{1, 159} = 313.14$ $p < .001$
Condition	$F_{1, 154} = 0.23$, $p = .634$	$F_{1, 201} = 20.00$, $p < .001$
Time	$F_{5,74} = 2.08$, $p = .077$	$F_{5, 106} = 3.64$ $p = .004$
Sex	$F_{1, 23} = 7.12$ $p = .013$	$F_{1, 27} = 1.04$, $p = .316$
Condition*Time	$F_{5, 61} = 1.06$, $p = .931$	$F_{5, 64} = 4.43$, $p = .002$
Condition*Sex	$F_{1, 151} = 7.71$, $p = .006$	$F_{1, 205} = 1.05$, $p = .306$
Time*Sex	$F_{5,}$ 73 = 1.06, $p = .387$	$F_{5, 61} = 3.16$, $p = .012$
Condition*Time*Sex	$F_{5, 60} = 1.13$, $p = .357$	$F_{5, 61} = 0.91$, $p = .482$

Accuracy. Mixed models for repeated measures analysis controlling for BrAC recorded prior to the DT revealed significant main effects of Session and Sex for accuracy, as well as a significant Condition x Sex interaction. Main effects of Condition and Time were non-significant, as were the Condition x Time, Time x Sex and Condition x Time x Sex interactions (Table 10). Accuracy was significantly higher in Session 2 compared to Session 1 (g= 0.16).

Pairwise comparisons for the Condition x Time interaction showed non-significant small magnitude differences between Alcohol-only and AmED at all six time points (Figure 7). Pairwise comparisons of the Condition x Sex interaction showed that females were significantly more accurate than males in both the Alcohol-only (p =.039, g=0.58) and the AmED (p =.003, g=0.84) conditions.

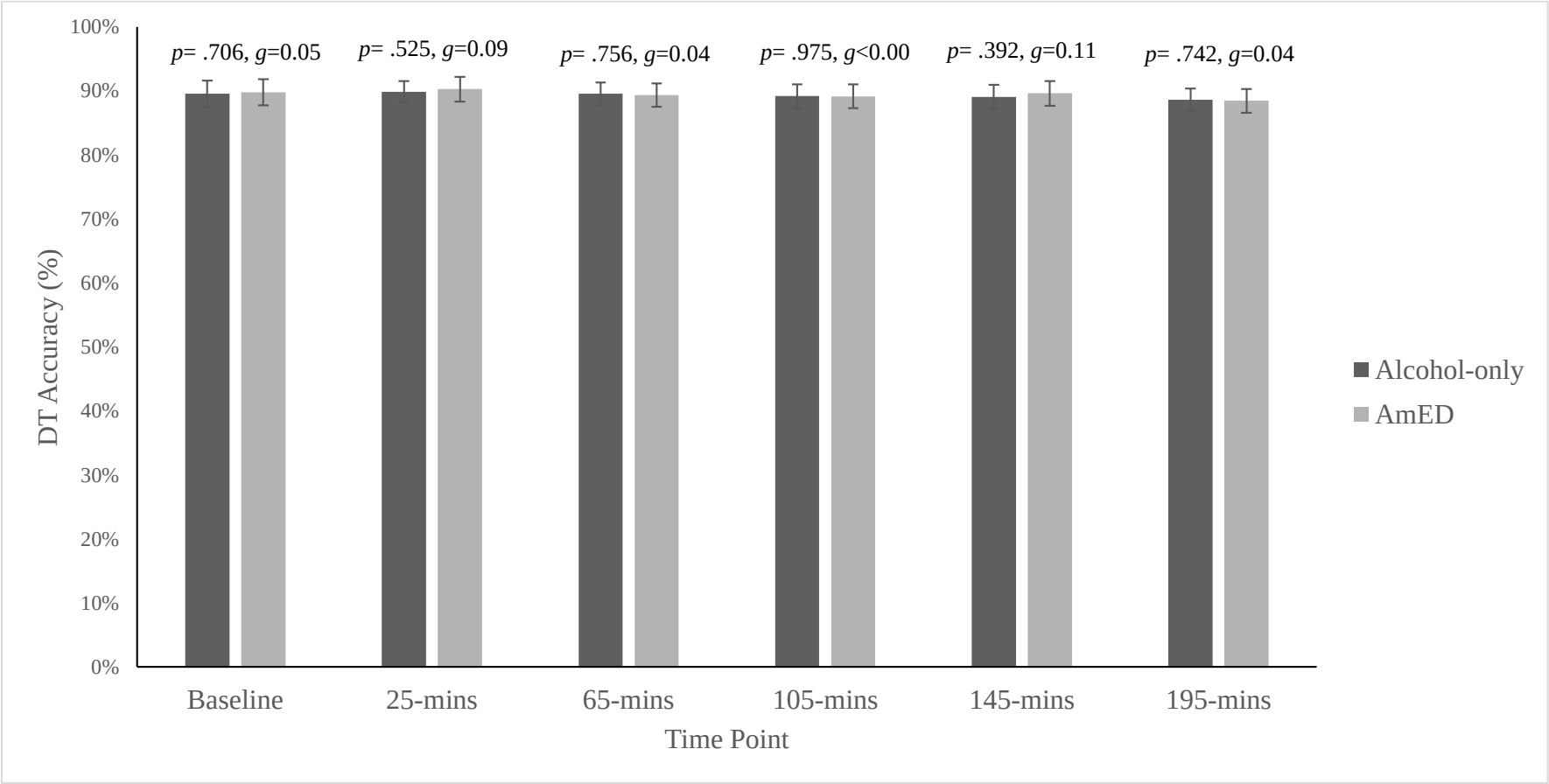

Figure 7. Mean Accuracy Percentage and 95% CI on the Determination Test for each of the two conditions across the six testing time points. NB: *Hedge's gs>0.40 appear in* ***bold****. Ps < .050 appear in* italics

RT. Mixed models for repeated measures analysis controlling for BrAC recorded prior to the DT revealed significant main effects of Session, Condition and Time for RT. The Condition*Time and Time*Sex interactions were also significant. The main effect of Sex and the Condition*Sex interaction were non-significant (Table 10). RT was significantly faster in Session 2 than Session 1 (g=0.01).

Pairwise comparisons of Condition x Time interaction revealed that RT was significantly faster in the AmED relative to Alcohol-only condition at 25-145-minutes (Figure 8), although only a small magnitude decrease was observed at 25 and 65-minutes. Breakdown of the Time*Sex interaction revealed no significant differences between sexes at any of the six testing time points, however significant differences were observed between time points among females (Table 13) and males (Table 14) separately.

