

Impulsivity, peer influence, and adolescent substance use

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Declaration

I declare that the work presented in this thesis is my own. All research and work detailed in the text of this thesis is novel and has not been previously submitted as part of the requirements of a higher degree.

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Abstract

Individuals in Western societies commonly begin to experiment with alcohol and/or cannabis during their adolescent years. Many experience negative consequences from the use of these substances and a minority develop pathological problems such as abuse and dependence. Previous research has identified myriad individual and environmental variables that precede and predict problematic substance use. Two such risk factors are the personality trait impulsivity and the influence of substance-using peers. This thesis aimed to study possible interactive effects of these factors on adolescent alcohol and cannabis use. A systematic review of the literature identified that a trait termed urgency, reflecting emotion-based impulsivity, showed larger associations than other impulsivity-related traits with problematic alcohol use. A study of 270 adolescent students found urgency to be significantly related to problematic alcohol and cannabis use. This study also identified a moderating effect of urgency on the relationship between perceived peer alcohol use and own problematic use. These findings were replicated in a late adolescent undergraduate sample. A three month follow-up of these participants found that urgency also predicted later problematic alcohol use. Next, an experimental study sought to identify social and emotional conditions in which impulsivity-related traits might influence alcohol use more strongly. This study found that an approach-motivated positive mood state and the presence of a friend did not influence trait effects on alcohol consumption in a beer taste test, although a main effect of sensation seeking was identified. The final study of the thesis considered how affective associative thoughts might explain links between urgency, peers, and substance use, particularly amongst adolescents. These findings help to further understanding of the role of impulsivity in adolescent substance use, and contribute to theoretical models of risk for substance use disorders.

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Table of contents

Declaration	2
Abstract	3
Acknowledgements	4
List of tables	10
List of figures	12
List of publications relevant to this thesis	13
List of presentations relevant to this thesis	14

Chapter 1

Introduction

Overview	15
Adolescence	16
Substance use	19
Substance use outcomes	21
Risk factors	23
Individual factors	23
Environmental factors	25
Impulsivity	28
Impulsivity in adolescence	28
Impulsivity and substance use	29
Conceptualisation and operationalisation	30
Peer influence	36
Interplay of peer influence and individual factors	40
Aims and research questions	42

Chapter 2

Impulsivity and adolescent alcohol use: A meta-analytic review

Overview	46
Introduction	47

Method	53
Literature search	53
Inclusion criteria	54
Exclusion	54
Study coding	55
Meta-analytic procedure	61
Outliers and heterogeneity	61
Publication bias	62
Moderator analysis	62
Statistical software	63
Results	63
Cross-sectional data	63
Comparing problematic use outcomes	64
Alcohol use initiation	65
Prospective data	66
Moderation	74
Discussion	80
Implications for intervention	84
Limitations and future directions	85
Conclusion	87

Chapter 3

Impulsivity and problematic substance use in adolescence: Direct effects of urgency traits and moderation of perceived peer use

Overview	88
Introduction	89
Impulsivity and adolescent cannabis use	89
Urgency and problematic substance use	92
Urgency as a moderator	94
Method	96
Participants	96
Procedure	97
Measures	97

Data analysis	100
Results	101
Problematic alcohol use	103
Problematic cannabis use	109
Discussion	112
Limitations	114
Future directions	116
Conclusion	116

Chapter 4

Impulsivity and peer influences on substance use in late adolescence: A prospective study

Overview	117
Introduction	118
Peer selection	119
Urgency as a risk factor	121
Aims and hypotheses	122
Method	123
Participants	123
Measures	123
Procedure	125
Results	126
Data screening	126
Attrition	126
Descriptive statistics and correlations	127
Concurrent prediction of problematic substance use by urgency	127
Prospective prediction of problematic substance use by urgency	134
Peer selection	138
Discussion	139
Limitations and future directions	143
Conclusion	144

Chapter 5

Effects of impulsivity, approach-motivated positive affect, and social context on alcohol consumption in late adolescence

Overview	146
Introduction	147
Impulsivity-related traits and positive affect	147
Social modelling	150
Aims and hypotheses	152
Method	153
Design	153
Participants	153
Measures	154
Mood induction stimuli	155
Procedure	156
Results	158
Data screening	158
Sample characteristics	158
Mood induction	159
Beer consumption	160
Experimental effects	160
Trait effects on drinking similarity	162
Discussion	164
Limitations and future directions	167
Conclusion	168

Chapter 6

Urgency, peers, and the affect heuristic: Implications for understanding risky decision making

Overview	169
Introduction	170
Implicit cognition and the affect heuristic	171
Peers as an affective stimulus	173

Substance use assessment	175
Aims and hypotheses	176
Method	177
Participants and procedure	177
Measures	177
Analysis	180
Results	181
Path analysis	183
Test of interaction between urgency and affective associations	186
Discussion	188
Implications for intervention	190
Limitations	190
Future directions	192
Conclusion	192

Chapter 7

General discussion

Overview	194
Key findings	195
Implications	201
For theory	201
For intervention	203
Limitations	205
Samples	205
Measures and stimuli	206
Future directions	208
Conclusion	212

References	213
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List of tables

1.1	Facets of the UPPS framework of impulsivity	34
2.1	Impulsivity-related trait categories and measures	58
2.2	Alcohol use categories and measures	60
2.3	Studies contributing effect sizes to meta-analyses	67
2.4	Meta-analyses - cross-sectional data	73
2.5	Meta-analyses - binge/heavy drinking	73
2.6	Meta-analyses of prospective data	74
2.7	Categorical moderator subgroup analyses	78
2.8	Continuous moderator analyses using meta-regression	79
3.1	Bivariate correlations and descriptive statistics	106
3.2	Zero-inflated negative binomial regression analysis – Problematic alcohol use	107
3.3	Zero-inflated negative binomial regression analysis – Problematic cannabis use	111
4.1	Bivariate correlations and descriptive statistics for T1 measures	130
4.2	Differences between T1 and T2 substance use scores in follow-up sample	131
4.3	Prospective correlations between T1 trait scores and T2 substance use variables	131
4.4	ZIP regression with T1 RAPI scores as outcome	132
4.5	ZINB regression with T1 CPQ scores as outcome	134
4.6	ZINB regression with T2 RAPI scores as outcome	135
4.7	ZINB regression with T2 CPQ scores as outcome	137

5.1	Scenarios used for mood induction	156
5.2	Bivariate correlations and descriptive statistics	159
5.3	ANCOVA interaction results	161
5.4	Hierarchical multiple regression predicting difference in beer remaining for participants in +friend condition	163
6.1	Descriptive statistics	182
6.2	Pattern matrix of exploratory factor analysis	182
6.3	Bivariate correlations for entire sample	183
6.4	Indirect effects	186
6.5	Moderated multiple regression analysis with likelihood of substance use as criterion	187

List of figures

2.1	Flowchart for study selection	57
3.1	Moderation effect of negative urgency on the relationship between perceived peer alcohol use and problematic alcohol use.	108
3.2	Moderation effect of positive urgency on the relationship between perceived peer alcohol use and problematic alcohol use	108
4.1	Moderation effect of urgency on the relationship between perceived peer alcohol use and concurrent problematic alcohol use	133
4.2	Moderation effect of negative urgency on the relationship between perceived peer cannabis use and prospective problematic cannabis use	138
5.1	Beer consumption across experimental conditions	162
5.2	Associations between positive urgency and partner similarity in beer consumption	163
6.1	Multiple-group path model	185
6.2	Moderation effect of urgency on the relationship between affective associations and hypothetical substance use likelihood	187

List of publications relevant to this thesis

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Chapter 1

Introduction

Overview

This introductory chapter will present key aspects of the literature that have informed the work presented in this thesis. First, a definition of adolescence will be provided, along with a description of why adolescents as a group are particularly vulnerable to risk-taking behaviours including substance use. Second, the specific substances of interest will be outlined, with explanation of key terms. Third, the concept of risk factors will be introduced, and a brief background of research looking at risk factors for adolescent substance use will be presented. Fourth, two key risk factors, trait impulsivity and peer influence, will be defined and an overview of the literature regarding these factors will be given. Finally, the programme of research described in this thesis will be introduced by outlining specific aims and research questions. The intention of this chapter is not to provide a comprehensive review of this diverse set of topics. Rather, it aims to give a concise account of current knowledge in each of these areas, and to show why the present programme of research is necessary.

Adolescence

Adolescence is the period of transition from childhood to adulthood (Spear, 2000), defined by the World Health Organisation as the second decade of life. Although it is widely agreed that the beginning of adolescence is marked by the onset of puberty, which can range from age 8 to 15 in females and 10 to 14 in males (Lee, 1980), the end of adolescence is less clearly defined. Rather than being tied to any specific biological event, maturing out of adolescence involves the attainment of various milestones of cognitive, emotional, and behavioural developments, along with highly variable socioculturally-defined events signifying the transition to independence (Arnett & Taber, 1994). In industrialised societies this period of 'emerging adulthood' can take place well into the 20s (Arnett, 2000).

During adolescence the human brain undergoes substantial structural and functional maturational changes. From around puberty the brain experiences a reduction in grey matter, thought to reflect synaptic pruning and processes such as glial cell changes (Geier & Luna, 2009). Brain areas associated with basic functions such as sensory and motor processing mature earlier, whereas frontal areas associated with executive function develop much more gradually (Gogtay et al., 2004). Alongside this reduction in grey matter, there is a linear increase in white matter reflecting increased myelination of neural pathways, thought to underlie strengthened connectivity (Spear, 2011). It is notable that myelination within and between regions involved in incentive processing and executive function continues well into adolescence (Geier & Luna, 2009). Functional changes include the development of connections between the prefrontal cortex and subcortical regions such as the nucleus accumbens and amygdala (Doremus-Fitzwater, Varlinskaya, & Spear, 2010), alterations to dopaminergic processes including a subcortical increase in available dopamine (Wahlstrom, Collins,

White, & Luciana, 2010), and enhanced activity in parts of the glutamate system (Spear, 2011).

Historically, adolescence has been viewed as a time of psychological upheaval. Hall (1904) famously declared this developmental period to be one of 'storm and stress'. Arnett (1999) has tempered this view somewhat, highlighting that a tumultuous adolescence is neither universal nor inevitable and that the degree to which each adolescent undergoes psychological turbulence is likely to be influenced by many individual and cultural differences. However, Arnett acknowledges that adolescence is regularly marked by upheaval, and notes three commonly experienced difficulties: conflict with parents, increases in mood disruption, and heightened risk behaviour. Indeed, a key characteristic of adolescent behaviour is an increased level of risk-taking or reckless behaviour, relative to children and adults (Spear, 2000). A sizeable proportion of adolescents report dangerous driving, unprotected sex, minor criminal activity, antisocial behaviour, and substance use (Arnett, 1992). Spear (2000) suggests that the escalation in risk-taking during adolescence reflects an evolutionarily preserved tendency for individuals to explore new environments and behaviours as part of the transition away from parents and towards adult independence.

Several researchers have linked the general increase in risk-taking behaviour during adolescence to the neurodevelopmental changes outlined above. Steinberg (2007; 2010) posits that such behaviour may result from the competing activity of two conceptual brain systems: a socio-emotional system comprising areas responsible for emotion and reward processing such as the amygdala, ventral striatum, and medial prefrontal cortex; and a cognitive control system that encompasses frontal areas responsible for executive functioning, including the lateral prefrontal cortex and parts of the anterior cingulate cortex. The post-pubertal burst of activity in the socio-emotional system appears to underlie dramatic alterations in incentive processing and

affective reactivity (Galvan, 2010; Geier & Luna, 2009; Spear, 2011). Late-developing frontal areas thought to underlie cognitive control may be ill equipped to regulate this activity. This imbalance may result in increased risk-taking, particularly in conditions of potential reward or emotional salience (Casey, Getz, & Galvan, 2008).