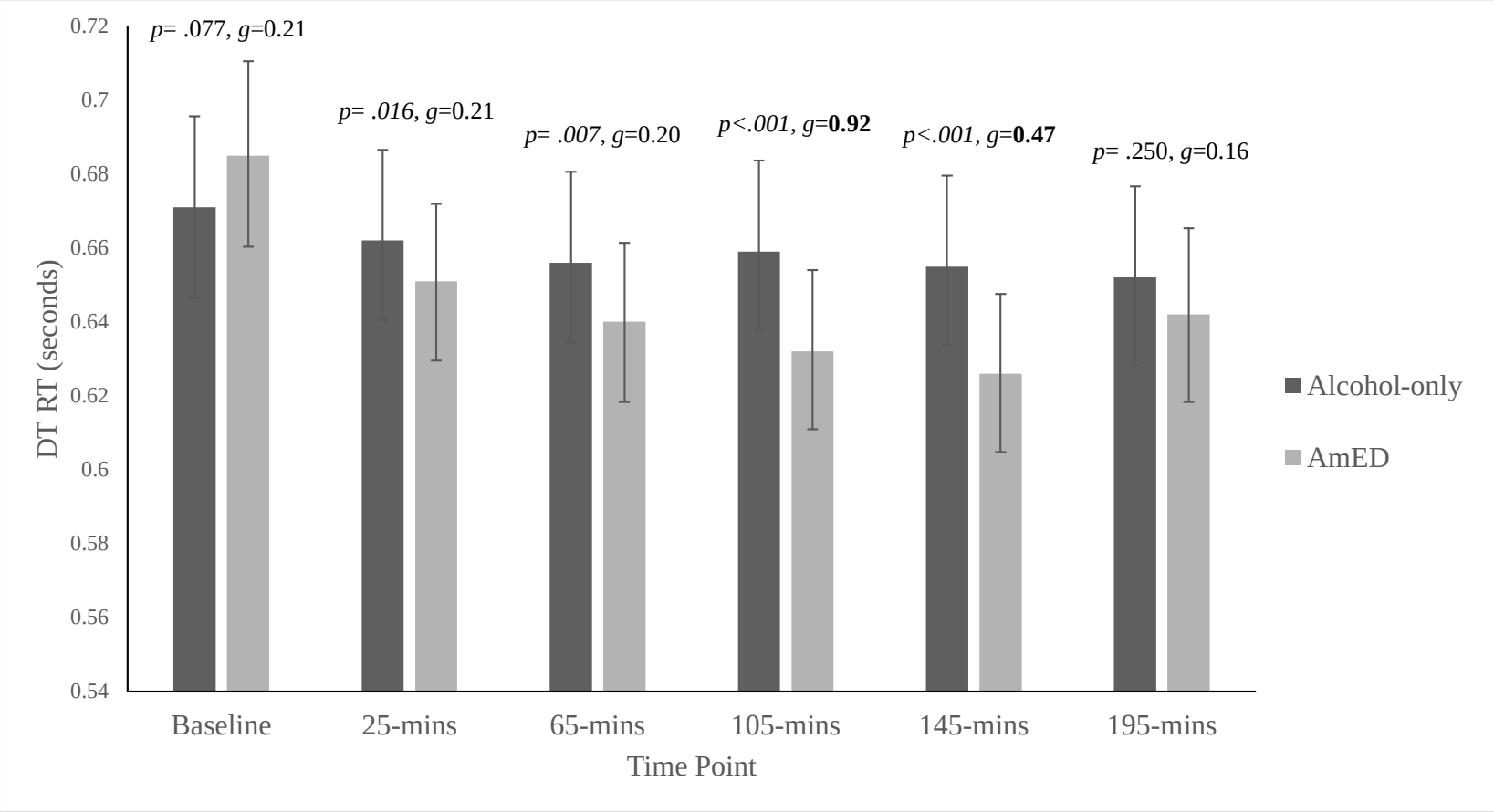

Figure 8. Median Reaction Time (seconds) and 95% CI on the Determination Test *for* each of the two treatment conditions across the six testing time points. NB: *Hedge's gs>0.40 appear in* ***bold****. Ps < .050 appear in* italics

Discussion

The present study examined the effects of AmED consumption on risk-taking behaviour relative to alcohol-only consumption, extending on existing work by replicating real-world drinking practices through a multi-dosing, standardised procedure in which all participants received the same alcohol and ED doses, typical of those served in a licensed venue. Results supported the hypothesis that there would be a significant Condition x Time interaction on RT on the DT, with RT being significantly faster in the AmED relative to the alcohol-only condition, at peak caffeine and alcohol levels (105 and 145-minutes). The hypothesis that accuracy would be significantly lower in the AmED relative to alcohol-only condition at peak caffeine and alcohol levels, as evidenced by a significant Condition x Time interaction, was not supported, with no significant differences in accuracy between AmED and alcohol-only at any of the six testing time points. Finally, the hypothesis that there would be a significant Condition x Time interaction on average number of pumps on the A-BART, with number of pumps being significantly higher in the AmED relative to alcohol-only condition at peak caffeine and alcohol levels was not supported, there were no significant differences between conditions at any of the six testing time points. Although there was some evidence of increased risk-taking as measured by other possible indices of risk-taking for the A-BART

BrAC

Mean BrAC was significantly lower after ingesting AmED relative to Alcohol-only at all active time points (Time 25-195 minutes) at both DT and A-BART administration. This result is consistent with past research demonstrating lower objective intoxication following consumption of moderate to large ED doses

with alcohol relative to alcohol-only (Lubman, 2013). This discrepancy between treatment conditions is likely due to the influence of sugar in the ED slowing the rate of gastric emptying, thus decreasing alcohol absorption and lowering BrAC (Oneta et al., 1998). Future studies should make sure to control for BrAC to rule out this explanation for changes in performance, and consider use of sugar-matched placebos for ecological validity, given that most non-ED alcohol mixers (e.g., Coca-cola) typically contain sugars.

Session

There was a significant main effect of session on RT, Accuracy, Average Pumps and Earnings. Performance improved from session 1 to session 2 indicating practice effects, despite effective counterbalancing of condition order. Falleti, Maruff, Collie, and Darby (2006) showed that RT on the CogState Battery, which assesses RT and accuracy on various tasks, was highly susceptible to practice effects, while accuracy was moderately correlated on test-retest trials, it is therefore important to control for the effect of session. While practice effects were observed in the current study, there were no differential carryover effects (i.e., Session x Condition or Session x Time interactions), therefore, the effect of learning was consistent regardless of whether the initial session was Alcohol-only or AmED.

Determination Test

RT. AmED consumption produced consistent improvements in RT relative to alcohol-only after controlling for BrAC. Exceeding maximum recommended daily intake for ED produced larger effects, with condition differences reaching moderate to large magnitude effects at 105-minutes (post ingestion of 500ml) and 145-minutes (post ingestion of 625ml). This finding is consistent with previous research (Peacock

et al., 2015) that administered ED doses of 500ml and 750ml. Results such as these suggest that consuming ED in combination with alcohol improves cognitive performance relative to Alcohol-only, at least in terms of RT.

The current study observed significantly faster RTs at 25mins and 65mins in the AmED relative to alcohol-only condition, when ED doses were 1.5 (375ml), and 2 (500ml) standard EDs, respectively. This indicates that consumers do not need to consume EDs in excess of guidelines for there to be an impact on the cognitive effects of alcohol. While the current study administered moderate alcoholic doses (5 standard drinks, mean peak BrAC 0.05%), Peacock et al. (2015) dosed participants to reach a BrAC of 0.08%, demonstrating that improved RT under AmED is persistent at higher alcoholic doses.

Accuracy. AmED administration did not significantly impact accuracy relative to alcohol-only. It was expected that in the current study increased risking-taking would be evidenced by a SAT on the Determination Test measures. The SAT proposes that speed and accuracy are competing demands, therefore if speed is to increase accuracy will suffer (Bogacz et al., 2010). As hypothesised RT was faster under AmED, however there was no corresponding decrease in accuracy. This result is in contrast to previous findings which showed that AmED decreased the amount of errors made during the ascending limb on the Digit Symbol Substitution Task (DSST) following 500ml and 750ml ED doses, whilst RT was also improved. However, accuracy following a 750ml ED AmED dose was not significantly different to alcohol-only at peak intoxication (0.08% BrAC), with a significant yet small magnitude decrease on the descending limb (Peacock et al., 2015).

In the current study, participants consumed an accumulative total of 625ml (2.5) ED by the final dose, alcohol administration was also accumulative, and BrAC did

not peak until 145-minutes. It is therefore possible that ED doses were too low during the ascending limb for improvements in accuracy to occur and, by the time the ED consumption peaked at 625ml (195-minutes), participants were also at peak alcohol intoxication (0.05% BrAC), therefore they were too intoxicated for ED to have an attenuating effect. Furthermore, no significant difference in accuracy between AmED and Alcohol-only was observed when BrAC had begun to decrease (195-minutes) because ED dose had exceeded the point at which performance enhancing effects can be seen on the descending limb (500ml) (Peacock et al., 2015).

Although no effects of condition were observed, sex did differentially affect accuracy, with females performing significantly better than males at all time points. This is in contrast to recent findings that show males to be more accurate than females on various measures of multi-tasking (Mäntylä, 2013), as the DT requires participants to respond to colour, tone, direction and orientation, performance on this task might be likened to multi-tasking. However, the task was used specifically for its ability to assess frustration tolerance in relation to risk-taking. High levels of testosterone in males contribute to impatient and irritable behaviours that are counter-productive to inhibition of frustration (Olweus, Mattsson, Schalling, & Loew, 1988), explaining why they might perform poorly on the DT task.

Automatic-Balloon Analogue Risk Task

Average pumps. Risk-taking propensity, as measured by average number of pumps on the A-BART, was not significantly increased by AmED consumption relative to alcohol-only. These results contradict self-reported drinking behaviour: Woolsey, Waigandt, and Beck (2010) found that risk-taking was increased when consumers had AmED compared to alcohol-only, whereas, Peacock et al. (2014)

found that self-reported risk-taking was lower when AmED was consumed, relative to alcohol-only.

Average number of pumps in the present study were not altered by alcohol administration regardless of condition, as evidenced by the non-significant main effect of Time. Experimental research regarding the impact of alcohol on risk-taking is mixed. Researchers such as Lane, Cherek, Pietras, and Tcheremissine (2004) and Rose, Jones, Clarke, and Christiansen (2014) observed increased risk-taking propensity on decision making tasks in alcohol (0.02, 0.04 & 0.09 BrAC% and 0.036 BrAC %, respectively) vs placebo conditions whereas, others saw no such effects when BrAC% ranged from 0.03% up to 0.12% (George, Rogers, & Duka, 2005; Reynolds et al., 2006). The lack of effect in the current study might be attributable to low alcoholic doses. Previous studies have dosed participants to reach a BrAC of 0.08% (Lane et al., 2004; Rose et al., 2014), while peak BrAC in the current study was 0.05%. The alcohol dose administered in the current study may not have been sufficient to induce impairment to a meaningful degree.

Despite being significantly correlated with self-reported risk-taking and substance use, (Lejuez, Aklin, Zvolensky, & Pedulla, 2003), the A-BART itself may not be sufficient to detect risk-taking. The original BART has been criticised for potentially biasing participants' risk-taking downwards: due to repetition participants often administer a low number of pumps in order to complete the task faster, (Pleskac et al., 2008). The BART is further criticised for potential practice effects (DeMartini et al., 2014). The A-BART improves on the standard BART by limiting biases towards under-reporting of risk. Furthermore, the A-BART performs better on measures of external validity with correlations improving on measures of sensation seeking r = .28 to r =.33 and impulsivity r =.06 to r =.17 (Pleskac et al., 2008).

Despite its improvements on the original design, participant responses on the A-BART can be influenced by the task itself. For instance, if a participant enters a certain number of pumps and the balloon explodes, this may increase cautiousness in one person or risk-taking in another. A successful run of consecutive high pumps without an explosion may encourage further application of a higher number of pumps whereas, an explosion may deter high pumps despite previous success (Humphries, 2016). For instance, Euser, Van Meel, Snelleman, and Franken (2011) administered 60 BART trials in 20 trial blocks and found that participants in alcohol and placebo conditions modified their strategies based on outcomes in the initial block of trials. Participants in the placebo condition were more cautious to begin with whereas, those in the alcohol condition started out quite risky then reigned in their behaviour to become more cautious over time. Therefore, simply averaging number of pumps, earnings or percentage of explosion may not be sufficient to determine an individual's overall risk-taking propensity (Humphries, 2016). Although characteristics of the task may influence performance, there is no reason to suspect that they would have differentially affected AmED versus Alcohol-only sessions in the current study. Furthermore, the current study controlled for Session in order to minimise the impact of such factors.

Whilst AmED did not increase average number of pumps on the A-BART, there was an effect of sex, with males entering significantly higher number of pumps than females at 115-minutes and 155-minutes post-consumption. Given that BrAC peaked for both males and females at 155-minutes, this result indicates a trend towards greater risk-taking on the A-BART at peak intoxication in males that is not present for females. This is consistent with poorer frustration tolerance among males (Olweus et al., 1988) as indicated by lower accuracy on the DT reported above.

Psychometric testing of the A-BART revealed that females are in fact more risk averse on this task than males (Pleskac et al., 2008). Literature on sex differences in risk-taking indicates that males are generally riskier than females, particularly in younger generations (Byrnes, Miller & Schafer, 1999). Taken together these results have real-world implications in terms of males being riskier when drinking. Given that analyses of results from the current study returned no significant Time x Condition x Sex interactions, sex effects were consistent regardless of alcohol-only or AmED administration.

Earnings and explosion percentage. Although there was no consistent effect of condition on earnings or explosions in the current study there was a significant difference at 35-minutes with earnings being higher in the alcohol-only condition and at 75-minutes with earnings being higher in the AmED condition. Caffeine peaks between 15 and 30 minutes' post consumption (Teekachunhatean et al., 2013), coinciding with administration of the A-BART at time one (35mins), theoretically AmED could be impacting risk-taking propensity at this time.

Lower earnings tend to indicate less risk-taking, however, there was no significant difference in percentage of explosions between conditions at 35mins. A significant difference was observed at 75-minutes though, with percentage of explosions being higher in the alcohol-only condition, corresponding to the significant difference in earnings at 75-minutes. Higher earnings should be indicative of higher number of pumps and thus greater risk taking. Indeed, DeMartini et al. (2014) observed earnings on the BART increase in line with number of pumps, while the number of explosions decreased. Therefore, higher earnings in the AmED condition at 75-minutes could be indicative of greater risk-taking. Although average number of pumps is the primary measure of risk-taking for the A-BART, these

findings justify further work investigating whether other outcomes might also be sensitive indices of risk-taking, looking at the associations with other objective laboratory based measures and real-world risk-taking.

Sex differences were once again evident with a significant effect on earnings, with males earning significantly more than females in the alcohol-only condition. This result is unsurprising given the sex effect on average number of pumps, as total earnings are influenced by the number of pumps administered (DeMartini et al., 2014; Pleskac et al., 2008). This result can also be interpreted in light of the significant effect of condition on RT. RT was significantly faster in the AmED condition relative to alcohol-only, suggesting that cognitive performance is actually improved under AmED administration, which may account for the lack of a sex effect on earnings under AmED. However, it is also likely that differences are attributable to the fact that females tend to be more risk averse than males on the A-BART (Pleskac et al., 2008).

Implications

Although participants typically did not demonstrate increased risk-taking under AmED administration in terms of decision making on the A-BART, reductions in RT following AmED ingestion, may cause individuals to underestimate alcohol-induced impairment, as consumers judge their level of intoxication on various cognitive abilities (Celio et al., 2014). Improvements in RT were observed in the current study when controlling for BrAC. This underestimation may lead to increased likelihood of adverse events, such as accidental injury. Leong (in press) found that participants rated their ability to drive as better under AmED compared to alcohol-only administration when BrAC was controlled for. Although this does not indicate intent to drive, this result is concerning as consumers perceive their overall

cognitive functioning as better than relative to alcohol-only. In addition, improvements in RT following ingestion of AmED relative to alcohol could predict lower subjective intoxication (Celio et al., 2014), and thus increased consumption and prolonged drinking sessions.

Whilst RT was attenuated under AmED administration in the current study Bellamy (in press) found that consuming 500ml of ED did not improve RT relative to placebo. This discrepancy is likely due to the cognitive state of participants at the time of ED administration. A the current study combined alcohol with ED it is likely that attenuation of RT is due to participants being cognitively impaired due to the adverse effects of alcohol whereas, participants in Bellamy's (in press) study were sober and well rested thus they were unimpaired at time of ED administration. Research suggests that fatigue caused by 24 hours of sleep deprivation causes cognitive impairment equivalent to that seen at 0.10% BrAC (Dawson & Reid, 1997). Previous studies have found EDs to be helpful in reducing fatigue (Jay et al., 2006; Kennedy & Scholey, 2004). Therefore, if ED can relieve fatigue and fatigue induces similar impairments to alcohol, then the fact that ED reduced alcohol induced impairment in terms of RT in the current study is not surprising.

The implementation of real-world drinking practices in dose administration makes these results generalizable to a community context. What this shows is that AmED consumers are likely to have better RT and hence these cues may lead them to misperceiving their level of intoxication when drinking at moderate levels, thus causing them to drink more. Consistent with field research by Peacock et al. (2012) participants in the current study were no more risky following AmED consumption than when they had alcohol-only.