Ernst and colleagues (Ernst & Fudge, 2009; Ernst, Pine, & Hardin, 2006) present a three system model of adolescent behaviour, whereby each system reflects the functioning of a specific brain area. Under this triadic model, motivated behaviour during adolescence is believed to be dependent on an approach system (reflecting the activity of the ventral striatum), an avoidance system (amygdala), and a modulation or regulation system (medial and ventral prefrontal cortices). It is suggested that adolescents experience high approach motivation due to heightened sensitivity to reward, minimal avoidance motivation due to a low aversion to harm, and an immature ability to regulate behaviour. Risk-taking may therefore be the result of a pattern of neural activity that biases preference towards potential reward despite potential risk.

Despite their intuitive appeal systems models have received criticism. Grouping intricate neural processes into conceptual systems to explain complex brain-behaviour relationships is likely to be overly simplistic, and as yet very few studies have assessed the function of these systems in relation to real-world behaviours (Johnson, Blum, & Giedd, 2009; Pfeifer & Allen, 2012). Furthermore, there are doubtlessly multiple sources of influence on adolescent risk behaviour other than neuroscientific factors. Romer (2010), for instance, highlights the importance of experiential factors, suggesting that many of the problematic behaviours of adolescents might simply be the result of a lack of experience with potentially risky situations. Furthermore, Crone and Dahl (2012) note that adolescent capacity for cognitive control is highly flexible, yet also strongly dependent on socio-affective context. The view that the adolescent brain is immature or inferior compared to adults may therefore be misleading. Adolescent

functioning may be adaptive in many circumstances, yet liable to disruption when faced with potentially important social or affective stimuli.

Another drawback in relying on heuristic models of complex behaviour is that individual differences can be downplayed. Despite the normative increase in risk-taking in adolescence, there is of course significant individual variation in the propensity to engage in such behaviour. A number of researchers have begun to link individual differences in behaviour to the development of specific brain areas (Galvan, Hare, Voss, Glover, & Casey, 2007). Casey et al. (2008), for instance, posit that individual propensity towards impulsive responses may be underpinned by differences in ventral prefrontal development, whilst a tendency towards risky choice may reflect development of the nucleus accumbens.

These points are important considerations for the current thesis. Systems models of adolescent risk-taking are certainly useful heuristics (Strang, Chein, & Steinberg, 2013). However, as Wiers et al., (2007) assert, a deeper understanding of complex risk behaviours such as substance use also requires an appreciation of individual and social factors.

Substance use

Substance use is an archetypal risk activity, offering the potential for rewarding experiences along with the possibility of negative consequences. Alcohol and cannabis are particularly popular substances among adolescents in Western countries. Use of these substances often begins during the second decade of life and prevalence rates increase almost linearly from the age of 11 to 18 (Fuller, 2012; Young et al., 2002). Data from the Monitoring the Future study (MTF; Johnston, O'Malley, Bachman, & Schulenberg, 2012), an annual survey of a representative sample of adolescents in the

United States, indicate that alcohol is the most commonly used substance among American adolescents despite a continuing long-term decline in reported use prevalence. Cannabis is the most commonly used illicit substance, with prevalence increasing over the past four years alongside a decline in perceived risk. In the United Kingdom 45% of 11-15 year olds report ever using alcohol and 47% of 16-24 year olds report past week alcohol use, whilst 7.6% of 11-15 year olds and 17.1% of 16-24 year olds report past year cannabis use (Dunstan, 2012; Fuller, 2012; Smith & Flatley, 2011). Reported prevalence of use of both substances has declined over the past decade, yet alcohol and cannabis remain the most commonly used licit and illicit substances, respectively.

Although consumption of alcohol and cannabis is widespread, there are significant risks associated with their use. Individuals who begin using alcohol or cannabis at younger ages are at increased risk of developing a substance use disorder, and males who drink heavily in adolescence are at increased risk of premature death (Grant & Dawson, 1997; McCambridge, McAlaney, & Rowe, 2011; Winters & Lee, 2008; Zeigler et al., 2005). Those who initiate cannabis use in adolescence are more likely to become persistent users and appear to be at risk of developing problems with neuropsychological functioning as a result (Meier et al., 2012). Frequent cannabis use is associated with the development of psychosis, perhaps through an exacerbating effect on other risk factors (Shapiro & Buckley-Hunter, 2010). There is also a cost to public services. In the UK, over 90% of under 18s seeking substance use treatment do so for problematic use of alcohol or cannabis or both (Lewis & Jones, 2012).

This thesis will therefore focus on alcohol and cannabis use. The use of other substances during adolescence is certainly of interest and importance, but samples from normal populations tend to report relatively low levels of use. For example, the MTF study reports current prevalence rates among adolescents of less than 4% for

cocaine, less than 6% for ecstasy, and less than 10% for amphetamines (Johnston et al., 2012). Similarly, UK data show that only 6.6% of young adults (aged 16-24) report using any Class A substances within the past year (Smith & Flatley, 2011). Identifying sufficient numbers of users of these substances within the modestly-sized samples tested in this thesis would therefore be unlikely, and analysis relating to the use of these substances would likely be underpowered.

Substance use outcomes

Substance use can take many forms, including one-off experimentation, infrequent recreational use, regular use, and dependence. Three aspects of substance use will be considered in this thesis: initiation, typical use, and problematic use. Substance use *initiation* refers to the uptake of a drug, and can be measured by age of first use or first regular use (Maggs & Schulenberg, 2006). As noted above, earlier initiation is associated with greater levels of later problems. This may be due to earlier substance exposure leading to heavier, more frequent use, increasing the likelihood of negative consequences. Alternatively, early initiation may be a manifestation of a more general vulnerability or susceptibility to problematic substance use (Maggs & Schulenberg, 2006; Zucker, 2006). Initiation is a useful measure when assessing the substance use behaviour of younger respondents who may not vary largely on more specific measures.

Typical use or *consumption* refers to general levels of substance intake, and can be assessed by measures of average quantity consumed per session, frequency of using the substance within a specified timeframe, or a combination of the two (e.g. Sobell & Sobell, 2003). With regard to alcohol, heavy episodic use, more commonly known as binge drinking, is also of interest. Binge drinking is defined by the National Institute of Alcohol Abuse and Alcoholism (NIAAA) as consuming so much alcohol within a two

hour period that blood alcohol level (BAC) reaches 0.08g/dl. Five alcoholic drinks for males and four for females is a widely used metric for binge drinking (Wechsler & Nelson, 2001). Donovan and Molina (2013) have recently shown that such levels of heavy use are rare before age 16. By college age, however, binge drinking is pervasive. One large study of over 14,000 American college students found that 44% of respondents reported recent binge drinking, and 23% identified as being frequent binge drinkers (Wechsler, Lee, Kuo, & Lee, 2000).

The term *problematic use* refers to a pattern of substance use marked by negative consequences (Stice, Barrera, & Chassin, 1998). These may be short-term, for instance sustaining an injury whilst intoxicated, or long-term, such as the development of abuse and dependence symptoms. The distinction between typical use and problematic use is important. With regard to alcohol, although increased consumption has been found to be associated with increased negative consequences, the correlation is more modest than might be supposed (Park & Grant, 2005). Sadava (1985) reviewed studies that tested the association between consumption and consequences, finding an average correlation of $r = .36$. Several authors have suggested that consumption and negative consequences do not lie on a continuum, but that psychological characteristics may increase their association (Colder & Chassin, 1999; Stice et al., 1998). Such observations present the possibility that there are at least two routes to problematic substance use: the first caused by elevated or excessive consumption, and the second by predisposing factors that lead an individual to be at higher liability of problematic use even at relatively low levels of consumption. As Chambers, Taylor, and Potenza (2003) note, a preponderance of such factors could reduce the threshold of substance exposure required for negative consequences, or make 'tripping the switch' from recreational use to problematic use more likely. Adolescence appears to be a time when multiple predisposing variables begin to act together, leading to an increased

prevalence of problematic substance use during this period (Merikangas & McClair, 2012).

Risk factors

Kramer et al. (1997, p. 338) define a risk factor as “a measurable characterisation of each subject in a specified population that precedes the outcome of interest and which can be used to divide the population into two groups (the high-risk and the low-risk groups) that comprise the total population.” Decades of research have identified a vast number of risk factors for adolescent alcohol and substance use. This work has been documented thoroughly in earlier literature reviews (Donovan, 2004; Hawkins, Catalano, & Miller, 1992; Petraitis, Flay, & Miller, 1995; Swadi, 1999; Tarter, 2002). The following overview organises key risk factors into two domains: those that pertain to the individual and those related to the individual’s environment.

Individual factors

Individual risk factors include constitutional attributes such as genetic variation and neurobiological differences, as well as personality characteristics, aspects of psychological functioning, and behavioural tendencies that make substance use more likely. Genetic factors appear to play a considerable role in the aetiology of substance use disorders, with heritability estimates ranging from 0.5 to 0.6 for alcohol and from 0.3 to 0.8 for other substances (Urbanoski & Kelly, 2012). Children whose biological parents have substance use disorders are at heightened risk for developing problematic substance use, even when raised away from their parents in adoptive families (Vanyukov et al., 2003). The mechanisms of genetic risk for substance use disorders are not yet clearly understood. However, in a review of the literature regarding genetic

influences on alcoholism, Schuckit (2009) identifies four intermediate variables: a skin flushing response to consumption of alcohol (associated with low risk of alcoholism), a low level response to alcohol, psychiatric conditions that in turn lead to increased alcohol use, and the personality trait cluster of impulsivity and behavioural disinhibition.

Studies from the personality literature support the idea that impulsivity is an endophenotype of risk for problematic substance use. As will be detailed later in this chapter, impulsivity is the personality trait most clearly associated with alcohol and substance use (Sher, Trull, Bartholow, & Vieth, 1999; Tarter et al., 2003). Other traits, particularly negative affectivity or neuroticism, have shown positive associations with substance use in a number of studies, but effect sizes are smaller and much less consistent than those shown for impulsivity (Donovan, 2004; Murphy, Taylor, & Elliott, 2012; Wray, Simons, Dvorak, & Gaher, 2012). Interestingly, it appears that the influence of other personality traits may even be dependent on their interaction with impulsivity (Colder & Chassin, 1997).

Early psychopathology has also been linked to substance use. Externalising behaviour problems such as conduct disorder and oppositional defiant disorder are associated with lower age of alcohol initiation (McGue, Iacono, Legrand, Malone, & Elkins, 2001) and show high comorbidity with substance use, abuse, and dependence in adolescent samples (Armstrong & Costello, 2002; Roberts, Roberts, & Xing, 2007). In a representative sample of American children followed annually from age 9-13 until age 16, conduct disorder was found to be both highly comorbid with current substance use disorder and predictive of later substance use disorder (Costello, Mustillo, Erkanli, Keeler, & Angold, 2003).