Limitations and Directions for Future Research

While AmED doses reflected those consumed naturalistically (Peacock, Raimondo & Martin, 2013; Pennay et al., 2015), the current study does not account for the impact that other alcoholic beverages consumed in addition to AmEDs might have on risk-taking. Peacock et al. (2013) found that AmEDs made up less than half of the alcoholic drinks consumed in drinking sessions. In addition, experimental conditions would have limited the impact that drinking environment and social interaction might have on risk-taking in the real-world, limiting ecological validity and thus generalisability. Although not necessarily a limitation it should be noted that BrAC peaked at 0.05% which is essentially the legal driving limit in Australia. It is possible that larger doses may elicit greater risk-taking however, the aim of the study was to measure risk-taking at moderate AmED doses.

The lack of effect of AmED on risk-taking may be attributable to low sensitivity of tasks. As previously discussed, critics of the A-BART claim that the outcome measures of average number of pumps, earnings and percentage of explosions are insufficient to determine risk-taking propensity. In addition, it is unclear whether the Determination Test was difficult enough to elicit a SAT, as RT was improved but accuracy was unaffected under AmED administration. Assessing measures using more complex models that take into account detailed aspects of performance, such as consecutive wins on the A-BART (Humphries, 2016), would enable thorough measurement of risk-taking. Finally, abstinence from caffeine and food prior to testing may have exacerbated the effects of the caffeine and sugar in the ED. Caffeine is sensitive to reinstatement effects, meaning that administration following abstinence predicts a return to base-line functioning (Rogers et al., 2005). Therefore, poorer performance in the alcohol-only condition would be due to caffeine

withdrawal. This would likely be the case in caffeine dependant individuals (Rogers et al., 2005) however, this effect cannot be assessed in the current study as dependence and withdrawal were not measured.

While it can be inferred that a misperception of degree of intoxication due to improved cognitive function (faster RT) might increase the likelihood of adverse events, the current study found no direct effect of AmED on risk-taking. In addition, while the companion study found that participants rated their ability to drive as better in the AmED relative to alcohol-only study (Leong, in press), intent to drive was not assessed. Future research should aim to test whether underestimation of intoxication really does lead consumers to engage in risky behaviours such as drink driving. Testing AmED consumers in informal environments would enable examination of associations between objective cognitive impairments and actual risk-taking behaviours. Ecological momentary assessment (EMA) has been used in clinical research to assess participants' behaviours in real time in their natural environment (Shiffman, Stone, & Hufford, 2008). By administering cognitive behavioural tasks via electronic devices, with real time self-reports of alcohol consumption and risk-taking, and objective assessments of BrAC via wearable alcohol biosensors, EMA could examine the relationship between intoxication, objective cognitive performance and actual risk-taking.

Conclusion

The present study examined the effects of AmED administration on risk-taking at moderate naturalistic doses. Results revealed that AmED administration did not typically increase risk-taking as measured by the A-BART. However, a trend towards greater risk-taking on the ascending BrAC limb, was evidenced by significantly higher earnings in the AmED relative to alcohol-only condition at 75-

minutes. Furthermore, AmED ingestion did improve cognitive function in terms of RT, which could potentially impact AmED consumers ability to gauge their level of intoxication. If consumers are feeling as though they are performing better cognitively, they are likely to misperceive how drunk they are (Celio et al., 2014). For consumers, perceiving themselves as less intoxicated relative to alcohol-only could impair their ability to judge risk and thus increase the likelihood of adverse events, such as accidental injury, occurring. Therefore, consuming AmED may increase the possibility of risk-taking compared to consuming alcohol-only.

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Appendices

Appendix A

Ethics Amendment Approval Letter

From: Lauren.Black@utas.edu.au <Lauren.Black@utas.edu.au>
Sent: Monday, 2 May 2016 4:18 PM
To: Raimondo Bruno
Cc: Amy Peacock; Jess Forward; Lauren Black
Subject: Notification of Amendment Approval: H0014110 Alcohol and Energy Drink Component Interactions

Dear AssocProf Bruno

Ethics Ref: H0014110
Title: Alcohol and Energy Drink Component Interactions

This email is to confirm that the following amendment was approved by the Chair of the Tasmania Health and Medical Human Research Ethics Committee on 2/5/2016:

Amendment Protocol study 2 version April 2016
Amendment Protocol study 1 version April 2016

All committees operating under the Human Research Ethics Committee (Tasmania) Network are registered and required to comply with the National Statement on Ethical Conduct in Human Research (NHMRC 2007).

This email constitutes official approval. If your circumstances require a formal letter of amendment approval, please let us know.
Should you have any queries please do not hesitate to contact me.

Kind regards
Lauren Black
--
Lauren Black
Executive Officer - Ethics
Office of Research Services
University of Tasmania
Private Bag 01
Hobart TAS 7001
Phone: (03) 6226 2764
Fax: (03) 6226 2765
Email: Lauren.Black@utas.edu.au
Web: http://www.research.utas.edu.au/

University of Tasmania Electronic Communications Policy (December, 2014).
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Appendix B

Online Screening Questionnaire

School of Medicine (Psychology) - On-line Surveys (surveys.psychol.utas.edu.au)

2016 Honours Alcohol & Energy Drinks Screening Questionnaire

Thank you for your interest in participating in this research. The purpose of this study is to investigate the impact of alcohol, with and without energy drinks, on cognitive performance through measurement of behavioural outcomes.

Participation will involve attending one 60 minute familiarisation session and four 270 minute experimental sessions at the Psychology Research Centre, Hobart campus, University of Tasmania. In each experimental session participants will consume one beverage containing a maximum of three standard 250mL energy drinks, and/or a maximum of six standard alcoholic drinks. Participants will then complete computerised behavioural laboratory tasks. Breath alcohol concentration (BrAC) & Blood glucose levels will be monitored and participants will complete several scales assessing their feeling of intoxication and impairment. At the end of each session, participants will remain at leisure at the Psychology Research Centre until two consecutive BrAC measurements of 0.03% or less are recorded. Upon completing the final session, participants will be reimbursed $160 (KHA111/112 students will receive up to 8 hours research credit plus monetary reimbusement for the remaining hours).

We are currently seeking healthy participants who:

Are male OR female

Are aged 18-35

Have English as a first language

Have completed Year 12

Have normal or corrected-to-normal vision

Have normal sleep patterns

Have no history of any significant neurological condition, including epilepsy

Have no significant current physical condition

Have no current diagnosis of a significant psychological condition or intellectual disability

Have consumed an energy drink in the last month

Regularly consume caffeine (e.g., tea, coffee, chocolate)

Regularly consume alcohol

Are not regularly taking prescription medication

Are not currently using illicit drugs

Are able to attend the Hobart campus of the University of Tasmania for one 60 minute session and four 270 minute sessions, beginning at 9am or 1pm.

If you are still interested and eligible to participate in this research, please complete the following online screening questionnaire. Please note that all information will be kept confidential and securely stored. You can close this browser window at any point during the questionnaire if you are no longer interested in participating.

Once again, thank you for your interest in our research. We appreciate your assistance.

There are 65 questions in this survey

Demographics and Contact Details

[]What is your current age in years? *

Only numbers may be entered in this field.

Please write your answer here:

[]What is your sex? *

Please choose only one of the following:

○ Female

○ Male

[]Is English your first language? *

Please choose only one of the following:

○ Yes

○ No

[]Are you currently studying KHA111 Psychology A or KHA112 Psychology B and seeking research participation credit? *

Please choose only one of the following:

○ Yes

○ No

[]What was the highest grade of school you completed? *

Please choose only one of the following:

○ Grade 6

○ Grade 7

○ Grade 8

○ Grade 9

○ Grade 10

○ Grade 11

○ Grade 12

○ Grade 13

○ Other

[]Are you currently studying for any further qualification(s)? *

Please choose only one of the following:

○ Yes

○ No

[]If yes, what qualification(s) are you currently studying for? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '6 [q15]' (Are you currently studying for any further qualification(s)?)

Please choose all that apply:

☐ Trade Certificate

☐ Other Certificate (e.g., TAFE, Cert III)

☐ Associate or Undergraduate Diploma

☐ Bachelor Degree

☐ Graduate Diploma/Certificate

☐ Honours Degree

☐ Postgraduate Degree

☐Other:

[]Have you completed any further qualifications? *

Please choose only one of the following:

○ Yes

○ No

[]What further education qualifications have you completed? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '8 [q152]' (Have you completed any further qualifications?)

Please choose all that apply:

☐ Trade Certificate

☐ Other Certificate (e.g., TAFE, Cert III)

☐ Associate or Undergraduate Diploma

☐ Bachelor Degree

☐ Graduate Diploma/Certificate

☐ Honours Degree

☐ Postgraduate Degree

☐Other:

[]

What driver licence do you currently hold? *

Please choose only one of the following:

○ No driver licence

○ Learner licence

○ Provisional P1 licence

○ Provisional P2 licence

○ Full licence

○ Other

[]

What is your email address?

Please write your answer here:

[]What is the phone number which you are most easily reached on? *

Please write your answer here:

Medical History

[]Do you have any difficulties with vision? *

Please choose only one of the following:

○ Yes

○ No

[]

If yes, are these difficulties corrected (i.e., glasses/contacts)? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '13 [q21]' (Do you have any difficulties with vision?)

Please choose only one of the following:

○ Yes

○ No

[]

Do you have a sleep disorder or any sleeping difficulties? *

Please choose only one of the following:

○ Yes

○ No

[]On average, how many hours do you sleep on a: *

Please write your answer(s) here:

Weeknight

Weekend

[]Do you work night shifts (e.g., 10pm until 6am)Â or double shifts (e.g., 8am until midnight)? *

Please choose only one of the following:

○ Yes

○ No

[]If yes, how many times per week do you work night shifts/double shifts? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '17 [q24]' (Do you work night shifts (e.g., 10pm until 6am)Â or double shifts (e.g., 8am until midnight)?)

Only numbers may be entered in this field.

Please write your answer here:

[]Have you ever had or are you now suffering from any of the following? *

Please choose the appropriate response for each item:

	Yes	Uncertain	No
Fits or convulsions	○	○	○
Epilepsy	○	○	○
Regular giddiness	○	○	○
Concussion	○	○	○
Severe head injury	○	○	○
Loss of consciousness	○	○	○

	Yes	Uncertain	No
Diabetes	○	○	○
Hypertension	○	○	○
Gastro-oesophageal reflux condition	○	○	○
Heart condition	○	○	○
Substance abuse/dependence disorder	○	○	○

[]Do you have any other serious physical conditions? *

Please choose only one of the following:

○ Yes

○ No

[]Are you currently suffering from anxiety or depression? *

Please choose only one of the following:

○ Yes

○ No

[]Do you have any other serious mental health condition? *

Please choose only one of the following:

○ Yes

○ No

[]

What is your approximate height in cm? Note that 1 foot = 30.5cm. Please write 'don't know' if not sure. *

Please write your answer here:

[]What is your approximate weight in kg? Please write 'don't know' if not sure. *

Please write your answer here:

K10

[]

These questions concern how you have been feeling over the past 30 days. Please indicate the response which best represents how you have been. Please be assured your answers will remain confidential.

During the last 30 days, about how often did you feel tired out for no good reason? *

Please choose only one of the following:

- ○ None of the time
- ○ A little of the time
- ○ Some of the time
- ○ Most of the time
- ○ All of the time

[]During the last 30 days, about how often did you feel nervous? *

Please choose only one of the following:

- ○ None of the time
- ○ A little of the time
- ○ Some of the time
- ○ Most of the time
- ○ All of the time

[]During the last 30 days, about how often did you feel so nervous that nothing could calm you down? *

Only answer this question if the following conditions are met:
Answer was 'All of the time' *or* 'Most of the time' *or* 'Some of the time' *or* 'A little of the time' at question '26 [r279q0]' (During the last 30 days, about how often did you feel nervous?)

Please choose only one of the following:

- ○ None of the time
- ○ A little of the time
- ○ Some of the time
- ○ Most of the time
- ○ All of the time

[]During the last 30 days, about how often did you feel hopeless? *

Please choose only one of the following:

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

[]During the last 30 days, about how often did you feel restless or fidgety? *

Please choose only one of the following:

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

[]During the last 30 days, about how often did you feel so restless that you could not sit still? *

Only answer this question if the following conditions are met:
Answer was 'All of the time' *or* 'A little of the time' *or* 'Some of the time' *or* 'Most of the time' at question '29 [q35]' (During the last 30 days, about how often did you feel restless or fidgety?)

Please choose only one of the following:

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

[]During the last 30 days, about how often did you feel depressed? *

Please choose only one of the following:

- ○ None of the time
- ○ A little of the time
- ○ Some of the time
- ○ Most of the time
- ○ All of the time

[]During the last 30 days, about how often did you feel that everything was an effort? *

Please choose only one of the following:

- ○ None of the time
- ○ A little of the time
- ○ Some of the time
- ○ Most of the time
- ○ All of the time

[]During the last 30 days, about how often did you feel so sad that nothing could cheer you up? *

Please choose only one of the following:

- ○ None of the time
- ○ A little of the time
- ○ Some of the time
- ○ Most of the time
- ○ All of the time

[]During the last 30 days, about how often did you feel worthless? *

Please choose only one of the following:

- ○ None of the time
- ○ A little of the time
- ○ Some of the time
- ○ Most of the time
- ○ All of the time

Caffeine Use

[]Have you consumed any caffeinated products in the last WEEK (e.g., tea, coffee, chocolate drinks, cola, chocolate, energy drinks)? *

Please choose only one of the following:

○ Yes

○ No

[]How many caffeinated products would you have consumed in the last WEEK (e.g., two coffees and one tea = 3)? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '35 [q41]' (Have you consumed any caffeinated products in the last WEEK (e.g., tea, coffee, chocolate drinks, cola, chocolate, energy drinks)?)

Only numbers may be entered in this field.

Please write your answer here:

[]How many times on average in a DAY do you eat/drink the following caffeine-containing products, from the time you wake up until the time you fall to sleep (e.g., 2 x 220ml tea = 2)?

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '35 [q41]' (Have you consumed any caffeinated products in the last WEEK (e.g., tea, coffee, chocolate drinks, cola, chocolate, energy drinks)?)

Please write your answer(s) here:

Instant coffee (220mL)

Instant coffee decaffeinated (220mL)

Ground coffee long black style (220mL)

Ground coffee cappuccino style (220mL)

Ground coffee expression style (30mL)

Decaffeinated ground coffee (220mL)

Iced coffee (375mL)

Tea (220mL)

Hot chocolate drink (220mL)

Chocolate milk (330mL)

Cola soft drink (375mL)

Cola soft drink (600mL)

Milk chocolate bar (snack size or approximately 20g)

Milk chocolate bar (standard size or approximately 50g)

Milk chocolate bar (king size or approximately 80g)

White chocolate (snack size or approximately 20g)

Dark chocolate (snack size or approximately 20g)

Chocolate biscuit (15g)

Chocolate cake (75g)

Energy drink (250mL)

NoDoz (1 tablet)

ED Use

[]

Have you consumed an energy drink in the past 30 days? *

Please choose only one of the following:

○ Yes

○ No

[]How frequently have you consumed an energy drink in the past 30 days? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '38 [q51]' (Have you consumed an energy drink in the past 30 days?)

Please choose only one of the following:

○ Monthly or less

○ 2 to 4 times per month

○ 2 to 3 times per week

○ 4 to 6 times per week

○ Daily

[]In the past 30 days, how many standard energy drinks did you have on a typical day when you were drinking energy drinks? Note: 1 standard ED = 250mL ED containing approximately 80mg caffeine (e.g., one serving of Red Bull). *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '38 [q51]' (Have you consumed an energy drink in the past 30 days?)

Only numbers may be entered in this field.

Please write your answer here:

[]In the last 30 days, how often did you drink three or more standard energy drinks in one day? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '38 [q51]' (Have you consumed an energy drink in the past 30 days?)

Please choose only one of the following:

- ○ Never
- ○ Monthly or less
- ○ 2 to 4 times per month
- ○ 2 to 3 times per week
- ○ 4 to 6 times per week
- ○ Every day

[]In the last 30 days, what is the greatest number of standard energy drinks you have consumed in one day? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '38 [q51]' (Have you consumed an energy drink in the past 30 days?)

Only numbers may be entered in this field.