The genetic, personality, and psychopathological risk factors described should not be viewed as a disparate list of variables. Alcohol and substance use disorders appear

to share a common genetic liability with externalising disorders (Dick et al., 2004; Kendler, Prescott, Myers, & Neale, 2003). Iacono, Malone, and McGue (2008) speculate that externalising behaviour and substance use are both outcomes of a genetic predisposition towards behavioural disinhibition, manifested in normal populations as trait impulsivity. Behavioural genetic data from Slutske et al., (2002) support this proposition, showing that genetic contribution to variation in impulsivity accounts for a substantial proportion of genetic risk for alcohol dependence and conduct disorder. Furthermore, Romer et al. (2009) have shown that an association between externalising problems and risk-taking behaviour in early adolescents (aged 10-12) is no longer present when controlling for trait impulsivity. It seems, then, that impulsivity may be a useful marker of a broader individual vulnerability towards substance use.

Environmental factors

Many features of an individual's environment can contribute to the initiation, maintenance, and problematic use of substances. These include aspects of the wider social, cultural, and economic context that an individual lives within, such as laws and moral norms surrounding the use of specific substances, the availability of these substances, and factors such as neighbourhood disorganisation (Hawkins et al., 1992). Experiencing traumatic life events during childhood and adolescence may also increase risk. As Swadi (1999) explains, factors such as homelessness, bereavement, sexual abuse, and major illness appear to be more prominent in adolescent substance users than in non-users. Negative life events may be particularly relevant to understanding female substance use (Conner, Helleman, Ritchie, & Noble, 2010).

Aspects of an individual's social environment such as family and peer relationships may also increase risk. Adolescents whose parents or other important

adult figures suffer from alcohol or substance use problems are at higher risk for substance abuse and dependence, as are those whose parents have permissive attitudes towards substance use (Kilpatrick et al., 2000; Martino, Ellickson, & McCaffrey, 2009). More general familial factors such as low parental monitoring, family conflict, and inconsistent discipline may also exert an effect (Lac & Crano, 2009; Swadi, 1999). Familial factors may be of greater importance during early adolescence (Cleveland, Feinberg, Bontempo, & Greenberg, 2008; Cleveland, Feinberg, & Jones, 2012), but appear to be less influential than peers in later adolescence, particularly with regard to cannabis use (Allen, Donohue, Griffin, Ryan, & Turner, 2003). Looking at this issue more closely, there is evidence to suggest that the influence of familial factors on substance use in older adolescents might be mediated by affiliation with deviant peers (Simons-Morton, 2007; Van Ryzin, Fosco, & Dishion, 2012). It has also been shown that family disruption and low parental involvement strengthens the association between peer and individual substance use (Prinstein, Boergers, & Spirito, 2001; Wood, Read, Mitchell, & Brand, 2004). Thus, family-related risk factors might act by way of compelling the individual to seek out environments that promote substance use, such as affiliating with substance-using peers. The impact of peer influence on adolescent substance use will be illustrated later in the chapter.

Despite the vast evidence base on risk factors, no single variable has yet been found to be a sufficient risk factor for substance use outcomes (Tarter, 2002). However, given the complex, heterogeneous nature of substance use, single-factor causal explanations are highly unlikely. Any attempt to understand problematic substance use must acknowledge the issue of equifinality, i.e. that multiple non-specific causes can lead to the same conclusion. To address this problem, researchers are beginning to consolidate current knowledge of risk factors into broad, multi-

component models that emphasise the interplay between factors. Windle (2010), for example, presents a dynamic diathesis-stress model of alcoholism (also applicable to other substance use disorders), that incorporates family history, biological, psychological, and social predisposing factors, chronic and acute stressors, and comorbid conditions. Similarly, Zucker (2006) stresses that an understanding of risk probability must take into account the interplay of genetic factors, intermediate traits, and socio-environmental factors, in the context of individual developmental stage.

Due to their complexity such theoretical models are incredibly difficult to study comprehensively during a single research programme. What is achievable, however, is to focus on additive and interactive effects that may exist between individual risk factors. This is an important step for this area of research and one that will assist in the refinement of complex theoretical models. To this end, two risk factors have been selected for investigation in this thesis: trait impulsivity and peer influence. These factors have been chosen on account of their consistent associations with adolescent substance use, as will be described below, and due to a current lack of study into their interactive effects. Furthermore, each of these factors may be a manifestation of wider risk. Trait impulsivity appears to reflect a more general genetic and neurobiological predisposition towards externalising behaviour, and affiliation with substance-using peers and responsiveness to peer influence may be a reflection of longer term familial risk factors. Understanding relationships between these factors and their joint influence on adolescent substance use therefore seems necessary. The following two sections introduce these factors in detail.

Impulsivity

Impulsivity can be defined broadly as the tendency to engage in action without deliberation. More specifically, the term reflects a tendency towards behaviours that are “poorly conceived, prematurely expressed, unduly risky, or inappropriate to the situation and that often result in undesirable consequences” (Daruna & Barnes 1993, p. 23, in Evenden, 1999, p. 349). At the psychometric level, Depue and Collins (1999, p. 495) define impulsivity as “a heterogeneous cluster of lower-order traits”, comprising constructs such as behavioural undercontrol, disinhibition, sensation and novelty seeking, and boredom proneness. In this section I will describe the nature of trait impulsivity in adolescence and detail a link between impulsivity and substance use outcomes. Key methodological issues such as how impulsivity is conceptualised and operationalised will then be addressed.

Impulsivity in adolescence

Aspects of trait impulsivity appear to be heightened during the adolescent years in comparison to adulthood. Steinberg et al. (2008) used cross-sectional data to gauge normative levels of impulsivity and the related trait of sensation seeking from the ages of 10 to 30. It was found that impulsivity declined linearly across these ages, whilst sensation seeking increased over the ages of 10 to 15 before declining. Harden and Tucker-Drob (2011) reported similar findings from a large sample of adolescents assessed longitudinally. Interestingly, these trajectories appear to map onto the differential development patterns of subcortical reward-processing areas and the prefrontal cortex, with sensation seeking appearing to peak during the period where reward pathways are highly developed in comparison with the late-developing frontal areas (Casey & Jones, 2010). These data are complemented by that of Roberts, Walton,

and Viechtbauer (2006), who conducted meta-analyses on studies examining rates of change in personality trait expression across the lifespan. Although impulsivity was not a focus of these authors' analysis, they found that trait conscientiousness, which includes sub-facets that reflect low impulsivity, increased gradually throughout adolescence before rising substantially after age 20.

Impulsivity and substance use

Impulsivity has been consistently found to be associated with a variety of substance use outcomes. High levels of impulsivity predict initiation of alcohol and other substances (Lejuez et al., 2010; McGue et al., 2001). Impulsivity and sensation seeking are elevated in cannabis users compared to non-users and in binge drinkers compared to non-drinkers (Moreno et al., 2012), as well as in early-onset compared to late-onset alcoholics (Dom, Hulstijn, & Sabbe, 2006).

This evidence clearly points to impulsivity being a potential causal risk factor for substance use outcomes, yet two caveats must be considered. First, as noted in the previous section, the association between impulsivity and substance use may reflect a shared underlying disposition towards both. Second, the relationship between impulsivity and substance use observed in cross-sectional studies may reflect bidirectional influence. Indeed, an influence of substance use on impulsivity may be particularly likely during adolescence. Heavy use of alcohol has been shown to have detrimental effects on frontal brain areas responsible for executive functioning and impulse control (Squeglia, Jacobus, & Tapert, 2009). Similar yet smaller effects have been shown with regard to cannabis (Squeglia et al., 2009). Crews, He, and Hodge (2007) outline the possibility of a critical period during adolescence during which heavy alcohol use may lead to a disrupted development of these brain areas. Some support for this theory has been provided by White et al. (2011), who examined

reciprocal relationships between self- and parent-reported impulsivity and heavy drinking in a longitudinal study of adolescent boys assessed annually from the ages of 8 to 18 and again at age 24/25. It was found that heavy alcohol use led to increased impulsivity amongst participants grouped into a modest impulsivity trajectory, but not in those in low or high impulsivity groups. Quinn, Stappenbeck, and Fromme (2011) found that heavy drinking predicted increases in impulsivity and sensation seeking in a sample of high school graduates followed up during their senior year at university. Conflicting results have recently been presented by Fernie et al. (2013), who tested 12-13 year olds' impulsivity and alcohol use over a two year period, and found no effect of alcohol use on later impulsivity. Notably, only behavioural impulsivity measures were employed in this study.

Verdejo-García, Lawrence, and Clark (2008) present a compelling review of the literature on impulsivity and substance use, detailing strong evidence that impulsivity is heightened not only in problematic substance users, but also in high risk populations such as the children of alcoholics, and in problem gamblers who do not engage in substance use. These authors conclude that impulsivity appears to be a reliable vulnerability marker for substance use disorders.

Conceptualisation and operationalisation

Many authors in the field of personality psychology have recognised that variation in the capacity for impulsive behaviour forms an integral part of human character. As such, a construct reflecting impulsivity appears in most major taxonomies of personality traits. Eysenck (1956) originally considered impulsivity to be an aspect of trait extraversion, along with sociability. In time this theory was revised and impulsivity was seen instead to be a component of trait psychoticism, the tendency for tough-mindedness and antisociality (Eysenck & Eysenck, 1975). Notably, the

Eysencks' (Eysenck & Eysenck, 1977; 1978) work uncovered a multidimensional nature to impulsivity, distinguishing between impulsiveness and venturesomeness (the tendency to seek out exciting experiences), and separating impulsiveness into four subtraits: risk-taking, non-planning, liveliness, and narrow impulsiveness (the tendency to act without thinking). Barratt also took the view that impulsivity was multifaceted (Barratt & Patton, 1983), identifying three subtraits in the development of a self-report measure (Patton, Stanford, & Barratt, 1995): attentional impulsiveness is characterised by an inability to concentrate, motor impulsiveness reflects a tendency to act without thinking, and non-planning impulsiveness reflects a reduced capacity for forethought.

In the original formulation of Gray's (1970; 1987) Reinforcement Sensitivity Theory, trait impulsivity was speculated to reflect the responsiveness of the Behavioural Activation System (BAS), a conceptual neural system responsible for approach motivation in response to incentives and active avoidance in response to punishment. Individuals exhibiting heightened impulsivity were thought to be especially sensitive to conditioned signals of reward, resulting in an enhanced tendency to approach potentially rewarding stimuli. More recent work has suggested that BAS activity might be best reflected by a broader trait cluster of impulsive antisocial sensation seeking (Pickering & Gray, 2001), or even by trait extraversion (Depue & Collins, 1999; Smillie, Pickering, & Jackson, 2006).

Zuckerman's (1979, 1994) work into the trait of sensation seeking is also noteworthy. Sensation seeking is a personality trait representing the tendency to pursue stimuli and experiences that are novel, exciting, and intense. It is a multi-faceted construct, comprising the need for physical thrills and adventure, the need for stimulation through experience, a susceptibility to boredom, and a tendency for disinhibited behaviour. Zuckerman (1994) has suggested that the trait cluster of

psychoticism, impulsivity, and unsocialised sensation seeking (termed ‘P-Imp-Uss’) forms a core dimension of human personality. Sensation seeking shows small to moderate associations with measures of alcohol use, with larger associations found when analysis focuses on the disinhibition aspect of the trait (Hittner & Swickert, 2006). Sensation seeking is also associated with the initiation of cannabis and other illicit substances (Andrucci, Archer, Pancoast, & Gordon, 1989).

A highly related construct to sensation seeking is Cloninger’s novelty seeking (Cloninger, 1987; Cloninger, Svrakic, & Przybeck, 1993), which incorporates tendencies towards both exploratory behaviour and impulsive decision making. Novelty seeking correlates highly with sensation seeking and psychoticism (Zuckerman & Cloninger, 1996), and its suggested biological basis links closely with Gray’s BAS (Cloninger, 1987). Heightened novelty seeking measured in childhood has been found to predict alcohol abuse in young adulthood (Cloninger, Bohman, & Sigvardsson, 1988).

In Tellegen’s multidimensional model of personality, a dimension labelled constraint is posited as one of three higher order factors, along with positive and negative emotionality (Tellegen, 1982; Tellegen & Waller, 2008). Constraint is essentially the reverse of impulsivity and is assessed by items tapping caution, reflection, harm avoidance, and traditionalism. Low constraint and high negative emotionality are prospectively associated with the onset of alcohol and illicit substance use, and with substance disorders (Elkins, King, McGue, & Iacono, 2006; Krueger, 1999). Low constraint has also been shown to differentiate individuals with and without a substance use disorder (McGue, Slutske, & Iacono, 1999).

Impulsivity’s position in lexical approaches to personality, notably the Five Factor Model (Costa & McCrae, 1992; Digman, 1990), is somewhat unclear. Whilst an impulsivity facet is placed under trait neuroticism in the NEO-PI scale, other

impulsivity-related behaviours appear as facets of other traits. For instance, excitement seeking is a facet of extraversion, and deliberation and self-discipline are facets of conscientiousness. DeYoung (2004) points out that certain facets of agreeableness and openness might also reflect impulsivity. This lack of clarity has led Revelle (1997, p. 204) to suggest that impulsivity is “a neglected part of the lexical description of personality”.

One conclusion that can be drawn from this express tour of the literature is that impulsivity is not a unitary construct. As Evenden (1999, p. 348) puts it, there are “varieties of impulsivity”, or several aspects of behaviour which are commonly classified under one term. A second conclusion is that many of these varieties appear across multiple theories and taxonomies. Recognising this overlap, several researchers have made efforts to integrate current knowledge of impulsivity. Two approaches have received empirical support: a theory-based model advocated by Dawe, Gullo, and Loxton (2004), and a data-derived model introduced by Whiteside and Lynam (2001). These models will be introduced only briefly here, as the distinction between them and their relationships to adolescent substance use will be covered extensively in Chapter 2.

Dawe et al. (2004) link commonly observed aspects of impulsivity with possible neurobiological underpinnings, proposing that impulsivity is best viewed as a two factor construct. The first factor is termed reward drive and represents Gray’s (1987) conceptualisation of impulsivity, i.e. the tendency for behavioural approach in response to incentives. It is proposed that reward drive is underpinned by activity in mesolimbic dopaminergic pathways. The second factor is termed rash impulsiveness and represents an inability to inhibit responses. This factor is thought to reflect impaired functioning of areas in the prefrontal cortex.

An alternative model has been put forward by Whiteside and Lynam (2001), who carried out a factor analysis on a number of frequently-used measures of impulsivity, extracting four underlying facets: lack of premeditation, lack of perseverance, sensation seeking, and urgency. To assess these facets, Whiteside and Lynam constructed the UPPS Impulsive Behaviour Scale. Definitions and a sample item for each facet are provided in Table 1.1. Expanding the UPPS model, Cyders and colleagues (Cyders et al., 2007; Cyders & Smith, 2008) have advocated splitting the urgency facet into two subtraits termed negative urgency and positive urgency. These traits are defined as the tendency to act rashly when in a very low or extremely positive mood, respectively.

Table 1.1

Facets of the UPPS framework of impulsivity

Facet	Definition	Sample item
Lack of premeditation	The inability to plan ahead or to consider the consequences of one's actions	"I usually think carefully before doing anything" (Reverse coded)
Lack of perseverance	The inability to persist with a task; a susceptibility to boredom	"I generally like to see things through to the end" (Reverse coded)
Sensation seeking	The tendency to seek out novel, thrilling, exciting experiences	"I quite enjoy taking risks"
Urgency	The tendency to act impulsively in response to elevated emotion	"When I am upset I often act without thinking"

The UPPS framework is beginning to gain consensus, with a number of studies supporting the separation of impulsivity into these separable domains (Miller, Flory, Lynam, & Leukefeld, 2003; Smith et al., 2007). One limitation to the data-driven UPPS approach is a lack of underlying theory. However, there are efforts underway to align the UPPS traits with neurobiological and genetic processes (Carver, Johnson, Joormann, Kim, & Nam, 2011; DeYoung, 2004).

It should also be noted that multiple behavioural tasks have been designed to assess impulsive behaviour and decision making. These include tasks such as the Go/No-Go task and the Stop Signal Task, which assess the ability to inhibit prepotent responses; Delay Discounting procedures, which assess the capacity to discount smaller, immediate rewards in favour of larger, later rewards; and tasks that assess the ability to resist distracting interference (Dick et al., 2010). Although performance on behavioural impulsivity tasks has been shown to be associated with substance use (Lejuez et al., 2010), there is little overlap between behavioural task performance and scores on self-report measures of impulsivity. In a meta-analysis of associations between the two forms of assessment, Cyders and Coskunpinar (2011) found little evidence of convergence between UPPS traits and various behavioural tasks (r values all less than .16). Similar results were found in an empirical study by these authors (Cyders & Coskunpinar, 2012). Several interpretations of these findings have been offered. Reynolds, Ortengren, Richards, and de Wit (2006) highlight the lack of convergence on the behaviours assessed by self-report and lab tasks, with lab tasks assessing very specific components of behaviour whereas self-report scales assess more general behavioural tendencies, whilst Dick et al. (2010) note that lab tasks focus on the cognitive aspects of impulsivity yet miss out potentially important affective components.

As yet, the multi-component perspective of impulsivity has not been widely considered in relation to adolescent substance use. Doing so may help to elucidate the processes by which impulsivity acts as a risk factor for problematic outcomes. Thus, in this thesis impulsivity will be operationalised as a group of separable yet related personality traits and assessed using validated self-report measures.

Peer influence

Peer substance use is perhaps the most pervasive environmental risk factor for individual use during adolescence and young adulthood (Baer, 2002; Hawkins, 1992; Neighbors, Foster, & Fossos, 2013; Swadi, 1999). A wealth of cross-sectional research has identified a strong link between individual and peer use of both alcohol and cannabis (e.g. Callas, Flynn, & Worden, 2004; Chabrol et al., 2006; Simons-Morton & Chen, 2006; Wills & Cleary, 1999). Peer substance use has also been found to prospectively predict individual substance initiation, level of use, and increases in use (Ali & Dwyer, 2010; D'Amico & McCarthy, 2006; Maxwell, 2002; Trucco, Colder, & Wieczorek, 2011). Such effects are often interpreted as being the result of peer influence. This section will differentiate between direct and indirect forms of peer influence and outline key theories that help to explain the association between peer and individual substance use. Reasons why peer influence may be particularly salient in adolescence will be explained. Finally, possible links between peer-related risk factors and individual factors such as impulsivity will be considered.

Peer influence on behaviour may take place through two processes: a direct process, whereby individuals are compelled to engage in behaviour through overt peer pressure, such as direct offers to use substances; or an indirect process, whereby individuals change their behaviour in line with the observed behaviour of others or perceived normative information (Neighbors et al., 2013). Despite the popular opinion that much adolescent substance use is the result of peer pressure (Kandel, 1978), research indicates that indirect processes may have greater influence on substance use than direct pressure (Simons-Morton et al., 2001). Reed and Wilcox Rountree (1997) compared direct and indirect peer influences using longitudinal data from over 1500 adolescent participants and found no evidence that direct peer pressure had a causal

influence on individual substance use. Many theories have been put forward to explain normative influence on individual behaviour. These have been reviewed with reference to substance use behaviour by Petraitis et al. (1995) and by Neighbors et al., (2013).

The most relevant theories for the current thesis will be briefly discussed here.

Social learning theory (Akers, 1977; Bandura, 1977) is a particularly enduring explanation of peer influence on behaviour. This approach suggests that substance use behaviour may be learned vicariously through observation of the substance-related attitudes and behaviour of role models, and by reinforcement of substance use by these models. Observation of models' behaviour is believed to influence an individual's outcome expectancies regarding that behaviour. For instance, if adolescents observe that many of their friends use cannabis, they may suppose that the consequences of cannabis use are positive and thus be more likely to engage in use.

The view that social norms influence individual decisions to engage in certain activities is also a key premise of the theory of reasoned action (Ajzen & Fishbein, 1980) and the theory of planned behaviour (Ajzen, 1988). These theories suggest that individuals modify their own substance use behaviour to comply with the perceived substance use norms of their peers. Norms may be descriptive, reflecting the degree to which behaviours are perceived as typical; or injunctive, reflecting the degree to which they are perceived as being approved or disapproved of (Cialdini & Goldstein, 2004). Of course, individuals' perception of peer substance use norms may be inaccurate. Misperceptions of normative information include the false consensus effect, whereby individuals mistakenly believe that their peers' substance use is similar to their own (Henry, Kobus, & Schoeny, 2011; Ross, Greene, & House, 1977), and the pluralistic ignorance effect, whereby perceived peer substance use is exaggerated (Prentice & Miller, 1993). Whether accurate or not, it seems that perceived norms are more likely

to influence behaviour than actual norms (Neighbors et al., 2013). This topic will be covered in greater detail in Chapter 4.

Oetting and Beauvais' peer cluster theory (1986; 1987) places peers as the predominant risk factor for adolescent substance use, stating that "peers shape attitudes about drugs, provide drugs, provide the social contexts for drug use, and share ideas and beliefs that become the rationales for drug use" (1987, p. 206). Peer clusters are defined as small subsets of peers that share attitudes, values, and beliefs, with members each being involved in shaping the norms and behaviours of the cluster. Thus, peer cluster theory places the individual as very much an active participant in the transmission of substance use norms, rather than as a passive receptacle. Related to peer cluster theory is the issue of peer selection. It is known that the similarity observed between individual and peer substance use in adolescence is not only due to peer influence but also due to adolescents seeking out friends with similar substance use tendencies to their own (Bauman & Ennett, 1996). Longitudinal studies addressing this issue have found evidence for both selection and influence effects (Kiuru et al., 2010; Sieving, Perry, & Williams, 2000; Simons-Morton & Chen, 2006). Data from Poulin, Kiesner, Pedersen, and Dishion (2011) reveal the possible temporal sequence of these effects, showing that individuals first select into peer groups with similar substance use behaviour to their own, and peer influence effects then occurring once groups (or clusters) are established.

Although extremely useful, these long-standing theories are limited in their application to adolescent substance use as they do not explain why adolescents appear to be particularly vulnerable to peer influence relative to other age groups. Peers become exceptionally important during adolescence as individuals begin to spend greater amounts of time with their friendship group and less time with their parents (Csikszentmihali, Larson, & Prescott, 1977). As Erikson (1959) observed, an

individual's peers become fundamental to the establishment of personal identity during this developmental period. Although it is commonly assumed that adolescents are prone to succumbing to peer influence, recent research suggests that the rise in peer salience during adolescence coincides with an increasing ability to resist peer influence. Steinberg and Monahan (2007) found that self-reported resistance to peer influence increases linearly between the ages of 14 and 18 before reaching a plateau, a finding that has since been replicated (Sumter, Bokhorst, Steinberg, & Westenberg, 2009). However, some pressures may be harder to resist than others. When measures focus on deviant or delinquent behaviour, such as substance use, susceptibility to peer influence shows a curvilinear trajectory, with an increase during mid-adolescence (Sumter et al., 2009).