Please write your answer here:

Alcohol Use

[]Have you consumed an alcoholic drink in the last fortnight (i.e., 14 days)? *

Please choose only one of the following:

○ Yes

○ No

[]How many standard alcoholic drinks have you consumed in the last fortnight? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '43 [q61]' (Have you consumed an alcoholic drink in the last fortnight (i.e., 14 days)?)

Only numbers may be entered in this field.

Please write your answer here:

[]

The following questions ask about your alcohol use in the last 12 months. Please note that all alcohol quantities are provided in standard drink sizes. All information provided will be kept confidential.

How often do you have a drink containing alcohol? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '43 [q61]' (Have you consumed an alcoholic drink in the last fortnight (i.e., 14 days)?)

Please choose only one of the following:

○ Never

○ Monthly or less

○ 2 to 4 times a month

○ 2 to 3 times a week

○ 4 or more times a week

[]How many standard drinks containing alcohol do you have on a typical day when you are drinking? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '43 [q61]' (Have you consumed an alcoholic drink in the last fortnight (i.e., 14 days)?)

Please choose only one of the following:

○ 1 or 2

○ 3 or 4

○ 5 or 6

○ 7 to 9

○ 10 or more

[]How often do you have six or more standard drinks on one occasion? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '43 [q61]' (Have you consumed an alcoholic drink in the last fortnight (i.e., 14 days)?)

Please choose only one of the following:

○ Never

○ Less than monthly

○ Monthly

○ Weekly

○ Daily or almost dialy

[]How often during the last year have you found that you were not able to stop drinking once you had started? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '43 [q61]' (Have you consumed an alcoholic drink in the last fortnight (i.e., 14 days)?)

Please choose only one of the following:

○ Never

○ Less than monthly

○ Monthly

○ Weekly

○ Daily or almost daily

[]How often during the last year have you failed to do what was normally expected of you because of drinking? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '43 [q61]' (Have you consumed an alcoholic drink in the last fortnight (i.e., 14 days)?)

Please choose only one of the following:

- ○ Never
- ○ Less than monthly
- ○ Monthly
- ○ Weekly
- ○ Daily or almost daily

[]How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '43 [q61]' (Have you consumed an alcoholic drink in the last fortnight (i.e., 14 days)?)

Please choose only one of the following:

- ○ Never
- ○ Less than monthly
- ○ Monthly
- ○ Weekly
- ○ Daily or almost daily

[]How often during the last year have you had a feeling of guilt or remorse after drinking? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '43 [q61]' (Have you consumed an alcoholic drink in the last fortnight (i.e., 14 days)?)

Please choose only one of the following:

- ○ Never
- ○ Less than monthly
- ○ Monthly
- ○ Weekly
- ○ Daily or almost daily

[]How often during the last year have you been unable to remember what happened the night before because of your drinking? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '43 [q61]' (Have you consumed an alcoholic drink in the last fortnight (i.e., 14 days)?)

Please choose only one of the following:

- ○ Never
- ○ Less than monthly
- ○ Monthly
- ○ Weekly
- ○ Daily or almost daily

[]Have you or someone else ever been injured because of your drinking? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '43 [q61]' (Have you consumed an alcoholic drink in the last fortnight (i.e., 14 days)?)

Please choose only one of the following:

- ○ No
- ○ Yes, but not in the last year
- ○ Yes, in the last year

[]Has a relative or friend or a doctor or other health worker ever been concerned about your drinking or suggested you cut down? *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '43 [q61]' (Have you consumed an alcoholic drink in the last fortnight (i.e., 14 days)?)

Please choose only one of the following:

- ○ No
- ○ Yes, but not in the last year
- ○ Yes, during the last year

Other Drug Use

[]How often do you smoke tobacco? *

Please choose only one of the following:

- ○ Never
- ○ Monthly
- ○ Fortnightly

○ Weekly

○ Daily or almost daily

[]Have you used cannabis in the past month? *

Please choose only one of the following:

○ Yes

○ No

[]Have you used any form of illicit drugs in the past 6 months? *

Please choose only one of the following:

○ Yes

○ No

[]Are you currently regularly taking prescription medication for medicinal or recreational purposes? *

Please choose only one of the following:

○ Yes

○ No

[]Have you participated in another study within the last three months for which you had to consume any drugs? *

Please choose only one of the following:

○ Yes

○ No

Statement of Study Restrictions

[]

Thank you for answering the previous questions. There are now just a few questions to ensure you are aware of what participation involves and to ensure that you will be able to complete the study.

Will you be able to attend one 60 minute familiarisation session and four 270 minute experimental sessions at the Hobart campus of the University of Tasmania, beginning at either 9am or 1pm? *

Please choose only one of the following:

○ Yes

○ No

[]Are you willing to drink up to six standard alcoholic drinks and three 250mL energy drinks per session? Please note that you will not be informed of the specific quantity of alcohol/energy drink administered in the beverage until the conclusion of all sessions. *

Please choose only one of the following:

○ Yes

○ No

[]

Prior to each experimental session, participants will be asked to abstain from:

- Food for 4 hours

- Caffeine for 8 hours

- Alcohol for 24 hours

- Prescription medication for 24 hours

- Illicit drugs for the duration of participation

Participants will be provided with a standard breakfast or lunch snack to eat 60 minutes prior to each session. Food and drink will also be provided at the end of each session.

Will you be willing to comply with these restrictions? *

Please choose only one of the following:

○ Yes

○ No

[]

Are you willing to remain in the laboratory until your breath alcohol concentration is recorded at .03% or less?

Provisional licence holders who are intending to drive will have to remain in the laboratory until their breath alcohol concentration is .00%.

If not intending to drive provisional licence holders will have to remain in the laboratory until their breath alcohol concentration reaches .03% and be required to organise alternative transportation after the session.

In addition to food and drink, DVDs and magazines will be provided in the interim. *

Please choose only one of the following:

○ Yes

○ No

[]Which session time would you prefer? *

Please choose all that apply:

☐ 9am

☐ 1pm

[]Please indicate which days would best suit you for completing the experimental sessions. Note that the 270 minute sessions will begin at 9am or 1pm and will be separated by a minimum of 4 and maximum of 10 days.

Please choose all that apply:

☐ Monday

☐ Tuesday

☐ Wednesday

☐ Thursday

☐ Friday

☐ Saturday

☐ Sunday

Thank you answering the screening questionnaire, we appreciate your assistance. The researchers will be in contact with you as quickly as possible to confirm whether you are eligible to participate. Please email Jessica Forward and Jane Akhurst at energydrinkstudy@gmail.com if you have any queries or would like a copy of the information sheet.

Submit your survey.
Thank you for completing this survey.

---

https://surveys.psychol.utas.edu.au

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Info line 1300 363 864

Appendix C

Declaration of Abstinence Compliance

Participant ID: .....

Session Number: 1 2

Declaration of Abstinence Compliance

Participants are required to abstain from the following prior to the experimental sessions:

- No nicotine and illicit drugs for the duration of participation
- No alcohol for 24 hours
- No prescription medication for 24 hours
- No caffeine-containing products for 8 hours
- No food for 4 hours (preceded by a light meal not containing oil/dairy/caffeine)

I solemnly swear that I have complied with the above guidelines prior to this session.

Signature of participant: ..... Date: .....

Signature of experimenter: ..... Date: .....

Appendix D

Participant Information Sheet and Consent Form

Information Sheet

Alcohol and Energy Drink Component Interactions: Study 1 and Alcohol and Energy Drink Component Interactions: Study 2
March, 2016

Introduction

You are invited to participate in an experiment examining the effect of independent and combined consumption of energy drinks and alcohol on performance. The purpose of this study is to investigate whether energy drinks alter the impact of alcohol on risk-taking through measurement of behavioural outcomes. The research is being conducted by Holly Bromfield and Xiao Min Leong in partial fulfilment of the requirements of an Honours degree. Holly and Xiao are being supervised by Dr Raimondo Bruno and Dr Amy Peacock from the School of Psychology, University of Tasmania. The researchers can be contacted as following: Holly Bromfield; hollyb1@utas.edu.au: + 61 3 6226 2924; Xiao Min Leong; xmleong@utas.edu.au; + 61 3 6226 2924).