In situations involving potential risk, adolescent behaviour seems to be uniquely influenced by the presence of peers. In a landmark study, Gardner and Steinberg (2005) assessed risk-taking on a computerised driving task in adolescents (aged 13-16), young adults (18-22), and adults (24+). Participants completed the task either alone or with two peers present. Results indicated that adolescents took more risks in the task than the older participants, that those in the peer condition took more risks than those in the alone condition, and that this peer effect on risk-taking was largest in the adolescent group. A further study added a neuroimaging component to this paradigm (Chein, Albert, O'Brien, Uckert, & Steinberg, 2011). This study replicated Gardner and Steinberg's findings, and found that peer observation during the driving task led to increased activation in reward-related brain areas including the ventral striatum in adolescents but not adults.

These results can be interpreted using the theories of adolescent risk-taking presented earlier in this chapter. Adolescents appear to be highly sensitive to reward, and find the presence of peers especially rewarding. Although resistance to peer

influence increases throughout adolescence, perhaps in line with the maturation of frontal areas responsible for cognitive control, situations involving the possibility of peer judgement or social reward may compromise deliberative ability. Somerville, Hare, and Casey (2011) found that adolescents, but not children or adults, showed a reduced ability to suppress approach in a go/no-go task when presented with a picture of a smiling face. Adolescents also showed increased striatal activity when presented with this cue, relative to participants from other age groups, implying that positive social cues activate reward related neural areas, perhaps at the expense of areas involved in regulating approach behaviour.

Interplay of peer influence and individual factors

It has been shown that both impulsivity and peer influence are strongly related to adolescent substance use. However, there is currently a dearth of research examining the ways in which these factors might interact. In analysing individual and peer-related risk factors together, there are four possible outcomes. First, these factors might act in an additive, or cumulative manner, such that both individual factors and peer-related factors have significant, but separate, effects on substance use outcomes. Second, analysing these factors together could reduce the effect of one or both factors. This reduction in effect might occur if factors overlap in their aetiology. For example, impulsivity is modestly associated with susceptibility to peer influence in adolescents (Steinberg & Monahan, 2007). These variables may co-occur due to similar neural processes (e.g. Paus et al., 2008), and as such may provide limited additional predictive power when considered together. Third, individual differences might interact with peer influence to influence substance use behaviour. Evidence suggests that peer-related factors can exacerbate the influence of individual risk. For example, a behavioural genetic study by Guo, Elder, Cai, and Hamilton (2009) found a

moderating effect of peer alcohol use on the genetic predisposition to use alcohol, whereby a greater amount of alcohol-using friends led to a larger genetic contribution to individual alcohol use. In concordance, Glaser, Shelton, and van den Bree (2010) found that peer substance use moderated the association between conduct problems and problematic alcohol use in a sample of over 1000 adolescents aged 11-18. Finally, a more deterministic possibility is that individual risk factors encourage adolescents to seek out environments that promote substance use. Cleveland, Wiebe, and Rowe (2005) found that genetic factors explained a large amount of variance in the tendency to associate with friends who use alcohol and tobacco, whilst Gillespie, Neale, Jacobson, and Kendler (2009) identify a strong genetic component in the likelihood of affiliating with deviant peers, which in turn is a reliable predictor of substance use (Barnow et al., 2004; Trucco, Colder, & Wieczorek, 2011). These findings suggest that peer influence might mediate the association between individual risk factors, such as impulsivity, and substance use outcomes.

These issues form the crux of this thesis. The programme of research to be described considers the ways in which trait impulsivity and aspects of peer influence might act together to affect individual substance use outcomes. Almost twenty years ago, Wills, Vacaro, and McNamara (1994, p.18) wrote that “a conceptual problem for substance use theory has been the linking of abstract personality dimensions with evidence on social processes in adolescent substance use”. This problem is still far from being resolved. It is hoped that the work presented can contribute to its resolution.

Aims and research questions

The overall goal of this thesis is to examine discrete impulsivity-related personality traits alongside possible peer influences on substance use behaviour in order to test for interactive effects on alcohol and cannabis use in adolescent samples. To this end, four broad aims will be pursued:

1. To establish whether separable impulsivity-related personality traits show different relationships with aspects of adolescent alcohol and cannabis use
2. To examine relationships between impulsivity-related traits and social processes linked to substance use and to look into possible interactive effects on individual substance use behaviour
3. To explore contextual factors that might exacerbate the influence of ‘risky’ impulsivity-related traits
4. To investigate psychological processes that might account for relationships between impulsivity-related traits, peer influence, and substance use, and to link findings to current understanding of adolescent neurodevelopment

The programme of research will begin with an attempt to delineate the relative roles of separable impulsivity-related traits in adolescent substance use behaviour using the existing literature. It is well established that impulsivity is associated with adolescent substance use outcomes. What is not yet clear is which aspects of impulsivity show the largest relationships with substance use, and whether there are

different patterns of association for non-problematic and problematic substance use.

Chapter 2 addresses these issues with a focus on alcohol use, investigating the following research questions:

- (i) Do separate impulsivity-related personality traits show different relationships with adolescent alcohol use?
- (ii) Are there also differences between alcohol use outcomes, namely typical consumption and problematic use?
- (iii) Do demographic factors moderate these relationships?

The first empirical study of the thesis is reported in Chapter 3. This study aims to address a gap in the literature regarding links between the urgency facets of impulsivity and adolescent alcohol and cannabis use. This study also tackles the second overall aim of the thesis, as impulsivity-related traits are measured alongside perceived peer substance use, a key social influence on individual substance use. The following research questions are addressed:

- (i) Are negative and positive urgency associated with problematic alcohol and cannabis use in a pre-college adolescent sample?
- (ii) Are impulsivity-related traits associated with perceived peer use of alcohol and cannabis?
- (iii) Do negative and positive urgency moderate relationships between perceived peer use of alcohol and cannabis and individual problematic use of these substances?

Chapter 4 seeks to strengthen the preliminary findings of the thesis. The study reported in this chapter is primarily a replication attempt of the study reported in Chapter 3 using a late adolescent college student sample. This study also investigates the possibility that trait urgency is a risk factor for problematic substance use by testing prospective effects over a three month period. In addition, this chapter explores the issue of peer selection, examining whether impulsivity-related traits are associated with the selection of substance-using peers. The following questions are investigated:

- (i) Do the moderation effects found in younger adolescents replicate in a late adolescent sample?
- (ii) Do the urgency traits predict problematic alcohol and cannabis use over a three month period?
- (iii) Are impulsivity-related traits concurrently or prospectively associated with the selection of new alcohol- and cannabis-using friends during the first year at college?

Chapter 5 addresses the third overall aim of the thesis. Personality traits may influence substance use behaviour to a greater degree under trait-relevant circumstances. The study reported in this chapter uses an experimental design to test whether certain social and emotional contexts exacerbate the effect of specific impulsivity-related traits on alcohol consumption. The following questions are addressed:

- (i) Are sensation seeking and positive urgency associated with greater alcohol consumption when in an approach-motivated positive mood than when in a neutral mood?

(ii) Do higher levels of these traits combined with the presence of a friend lead to elevated alcohol consumption?

(iii) Do these traits influence similarity in alcohol consumption between friends?

Chapter 6 addresses the fourth aim of the thesis by attempting to link individual differences in trait urgency to processes of implicit, or affective, cognition. The study reported in this chapter looks at the possible role of a cognitive bias termed the ‘affect heuristic’ (Slovic, Finucane, Peters, & MacGregor, 2007) in the relationship between urgency and adolescent substance use, and attempts to align findings on urgency and implicit cognition with dual systems theories of adolescent risk-taking. A further issue addressed in this chapter is whether use of the affect heuristic might be related to peer-related risk factors. The following questions are addressed:

(i) What cognitive and affective processes might mediate the association between urgency and substance use?

(ii) Are adolescents more likely than older age groups to employ the affect heuristic when making a decision to engage in substance use?

(iii) Are affective representations about substance use related to perceived peer approval of substance use?

(iv) Are high urgency individuals more likely to use the affect heuristic?

Chapter 2

Impulsivity-related personality traits and adolescent alcohol use: A meta-analytic review

Overview

The aim of this chapter is to summarise existing evidence regarding how separate impulsivity-related traits are associated with alcohol use in adolescence. Meta-analysis was employed to assess the degree to which lack of premeditation, lack of perseverance, sensation seeking, negative urgency, positive urgency, and reward sensitivity are associated with alcohol consumption and problematic alcohol use in adolescent samples. All traits were positively associated with both alcohol outcomes. Sensation seeking and positive urgency showed the largest associations with alcohol consumption. Positive and negative urgency showed the largest associations with problematic alcohol use, although this was limited to older adolescent samples. A number of demographic and methodological variables were assessed as potential moderators of these associations. Results indicate that excessive alcohol consumption during adolescence may be driven in part by the desire to seek novel and exciting experiences. Problematic use, specifically amongst older adolescents, may be a consequence of a tendency to act rashly when in a heightened positive or negative mood.

Introduction

Adolescent alcohol use is a persistent social issue. Data from the US and UK indicate that the percentage of adolescents reporting alcohol use increases linearly with age, with a sharp rise in abuse and dependence symptoms during the ages of 16 to 18 (Johnston, O'Malley, Bachman, & Schulenberg, 2012; Fuller, 2012; Young et al., 2002). Quantity and frequency of alcohol use in adolescence is associated with levels of consumption in adulthood and heightened use is predictive of later alcohol problems (McCambridge, McAlaney, & Rowe, 2011). Such risks appear to be more likely in those who initiate alcohol use earlier in adolescence (Grant, Stinson, & Harford, 2001). Whilst for many individuals alcohol use in adolescence is a normative behaviour and part of a general increase in risk-taking during this developmental period (Spear, 2000), a number of teenagers seem prone to drink excessively and experience negative consequences. It is therefore important to establish risk factors that can reliably predict excessive and problematic drinking so that education and intervention strategies can be directed at the individuals they will most benefit.

Personality has been widely studied as a potential risk factor for alcohol-related problems. Personality traits may predispose an individual to alcohol problems through mechanisms such as a heightened vulnerability to alcohol's effects, an increased tendency to use alcohol to regulate emotions, and a propensity to engage in deviant or risky behaviour (Sher, Trull, Bartholow, & Vieth, 1995). The broad personality dimension of impulsivity appears to be the most relevant to alcohol use, and is consistently found to be elevated in alcoholics and heavy drinkers (Bjork, Hommer, Grant, & Danube, 2004; Dom, Hulstijn, & Sabbe, 2006; Rubio et al., 2008). Although the direction of association can be difficult to ascertain due to alcohol's damaging effects on brain areas associated with behavioural control (e.g. Oscar-Berman &

Marinković, 2007), impulsivity has been found to be elevated in at-risk populations such as those with externalising behavioural disorders and the children of parents with substance use disorders, even before initiation of alcohol or other substance use (Verdejo-García, Lawrence, & Clark, 2008). Impulsivity and related traits are most associated with what researchers have termed type 2 alcoholism, characterised by early onset, spontaneous alcohol seeking, and a higher frequency of antisocial and aggressive behaviour (Cloninger, 1987). The link between impulsivity and alcohol use is perhaps best seen as a reciprocal process whereby elevated levels of the trait influence the likelihood of heightened alcohol consumption, and are further exacerbated due to neurobiological changes caused by alcohol.