What is the purpose of the study?
The purpose of this study is to investigate whether energy drinks or caffeinated/sugary drinks alter the impact of alcohol on performance through measurement of behavioural (e.g., reaction time, accuracy, decision-making) outcomes; and to compare subjective and objective measures of intoxication.

Who can participate?
We are currently seeking participants who are:

- Male/Female
- Aged 18-35 years
- English as a first language
- Completed Year 12
- Normal or corrected-to-normal vision
- Normal sleep patterns
- Healthy (no history of significant neurological disorder or current psychiatric disorder, significant intellectual disorder, alcohol/drug dependence, regular tobacco use, or chronic health problems)
- Regular energy drink consumers (minimum consumption of 1 energy drink in the preceding month and maximum consumption of 1 energy drink per day in the last month)
- Regular caffeine consumers (minimum consumption of 5 caffeinated beverages in the last week)
- Regular alcohol consumers (minimum consumption of 5 standard alcoholic drinks on one occasion in the preceding month)
- Not currently using illicit drugs (i.e., use in the preceding six months)

- Able to attend the Hobart campus of the University of Tasmania for one 60-minute session commencing at a time between 9am and 5pm, and two240 minute sessions commencing at 9am or 1pm.

What does participation in the study involve?
This research will be conducted in the Perception Laboratory at the School of Psychology, University of Tasmania (Hobart). Interested individuals will complete a brief screening questionnaire online that collects data about demographics (e.g., age, sex), medical history, and use of caffeine, alcohol, energy drinks and other drugs. Eligible participants will be asked to attend the Perception Laboratory for three sessions: one familiarisation session conducted between 9am and 5pm and two experimental sessions commencing at either 9am or 1pm and separated by a minimum of 4 and maximum of 14 days.

Familiarisation session (session 1: 60-minutes duration)
To confirm eligibility prior to participation, volunteers will be asked to complete several paper screening questionnaires in person, including measures of general intellectual and psychological functioning.
If participants are deemed eligible following completion of these measures, they will be asked to complete a number of other measures assessing personality, and alcohol, caffeine, and energy drink use, and their height and weight will be measured. Participants will then practice the tasks which will be completed in the experimental sessions.

Experimental sessions (session 2 x 240 minutes duration/session)
At the beginning of each experimental session participants will consume a different beverage containing energy drink and/or alcohol and/or sugar and/or caffeine. Alcohol and energy drink content will be equivalent to a maximum of 6 standard alcoholic drinks, 3 250mL energy drinks, respectively per session. The caffeine beverage will contain the equivalent caffeine as the energy drink, the sugar beverage will contain equivalent sugar of the energy drink. Participants will not be informed of the beverage content administered in each session until the conclusion of all sessions.

After consuming the beverage, participants will be asked to complete a range of computerised behavioural laboratory tasks while their responses are recorded. A breathalyser will be used to monitor participants' breath alcohol concentration throughout the duration of the study. Throughout testing, participants will be asked to complete several scales assessing their mood and feeling of intoxication and impairment as well as computerised tasks. Participants will be debriefed regarding the order of dose administration at the conclusion of all sessions.

What are the restrictions regarding participating?
Participants will be asked to fast from food for 4 hours prior to each experimental session and abstain from caffeine for 8 hours and alcohol and prescription medication for 24 hours prior to each session. Participants will be asked to abstain from illicit drugs and tobacco for the duration of participation. Participants will be asked to consume a standard meal (provided in the familiarisation session) one hour prior to each session.

At the end of each session, participants will remain at leisure (with food and entertainment provided) until they attain two consecutive breathalyser recordings of 0.03% or less measured 15 minutes apart.

Participants holding their provisional driver licence, who are intending to drive will be required to remain in the laboratory until two consecutive BrAC measurements are recorded at .00%. Participants holding their provisional licence who are not intending to drive, will be able to leave the laboratory at .03% BrAC if they sign a declaration in which they agree to be escorted by a nominated guardian to their place of residence and accompanied for a two-hour period following session completion. The nominated guardian must be an adult aged 18 years or older who: (i) holds their provisional or full driver licence (ii) directly collects the participant from the research premises and meets the researcher in-person, and (iii) signs a declaration agreeing to escort the participant directly to their place of residence and accompany the participant for the two-hour period following session completion. The researcher reserves the right to retain participants in the laboratory until .03% BrAC for those holding their full driver licence and .00% BrAC for those holding their provisional licence when it is deemed unsafe for the participant to leave at .03% BrAC.

What are the benefits of participating?
Your participation will help us enhance our knowledge of the effects of popular energy drinks on people's perceived and actual level of alcohol-induced impairment. This knowledge can be used to help educate people regarding the potential outcomes of independent and combined alcohol and energy drink or caffeinated drink use.

What are the risks associated with participating?
There are no anticipated risks of this research. However, if in the unlikely event you experience negative side-effects, please inform the experimenter and the necessary assistance will be sought and provided. We ask that participants refrain from consuming alcohol or operating heavy machinery for four hours' post-session.

Is there any monetary reimbursement for participation?
Participants will be reimbursed $80 (i.e. $40 per experimental session) at the conclusion of the sessions as recompense for their time. Participants who do not complete the full schedule of sessions will not be reimbursed, unless withdrawal is necessary due to an unexpected adverse physiological reaction to the investigatory products. Partial reimbursement will be provided in this situation dependent on the number of sessions completed. KHA111/112 students may receive up to 8-hours research participation credit as reimbursement for time and expenses incurred, with a deduction of $10 monetary reimbursement for each hour of research participation credit awarded (e.g. total reimbursement of 6 hours credit plus $20, 5 hours credit plus $10, etc.).

How do I volunteer to participate? What if I want to withdraw from participating?
Participation in this study is voluntary. By signing the attached consent form, you are indicating that you are aware of the nature of the study and wish to participate. While we would be pleased to have you participate, we respect your right to decline. There will be no consequences to you if you decide not to participate. If you decide to discontinue participation at any time, you may do so without providing an

explanation. However, you will be required to remain in the laboratory until your breath alcohol concentration measurement equals 0.03% or less on two separate occasions measured 15 minutes apart.

What will happen to the information I provide?
All information collected will be kept confidential. Each participant will be assigned a treatment code and individual participant data will be identifiable only by that code. All of the data will be stored on password protected secure computers or in a locked cabinet in the School of Psychology for a minimum of five years after the publication of any academic journal articles, at which point all questionnaires will be destroyed using a paper shredder and electronic data will be deleted. The screening questionnaire will be securely destroyed immediately on completion of the study and that any information provided by the participant on the questionnaire will be identifiable only by participant number, kept confidential, and viewed only by the experimenter.

Who do I contact if I have any queries?
If you would like to discuss any aspect of this study, please contact Holly Bromfield (hollyb1@utas.edu.au; + 61 3 6226 2924) or Xiao Min Leong (xmleong@utas.edu.au; +61 3 6226 2924). Alternatively, you can contact Dr Raimondo Bruno on (03) 6226 2240 or email Raimondo.Bruno@utas.edu.au.

How do I find out the results of the study?
A summary of the results will be available on the Research webpage of the School of Psychology, University of Tasmania (http://fcms.its.utas.edu.au/scieng/psychol/). Results of the study can also be provided by Holly Bromfield (hollyb1@utas.edu.au; + 61 3 6226 2924) or Xiao Min Leong (xmleong@utas.edu.au; +61 3 6226 2924)

Who do I contact if I have a complaint about the study?
This study has been approved by the Tasmanian Social Science Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study should contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 7479 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. You will need to quote.

Thank you for taking the time to consider this study.
If you wish to take part in it, please sign the attached consent form.
This information sheet is for you to keep.