Impulsivity is represented in most contemporary models of human personality, yet the ways in which the trait has been conceptualised and measured differ to such a degree that combining findings can be problematic. To resolve this issue, researchers have attempted to recast the construct of impulsivity as a number of separate but related traits. Dawe, Gullo, and Loxton (2004; Dawe & Loxton, 2004) have proposed that impulsivity is best conceived as having two components, termed *reward sensitivity* (or *reward drive*) and *rash impulsiveness*. Reward sensitivity reflects the reactivity of a conceptual behavioural approach (or activation) system (BAS; Gray, 1991; Pickering & Smillie, 2008), a set of neural pathways involved in reward processing and incentive motivation, possibly best represented by dopaminergic projections from the ventral tegmental area to the nucleus accumbens (Gullo & Dawe, 2008; Pickering & Gray, 2001). Rash impulsiveness is defined as the inability to alter or inhibit responses even when behaviour may lead to negative consequences. Individual differences in this trait are thought to reflect functioning of frontal brain areas such as the orbitofrontal cortex and anterior cingulate cortex (Dawe et al., 2004).

Reward sensitivity can be measured with self-report questionnaires such as the Sensitivity to Reward scale (Torrubia, Ávila, Moltó, & Caseras, 2001) and the Drive and Reward Responsiveness subscales of the BIS/BAS scales (Carver & White, 1994). Scores on these measures are believed to indicate responsiveness to appetitive cues and the capacity to employ approach behaviour in situations of potential reward. Whilst high reward sensitivity may not necessarily entail frequent impulsive behaviour, individuals high in reward sensitivity would be expected to be more susceptible to the positive reinforcing aspects of stimuli such as alcohol (Gullo & Dawe, 2008), and may in turn act impulsively in response to conditioned cues related to such stimuli.

The measurement of rash impulsiveness is less straightforward. The construct has been gauged with a diverse set of scales including Eysenck's I_7 (Eysenck, Pearson, Easting, & Allsopp, 1985), Barratt's impulsivity scale (Patton, Stanford, & Barratt, 1995), Zuckerman's (1994) sensation seeking scale, Cloninger's (1989) measure of novelty seeking, and Dickman's (1990) measure of dysfunctional impulsivity (Gullo, Ward, Dawe, Powell, & Jackson, 2011). Consequently, although some studies have supported the two dimensional conceptualisation (Franken & Muris, 2006a; Quilty & Oakman, 2004), converging psychometric evidence suggests that two dimensions are insufficient to cover the wide variation in impulsive behaviour. Whiteside and Lynam (2001) used factor analysis on a number of frequently used self-report measures of impulsivity, deriving four dimensions termed *urgency*, *lack of premeditation*, *lack of perseverance*, and *sensation seeking*. Urgency, reflecting a disposition to engage in mood-based rash action, has since been separated into two facets (Cyders & Smith, 2007, 2008). The tendency to act impulsively when distressed is termed negative urgency, whereas the tendency to act impulsively when in an exceptionally good mood is termed positive urgency. The UPPS model helps to clarify the variation observed in behaviour characteristic of rash impulsiveness. However, the reward sensitivity aspect

of the two-factor model of impulsivity is not represented in the four UPPS dimensions, likely because measures of this construct were not included in Whiteside and Lynam's (2001) original factor analysis. This review will include reward sensitivity alongside the UPPS traits in order to provide a detailed as possible investigation into the relationship between impulsivity-related personality traits and adolescent alcohol use.

It seems particularly important to understand the effects of impulsivity on alcohol use in adolescence. This is a developmental period that is in many ways characterised by impulsive decision making and behaviour. Adolescents tend to frequently seek new experiences, act without forethought, take risks, and disregard potential negative consequences of their actions (Ernst, Romeo, & Andersen, 2009). Although expression of impulsivity-related traits declines into later adolescence, neural maturation continues into the early 20s (Steinberg, 2007). Thus, individuals viewed as adults according to certain sociocultural norms, and in turn provided with a greater degree of independence, might still be considered adolescent in terms of their neurodevelopment. This presents an interesting issue for the current review. Many studies investigating alcohol use among older adolescents draw participants from college student populations. College is an environmental context where adolescents experience a significantly lower degree of monitoring from their parents and an increase in freedom over their own behaviour. It is possible that any personality-related disposition towards alcohol use may become more prominent in this context. This issue will be addressed here by comparing data from college and non-college samples.

In studying the relationships between impulsivity-related traits and alcohol use, it is helpful to make a distinction between typical consumption and problematic use, a term that will be used here to encapsulate negative consequences from alcohol use and symptoms of abuse and dependence. Alcohol use does not necessarily lead to problems. It can often help to stimulate desirable positive experiences such as making

new friends and having fun (Lee, Maggs, Neighbors, & Patrick, 2011; Park, 2004).

Over a third of adolescent alcohol users report little or no negative consequences from use (Johnston et al., 1998; SAMHSA, 1998). Conversely, some may be prone to experience negative consequences despite not being heavy alcohol users (Lee, Rose, Engel-Rebitzer, Selya, & Dierker, 2011). Whilst continuously elevated use is likely to lead to problems, the association between typical consumption and problematic use has often been shown to be somewhat modest (Sadava, 1990). For instance, a study of over 10,000 participants found that responses to questionnaire items assessing alcohol consumption showed little correlation with responses to items assessing alcohol-related problems (Gmel, Heeb, & Rem, 2001).

Typical alcohol consumption and problematic use appear to show different patterns of association with impulsivity-related traits in older samples, with sensation seeking most related to alcohol consumption and urgency traits most related to alcohol-related problems (Curcio & George, 2011; Smith, Fischer, Cyders, Annus, Spillane, & McCarthy, 2007). Similar findings have been found with regard to wider substance use and risk-taking behaviour, with sensation seeking found to relate most strongly to frequency of engagement in such behaviour, and urgency found to relate more strongly to problematic involvement (Fischer & Smith, 2008; Smith et al., 2007; Verdejo-García, Bechara, Recknor, & Pérez-García, 2007). Additionally, urgency, but not sensation seeking, correlates with levels of problematic behaviours such as compulsive buying and excessive internet use, and distinguishes pathological gamblers from non-pathological gamblers (Billieux, Gay, Rochat, & Van der Linden, 2010; MacLaren, Fugelsang, Harrigan, & Dixon, 2011). Curcio and George (2011) have shown that these differences may lie in the separable mediating pathways associated with each trait. Sensation seeking may be uniquely associated to alcohol consumption through its influence on a tendency to drink for enhancement, i.e. drinking for fun or

for a pleasant feeling, whereas negative urgency might relate to problematic use through a tendency to use alcohol as a coping strategy. For findings of the present enquiry to be utilised in the consideration of prevention and intervention programmes, it will be helpful to establish whether adolescent data follow a similar pattern to that of older samples.

The present study

The body of research described here implies that impulsivity is best considered as a number of discrete traits, and that individual differences in these traits may provide some indication of dispositional risk towards problematic alcohol use. This may be especially so in adolescence when these traits are elevated, perhaps as a consequence of maturational brain development patterns. The traits outlined appear to show different patterns of association with typical and problematic alcohol use in older samples. It therefore seems necessary to cast new light on research that has examined associations between impulsivity and adolescent alcohol use with reference to current theory and evidence. The aim of this quantitative review is to assess relationships between impulsivity-related personality traits and adolescent alcohol use in order to establish the relative importance of each trait. Traits will be categorised in accordance with the UPPS framework, with an additional category for reward sensitivity. Two main alcohol-related outcomes will be examined: typical consumption and problematic use. Also considered were two lesser-studied alcohol use variables that are particularly relevant to adolescents: binge drinking and alcohol use initiation. Establishing whether certain traits show different patterns of association with these outcomes may provide insight into why certain adolescents are more prone to experience negative alcohol-related consequences and to more rapidly develop alcohol use disorders. In addition to

the primary analyses, potential moderator effects of age, sex, ethnicity, sample type, and problematic alcohol use measure employed will be tested.

Method

Literature search

An exhaustive search of published studies was carried out using the following online databases: PubMed, PsychINFO, Elsevier Science Direct, Wiley Online Library, Thomson Reuters Web of Knowledge, EBSCO Academic Search Complete, and Google Scholar. Three categories of search terms were used in combination. The first category contained keywords related to personality traits: *impulsivity, impulsive, disinhibition, premeditation, sensation seeking, novelty seeking, behavioural approach, behavioural activation, BAS, reward sensitivity, reward drive, urgency, positive urgency, perseverance, boredom proneness, and boredom susceptibility*. The second category related to alcohol use: *alcohol, drinking, binge, onset, initiation, and substance*. The third category related to age of sample: *adolescent, adolescence, teenage, and young adult*. Studies published up until December 2012 were included. Following the online search, an ancestry search was employed by inspecting reference sections of relevant articles and of related review articles to identify additional studies that could be considered for inclusion. The publication lists of leading researchers in the field were examined, and ten authors who had published extensively on the subject of adolescent alcohol use and personality were contacted by email with a request for unpublished data. No unpublished data were obtained. Figure 2.1 outlines the search and selection process in more detail.

Inclusion criteria

Articles retained for analysis met the following criteria: (1) the mean age of the sample was between 10.0 and 19.9, a range established using the World Health Organisation's definition of adolescence (WHO, 2011); (2) personality traits were assessed using self-report measures; (3) alcohol use outcomes were assessed using a measure of consumption or of problematic use, thus excluding studies which measured variables such as expectancies about alcohol use or motivations for use; (4) articles were empirical research studies.

There is disagreement over how best to define the period of adolescence (Roenneberg et al., 2004). Many researchers agree that adolescence begins at pubertal onset, which varies considerably across individuals and populations but tends to take place between the ages of 10 and 13, whereas the end of adolescence tends to be set more by sociocultural norms than by any biological event. Most studies reviewed here did not include a measure of pubertal onset, therefore a cut-off age had to be selected. The definition of adolescence provided by the WHO was employed in order to give a broad as possible review of the literature.

Exclusion

Studies that used a measure of impulsivity that amalgamated the facets of interest were excluded from analysis, as were studies that used a composite substance use measure combining alcohol and other drug use. For prospective studies where the mean age at time 2 was older than the criteria range, only cross-sectional time 1 data was used. Studies that included non-independent data were excluded. To assess independence, study method sections were checked for statements that a sample had been previously reported. Demographic data for all samples was then inspected to ascertain any overlap. For four studies, the sample information was identical to that

reported in another included study. Where sample duplication occurred, the study that included the largest amount of useable data was retained.

Ten studies did not include sufficient data to calculate effect sizes. For studies published within the last ten years, authors were contacted with a request for additional data. These requests pertained to further information relating to impulsivity subscale scores, or to correlations not previously reported. Of five authors contacted, two provided requested data.

Study coding

Sample size, personality and alcohol use measures employed, and effect sizes were coded for each study. The following study characteristics were also recorded for analysis as potential moderator variables: mean age of sample, percentage of sample that was male, type of sample (from normative populations such as school, college, or community; or from non-normative populations such as clinical or incarcerated), whether the sample was from a college student population (yes or no), and type of problematic alcohol use outcome measured (negative consequences or abuse/dependence). Ethnicity was also considered as a potential moderator. Of samples that reported ethnicity (70%), a majority (83%) used samples in which 60% or more of participants were white. Therefore, the percentage of sample that was white was coded. In studies where the age range but not the mean was reported, the median value of the range was coded. One study (McAdams & Donnellan, 2009) reported a sample of first year college students. For this a mean age of 18 was imputed.

Table 2.1 displays how impulsivity measures were categorised into trait domains. Assignment to UPPS trait domains followed previous organisation of existing impulsivity scales (Dick et al., 2010; Fischer, Smith, & Cyders, 2008; Whiteside & Lynam, 2001). If studies employed measures that had not previously been categorised

under a UPPS trait, these measures were analysed for content and categorised accordingly. This method of categorisation has been previously used for meta-analysis by Fischer et al. (2008; although this study did not include reward sensitivity). The sensation seeking category included measures of novelty seeking and BAS Fun seeking, as these have previously been shown to correlate highly and appear to represent a single construct (Franken & Muris, 2006a; McCourt, Gurrera, & Cutter, 1983; Zuckerman & Cloninger, 1996). The Drive and Reward Responsiveness subscales of the BAS measure (Carver & White, 1994) were originally planned to be considered together as a measure of reward sensitivity. However, effect sizes relating to the two scales were dissimilar. Only a modest correlation was observed in five studies that reported effect sizes for both subscales ($r = .23$), and four of the effect sizes relating to Reward Responsiveness were between .01 and .03. It was therefore inappropriate to combine data from these subscales, so only the Drive subscale data were used.

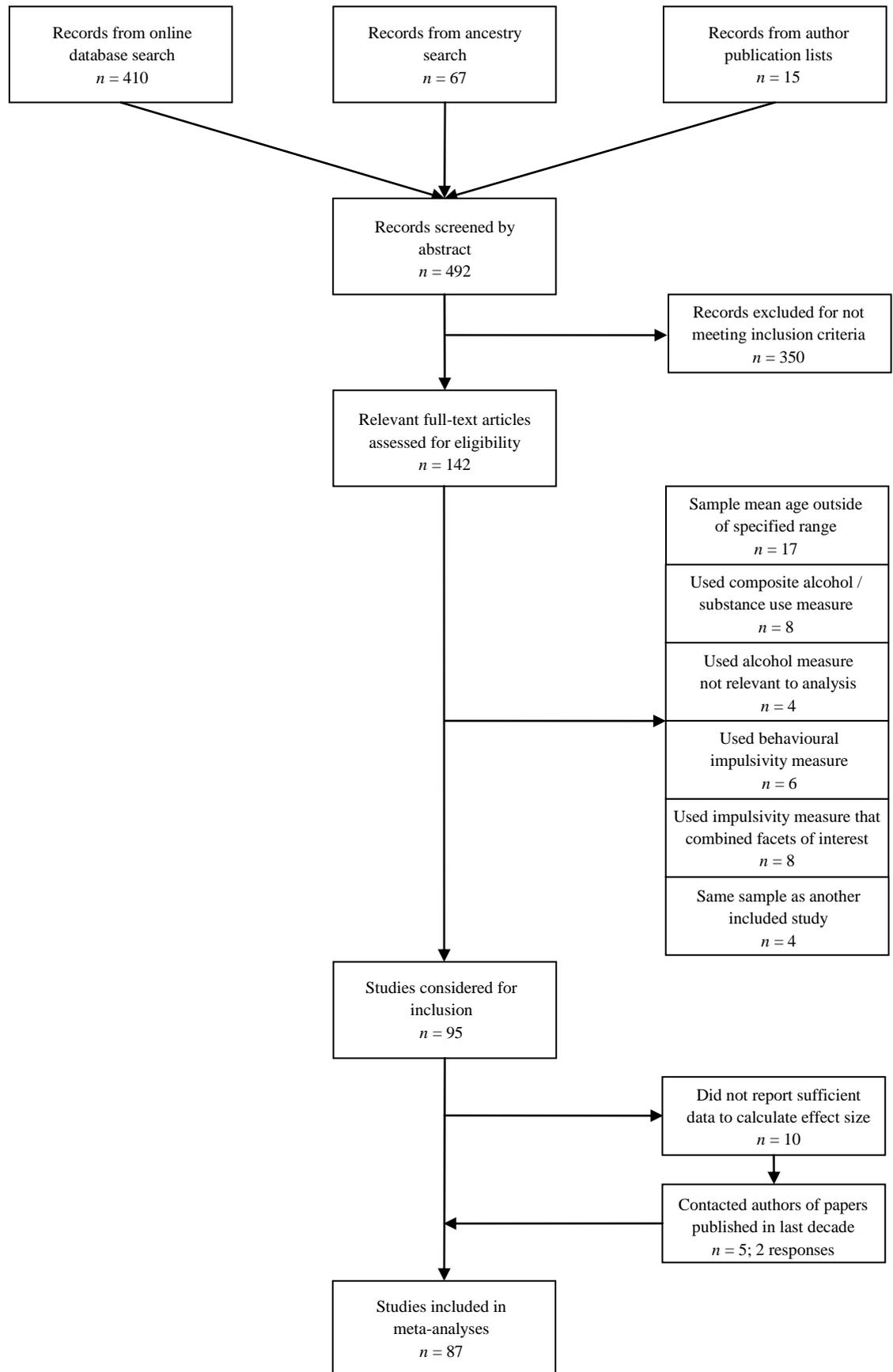


Figure 2.1. Flowchart for study selection.

Table 2.1

Impulsivity-related trait categories and measures

<i>Trait</i>	<i>Measure</i>
Lack of Premeditation	Barratt Impulsivity Scale – Nonplanning and Motor Impulsivity (Patton, Stanford, & Barratt, 1995) ^b Barratt Impulsivity Scale – Total score (Patton et al., 1995) ^a I-6 Impulsiveness (Eysenck, Easting, & Pearson, 1984) I-7 Impulsiveness (Eysenck, Pearson, Easting, & Allsopp, 1985) ^a Impulsivity Control Scale (Plutchik & van Praag, 1989) ^a Karolinska Scales of Personality - Impulsiveness (Schalling, 1978) ^a K-SADS-PL - Impulsivity questions (Kaufman et al., 1997) Personality Research Form – Impulsivity (Jackson, 1974) ^a Substance Use Risk Profile Scale – Impulsivity (Woicik, Conrod, Stewart, & Pihl, 2009) UPPS – Lack of Premeditation (Whiteside & Lynam, 2001) ^a Zuckerman–Kuhlman Personality Questionnaire – Impulsivity (Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993)
Lack of Perseverance	Sensation Seeking Scale – Boredom susceptibility, Disinhibition (Zuckerman, 1994) UPPS – Lack of perseverance (Whiteside & Lynam, 2001)
Sensation seeking	^a BIS/BAS Scales – Fun Seeking (Carver & White, 1994) ^a Brief Sensation Seeking Scale (Hoyle, Stephenson, Palmgreen, Pugzles Lorch, & Donohew, 2002) I-7 Venturesomeness (Eysenck et al., 1984) ^a JTCI – Novelty Seeking (Luby, Svrakic, McCallum, Przybeck, & Cloninger, 1999) ^a Karolinska Scales of Personality – Monotony Avoidance (Schalling, 1978) TCI – Novelty Seeking (Cloninger, Przybeck, Svrakic, & Wetzel, 1994) TPQ – Novelty Seeking (Cloninger, 1989) Sensation Seeking Scale – Thrill and adventure seeking (Zuckerman, 1994) ^b Sensation Seeking Scale – Total score (Zuckerman, 1994) ^a Sensation Seeking Scale for Children (Russo et al., 1993) ^a Substance Use Risk Profile Scale – Sensation seeking (Woicik et al., 2009) UPPS – Sensation Seeking (Whiteside & Lynam, 2001) ^a Zuckerman–Kuhlman Personality Questionnaire – Sensation seeking (Zuckerman et al., 1993)
Negative urgency	Barratt Impulsivity Scale – Attentional Impulsivity (Patton et al., 1995) NEO-PI-R Impulsiveness (Costa & McCrae, 1992) UPPS – Urgency (Whiteside & Lynam, 2001)
Positive urgency	Positive Urgency Measure (Cyders et al., 2007)
Reward sensitivity	BIS/BAS Scales – Drive (Carver & White, 1994) SPSRQ – Sensitivity to Reward (Torrubia et al., 2001)

^a = Scales categorised by author; ^b = used only if subscale scores unavailable

Alcohol variables were divided into two categories: alcohol consumption and problematic alcohol use. Table 2.2 displays how alcohol measures were categorised. Measures that appear in both domains contained separate subscales assessing consumption and problematic use. Alcohol consumption included measures assessing general drinking habits such as frequency of drinking alcohol and quantity usually consumed. Eight studies reported separate effect sizes for measures of quantity and frequency. These effect sizes showed a substantial positive correlation ($r = .91, p < .001$). It was therefore feasible to code an average of these values. Problematic alcohol use included measures of negative consequences experienced from alcohol use and symptoms of abuse and dependence. Whilst it is acknowledged that these are separable aspects of problematic alcohol use, measures such as the Alcohol Use Disorders Identification Test (AUDIT; Babor, Higgins-Biddle, Saunders, & Monteiro, 2001) contain items pertaining to each aspect and reported scores rarely differentiate between them. A number of studies reviewed used measures which combined negative consequences and dependence symptoms (e.g. Colder & Chassin, 1997; Littlefield, Sher, & Wood, 2009). Additionally, items assessing harmful alcohol use and dependence symptoms have been shown to correlate highly and to load on a single latent factor (Gmel et al., 1994; Hasin, Muthuen, Wisnicki, & Grant, 1994). A further aspect of problematic alcohol use, that of binge drinking or heavy episodic use, was considered in a separate set of analyses. This category included studies that assessed frequency of heavy episodic drinking, generally defined as five alcoholic drinks per session for males and four for females (Ferriter & Ray, 2011), those which assessed rates of heavy intoxication, and those which asked participants about their maximum amount of alcohol consumed during one occasion.

A small number of studies were obtained which assessed the traits of interest alongside a dichotomous (yes/no) measure of alcohol use initiation, generally in

samples of younger adolescents. This is an important variable to examine in younger samples, as early initiation is predictive of later alcohol use problems (Grant & Dawson, 1997). Meta-analysis was used where possible to summarise effect sizes from these studies. Original statistics are reported where only one relevant effect size was available.

All studies were coded by the author. Ten randomly selected studies were also coded by the primary supervisor to assess reliability. There was 98% agreement between coders.

Table 2.2

Alcohol use categories and measures

<i>Category</i>	<i>Measure</i>
Alcohol consumption	Daily Drinking Questionnaire (Collins, Parks, & Marlatt, 1985) Drinking Styles Questionnaire (Smith, McCarthy, & Goldman, 1995) Drug Use Screening Inventory (Tarter, 1991) Ontario Student Drug Use and Health Survey (Adlaf & Paglia-Boak, 2007) Teen Addiction Severity Index (Kaminer, Bukstein, & Tarter, 1991) Additional ad hoc quantity and frequency measures
Problematic alcohol use	Adolescent Alcohol Involvement Scale (Mayer & Filstead, 1979) Alcohol Use Disorders Identification Test (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001) College Alcohol Problems Scale—Revised (Maddock, Laforge, Rossi, & O’Hare, 2001) Diagnostic Interview (Robins, Cottler, & Babor, 1993) Drinking Styles Questionnaire (Smith, McCarthy, & Goldman, 1995) K-SADS-PL – Substance Abuse Questions (Kaufman et al., 1997) Ontario Student Drug Use and Health Survey (Adlaf & Paglia-Boak, 2007) Rutgers Alcohol Problems Index (White & Labouvie, 1989) Short Michigan Alcohol Screening Test (Selzer, Vinokur, & van Rooijen, 1975) Substance Abuse Subtle Screening Inventory - Adolescent Version 2 (Miller & Lazowski, 2001) Young Adult Alcohol Problems Screening Test (Hurlburt & Sher, 1992) Additional ad hoc binge drinking frequency measures

Meta-analytic procedure

Pearson's r was used as the effect size for relationships between personality and alcohol variables. Where r was not reported, it was calculated from d , F , odds ratio, or descriptive statistics using traditional formulae (DeCoster, 2004; Lipsey & Wilson, 2001). Standardised β values were converted to r using the equation proposed by Peterson and Brown (2005), i.e. $r = .98\beta + .05\lambda$ where λ is an indicator variable that equals 1 when β is non-negative and 0 when β is negative. Nineteen effect sizes from ten studies were converted using this method. All r values were converted to Zr s using Fisher's (1928) r -to- Zr transformation. The resulting effect sizes were weighted by the inverse variance to account for differences in sample size across studies. Meta-analyses were conducted using procedures outlined by Lipsey and Wilson (2001). Whilst a number of studies contributed multiple effect sizes, all effect sizes within any one meta-analysis were from independent samples. Mean effect sizes and confidence interval values were converted back to r values using the inverse Zr transformation.