School of Psychology
University of Tasmania

Consent Form

Alcohol and Energy Drink Component Interactions: Study 1 and Alcohol and Energy Drink Component Interactions: Study 2

1. I have read and understood the 'Information Sheet' for this project.
2. The nature and possible effects of the study have been explained to me.
3. I understand that the study involves attending the Cognitive Neuroscience Laboratory for one 60 minute familiarisation session and two 240 minute experimental sessions.
4. I understand that in the familiarisation session I will complete measures of psychological distress, premorbid intelligence, and alcohol use, as well as having my height and weight measured. If I am eligible to participate in the study, I will be asked to complete further measures of personality, behaviour and alcohol, caffeine, and energy drink use. I will also practice the tasks which form part of the experimental sessions.
5. I understand that I will be asked to abstain from food for 4 hours, caffeine-containing products for 8 hours, and alcohol and prescription medication for 24 hours prior to each session, and illicit drugs and tobacco for the duration of the study. I will be asked to consume a provided standard meal 60 minutes prior to each experimental session. I will be asked to sign a declaration and complete a breath alcohol concentration measurement (via a breathalyser) to confirm my abstinence at the start of each session.
6. I understand that in the two sessions I will receive a beverage containing energy drinks and/or alcohol and/or caffeine and/or sugar. I understand that I may be given a maximum of 6 standard alcoholic drinks and 3 250mL energy drinks per session, and that I will not be informed of the specific contents of the beverage for each session until the conclusion of testing. I understand that after beverage consumption, I will be asked to complete a number of computerised laboratory behavioural performance tasks during which my behavioural responses will be recorded. I understand that my breath alcohol concentration (as measured via a breathalyser) will be recorded throughout the session, and that I will be asked about my perception of my intoxication and level of impairment and will be required to complete computerised tasks.
7. I understand that I will be asked to remain in the laboratory until my blood alcohol concentration equals 0.03% or less on two occasions measured 15 minutes apart. I acknowledge that I have been advised to refrain from drinking alcohol or operating a vehicle or other heavy machinery for four hours after the end of the experimental session.
8. I understand that if I hold a provisional driver licence and I intend to drive I will be required to remain in the laboratory until my breath alcohol concentration is .00% on two consecutive occasions. I understand that if I hold a provisional driver licence and do not intend to drive I will be able to leave the laboratory at .030% BrAC after signing a declaration in which I agree to be escorted by my nominated legal adult to my place of residence and be accompanied for a two-hour period following session completion. I understand that the nominated legal guardian must be an adult aged 21 years or older who: (i) holds their provisional or full driver licence (ii) directly collects me from the research premises and meets the researcher

in-person, and (iii) signs a declaration agreeing to escort me directly to my place of residence and accompany me for the two-hour period following session completion. Furthermore, I understand that the researcher reserves the right to retain participants in the laboratory until .03% BrAC for those holding their full driver licence and .00% BrAC for those holding their provisional licence when it is deemed unsafe for the participant to leave at .03% BrAC. I acknowledge that I have been advised to refrain from drinking alcohol or operating a vehicle or other heavy machinery for four hours after the end of experimental sessions.

9. I understand that I will be reimbursed $80 (i.e., $40 per experimental session) for my participation on conclusion of the two experimental sessions. I understand that if I am a KHA111/112 student I can opt to be reimbursed up to six hours research participation credit in addition to at least $20 monetary reimbursement. If I withdraw from the study prior to concluding all sessions I will not be eligible for monetary reimbursement, unless the withdrawal is due to an unexpected adverse event occurring as a consequence of ingesting the beverage, whereby I will be provided partial reimbursement consummate with the number of sessions completed.
10. I understand that, while there are no anticipated risks associated with this study, I should inform the experimenter immediately if any unexpected negative side-effects are experienced. I understand the experimenter will immediately cease the session and seek the necessary assistance.
11. I understand that the researchers will maintain my confidentiality and that any information I supply to the researcher(s) will be used only for the purposes of the research. My data will only be identifiable by an individual numerical participant code.
12. I understand that the screening questionnaire will be securely destroyed immediately on completion of the study and that any information I provide on the questionnaire will be identifiable only by my participant number, kept confidential, and viewed only by the experimenter.
13. I understand that all research data will be securely stored on the University of Tasmania premises for at least five years, and will then be securely destroyed when no longer required.
14. I agree that research data gathered from me for the study may be published provided that I cannot be identified as a participant.
15. I agree to participate in this investigation and understand that I may withdraw at any time without any effect, and if I so wish, may request that any data I have supplied to date be withdrawn from the research.
16. Any questions that I have asked have been answered to my satisfaction.

Name of Participant:

Signature: Date:

Statement by Investigator

☐ I have explained the project & the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation

If the Investigator has not had an opportunity to talk to participants prior to them participating, the following must be ticked.

☐ The participant has received the Information Sheet where my details have been provided so participants have the opportunity to contact me prior to consenting to participate in this project.

Name of investigator _____

Signature of investigator _____

Date _____

Appendix E

Table 11

*Pairwise comparisons of Time x Sex Interaction on BrAC recorded prior to A-BART administration and BrAC recorded prior to DT administration, with Significance Values (*p*<0.05) and Effect Sizes (Hedge's* g*)*

		Baseline		**(35-mins)**		**(75-mins)**		**(115-mins)**		**(155-mins)**		**(205-mins)**	
		Sig. value	**Effect size**	**Sig. value**	**Effect size**	**Sig. value**	**Effect size**	**Sig. value**	**Effect size**	**Sig. value**	**Effect size**	**Sig. value**	**Effect size**
Female vs. Male	BrAC A-BART	.884	<.001	*.004*	**0.93**	*<.001*	**1.77**	*<.001*	**2.43**	*<.001*	**1.26**	*<.001*	**2.34**
	BrAC DT	.814	0.09	*.005*	**0.93**	*< .001*	**1.49**	*< .001*	**2.24**	*< .001*	**2.62**	*< .001*	**2.24**

NB: Hedge's gs>0.40 appear in **bold**. Ps <.050 appear in *italics*

Table 12

*Pairwise comparisons for Time x Sex interactions on DT RT (females), with Significance Values (*p*<0.05) and Effect Sizes (Hedge's* g*)*

	Baseline		**Time 1 (25-mins)**		**Time 2 (65-mins)**		**Time 3 (105-mins)**		**Time 4 (145-mins)**		**Time 5 (195-mins)**	
	Sig. value	**Effect size**	**Sig. value**	**Effect size**	**Sig. value**	**Effect size**	**Sig. value**	**Effect size**	**Sig. value**	**Effect size**	**Sig. value**	**Effect size**
Time 0			.055	0.19	.055	0.33	*.028*	0.30	.099	0.25	.195	0.19
Time 1	.055	0.19			*.033*	0.16	.508	0.29	.508	0.07	.961	0.01
Time 2	*.005*	0.33	*.033*	0.16			.362	0.03	.362	0.07	.156	0.14
Time 3	*.028*	0.30	.161	0.13	.735	0.03			.489	0.20	.239	0.08
Time 4	.099	0.25	.508	0.07	.362	0.07	.489	0.05			.545	0.06
Time 5	.195	0.19	.961	0.01	.156	0.14	.239	0.14	.545	0.06		

NB: Hedge's gs>0.40 appear in **bold**. Ps < .050 appear in *italics*

Table 13

*Pairwise comparisons for Time x Sex interactions on DT RT (males), with Significance Values (*p *<0.05) and Effect Sizes (Hedge's* g*)*

	Baseline		**Time 1 (24-mins)**		**Time 2 (65-mins)**		**Time 3 (105-mins)**		**Time 4 (145-mins)**		**Time 5 (195-mins)**	
	Sig. value	**Effect size**	**Sig. value**	**Effect size**	**Sig. value**	**Effect size**	**Sig. value**	**Effect size**	**Sig. value**	**Effect size**	**Sig. value**	**Effect size**
Time 0			*<.001*	**0.48**	*<.001*	**0.46**	*<.001*	0.30	*<.001*	**0.75**	*<.001*	**0.61**
Time 1	*<001*	**0.48**			.290	0.07	*.037*	0.16	*<.001*	0.36	*.013*	0.23
Time 2	*<.001*	**0.46**	.290	0.07			.255	0.09	*.001*	0.28	.081	0.16
Time 3	*<.001*	0.30	*.037*	0.16	.255	0.09			*.017*	0.05	.401	0.14
Time 4	*<.001*	**0.75**	*<.001*	0.36	*.001*	0.28	*.017*	0.20			.269	0.12
Time 5	**<.001**	.611	**.013**	.232	.081	0.16	.401	0.08	.269	.116		

NB: Hedge's gs>0.40 appear in **bold**. Ps < .050 appear in *italics*

Appendix F

For SPSS out-put please see CD inside cover.