A random effects model was employed for all analyses. The random effects model produces more conservative results with wider confidence intervals than a fixed effects model as it assumes that variability between effect sizes is due to variation at both the individual level and the study level. Results can therefore be generalised to wider populations. This was appropriate for the current analyses due to an expected difference in population effect sizes across ages and the disparity in measures used across studies.

Outliers and heterogeneity

Effect sizes within each analysis group were checked for univariate outliers by converting to Z scores and assessing whether any values were greater than $Z = 3.29$. To assess the heterogeneity of mean effect sizes, Q and I^2 statistics were calculated for

each analysis. The Q statistic represents a test of the null hypothesis that all studies within an analysis share a common effect size, with a significant value indicating the presence of heterogeneity (Borenstein, Hedges, Higgins, & Rothstein, 2009). I^2 is a measure of true heterogeneity, rather than random sampling error, in the observed variation across studies. Its value ranges from 0-100% with increasing values indicating higher true heterogeneity (Higgins, Thompson, Deeks, & Altman, 2003).

Publication bias

To examine potential publication bias, Orwin's (1983) fail-safe N (FSN) statistic was calculated. The FSN indicates the number of unpublished studies with an average effect size of 0 that would be necessary to reduce the observed effect size to a negligible magnitude. Here, $r = .10$ was used as the criterion effect size judged to be negligible.

Moderator analysis

Potential moderating effects of three categorical variables were tested: problematic alcohol use measure (negative consequences or abuse/dependence symptoms); whether participants were sampled from typical populations such as school, college, or community or from atypical populations such as clinical or incarcerated (normative or non-normative); and whether data were collected from a college undergraduate sample (yes or no). Categorical moderation analysis was conducted by dividing effect sizes into subgroups and testing the difference between their mean weighted effect sizes with a modified analysis of variance (ANOVA) procedure using a random effects model with method of moments estimation. Moderation is indicated by a significant value of the $Q(b)$ statistic, which is equivalent to the F statistic in ANOVA.

Potential moderating effects of three continuous variables were tested: the mean age of sample, percentage of male participants in the sample, and percentage of sample that was of white ethnicity. Continuous moderation analysis was conducted using weighted meta-regression, whereby potential moderators are entered as predictor variables and effect size weighted by the inverse variance is the criterion variable. A random effects model was used with method of moments estimation. Moderation is evidenced by the amount of between-study variance explained by the regression model, as indicated by a modified R^2 statistic (Borenstein et al., 2009). Bivariate associations were tested rather than a multivariate model due to the macro used carrying out listwise deletion for missing values. Individual predictor variables were tested for significance using a Z-test of their beta coefficient.

Statistical software

Meta-analyses, modified ANOVA, and weighted meta-regression analyses were conducted with IBM SPSS 19 using macros provided by Wilson (2010).

Results

Due to the large number of analyses conducted, a conservative alpha level of $p = .01$ was used for significance testing to reduce the likelihood of Type I errors. Any p values less than .05 are noted in tabulated data. A total of 240 effect sizes from 93 samples reported in 87 published articles were included (Table 2.3). The majority of these effect sizes pertained to sensation seeking (39%) and lack of premeditation (32%). No univariate outliers were found.

Cross-sectional data

Twelve meta-analyses were conducted (Table 2.4). All traits showed a significant positive relationship with both alcohol consumption and problematic use. Sensation seeking and positive urgency showed the largest associations with alcohol consumption with weighted mean effect sizes of $r = .28$ and $r = .27$, respectively. Positive and negative urgency showed the largest associations with problematic alcohol use with weighted mean effect sizes of $r = .32$ and $r = .31$, respectively. Non-independence of data precluded differences in weighted mean effect sizes across traits being tested for significance. Fail-safe N analysis indicated that for the majority of analyses a similar or larger amount of studies finding a null effect would be required to reduce the mean effect size to $r = .10$. For analyses relating to lack of premeditation and sensation seeking this suggests that the present results are unlikely to be dramatically altered by unpublished findings. For the remaining traits, however, there is a possibility that the mean effect sizes found could be reduced substantially with a reasonably small amount of unpublished data showing null results.

Comparing problematic alcohol use outcomes

Categorical moderator analysis was used to establish whether there were differences between mean effect sizes relating to measures of negative consequences from alcohol use and those relating to measures of abuse/dependence symptoms. This analysis could only be conducted for lack of premeditation and sensation seeking, as there were insufficient effect sizes for other traits. The following results are presented with 95% confidence intervals in parenthesis. For lack of premeditation, mean effect sizes did not significantly differ, $Q(b) = .25$, $p = .61$. Nineteen effect sizes pertaining to negative consequences showed a mean r of $.23$ (.19-.27), and six effect sizes pertaining to abuse/dependence showed a mean r of $.25$ (.18-.32). For sensation seeking, mean

effect sizes did not significantly differ, $Q(b) = .02, p = .90$. Fifteen effect sizes pertaining to negative consequences showed a mean r of .24 (.17-.31), and seven effect sizes pertaining to abuse/dependence showed a mean r of .24 (.12-.34). For lack of perseverance, only one effect size for abuse/dependence was found, $r = .07$. With this removed, the mean r pertaining to negative consequences was .18 (.12-.24). For negative urgency, only one effect size for abuse/dependence was found, $r = .31$. With this removed, the mean r pertaining to negative consequences was .31 (.26-.36). Regarding positive urgency and reward sensitivity, no effect sizes for abuse/dependence were found.

A total of 25 effect sizes were found regarding measures of binge drinking or heavy use. Three of these were from prospective studies, but were from independent samples so could be analysed together with cross-sectional studies. Results are presented in Table 2.5. Sensation seeking showed the largest association with binge drinking, with a weighted mean r of .26. Zero effect sizes were found for reward sensitivity.

Alcohol use initiation

Seven studies meeting inclusion criteria assessed sensation seeking and alcohol use initiation, giving a weighted r of .20 (CI = .13-.28, $Z = 5.42, SE = .04, p < .001$). Three studies assessed lack of premeditation and initiation, giving a weighted r of .15 (CI = .12-.17, $Z = 11.89, SE = .01, p < .001$). There were insufficient effect sizes available to warrant meta-analysis for the remaining traits. A study by Gunn and Smith (2010) examined the UPPS traits and alcohol initiation in a sample of 1843 schoolchildren. This study provided the only effect sizes for lack of perseverance ($r = .10$), negative urgency ($r = .20$), and positive urgency ($r = .18$) in relation to alcohol

use initiation. Only one study was found that examined reward sensitivity and initiation (Willem, Bijttebier, & Claes, 2010). This study reported an r of .17.

Prospective data

It was originally intended to analyse study design (cross-sectional or prospective) as a categorical moderator. However, a number of studies reported both cross-sectional and prospective data from the same samples. To maintain independence of observations, prospective data were analysed separately. A total of 45 effect sizes were recorded from prospective studies. Only one study was found that prospectively examined the urgency traits (Cyders et al., 2009). Meta-analyses were carried out for the remaining effect sizes (Table 2.6). Results indicated that lack of premeditation and sensation seeking had slightly smaller associations with alcohol consumption in prospective studies compared to cross-sectional studies, whilst these traits plus lack of perseverance showed slightly elevated associations with problematic alcohol use in prospective studies.

Table 2.3

Studies contributing effect sizes to meta-analyses

<i>Author(s)</i>	<i>Year</i>	<i>N</i>	<i>Age</i>	<i>% Male</i>	<i>%White</i>	<i>Sample</i>	<i>Design</i>	<i>Trait</i>	<i>Alcohol measure</i>	<i>r</i>
Adams et al.	2012	432	19	46.9	84	College	CS	Prem	P	.27
								Prem	B	.23
								Pers	P	.14
								Pers	B	.07
								SS	P	.16
								SS	B	.30
								NU	P	.31
								NU	B	.11
								PU	P	.31
								PU	B	.17
Alterman	1990	98	19	100	92	College	CS	SS	C	.28
								SS	P	.36
								Pers	C	.47
Andrew & Cronin	1997	274	14.9	93.7	School	CS	Pers	P	.39	
							Pers	C	.25	
							Pers	B	.22	
							SS	C	.26	
Ayer et al.	2011	507	14.9	46	Community	PR	Pers	C	.08	
							SS	C	.16	
Balodis et al.	2010	205	19.9	48.8	College	PR	Prem	C	.15	
							NU	C	.10	
Barnes et al.	1999 (first sample)	514	16.5	43	67	Community	PR	Prem	C	.16
		581 (second sample)	19.3	100	86.5	Community	CS	Prem	C	.29
Bates & Labouvie	1995	870	12-15	49.9	89	Community	PR	Prem	C	.20
								Pers	C	.36
								SS	C	.36
Becker & Grilo	2006	462	15.8	42	79	Clinical	CS	Prem	P	.25
Benjamin & Wulfert	2005	335	19.6	0	65	College	CS	Prem	C	.26
Castellanos-Ryan et al.	2011	76	14	72	34	School	PR	Prem	B	.27
								SS	B	.29
Clapper et al.	1994	575	17.8	50	66.2	College	CS	Pers	C	.49
								SS	C	.31
Colder & Chassin	1997	427	14.7	54	70	Community	CS	Prem	C	.29
								Prem	P	.27
Cooper et al.	2003	1978	16.7	49.6	49	School	CS	SS	C	.17
								NU	C	.22
Cyders et al.	2007(first sample)	326	19.1	52	90	College	CS	PU	C	.24

	(second sample)	216	18.2	21	90	College	CS	PU	P	.27
								PU	C	.32
Cyders et al.	2009	293	18.8	25	88	College	CS	PU	P	.43
								Prem	C	.28
								Prem	P	.34
								Pers	C	.11
								Pers	P	.17
								SS	C	.33
								SS	P	.32
								NU	C	.27
								NU	P	.33
								PU	C	.27
								PU	P	.35
							PR	Prem	C	.22
								Prem	P	.23
								Pers	C	.08
								Pers	P	.13
								SS	C	.27
								SS	P	.22
								NU	C	.21
								NU	P	.21
								PU	C	.23
								PU	P	.26
Esposito-Smythers et al.	2009	104	14.9	29	84.6	Clinical	CS	Prem	P	.21
Fernie et al.	2010	68	19.3	26.5		College	CS	Prem	C	.31
								Prem	P	.35
								Prem	B	.31
								NU	C	.18
								NU	P	.27
								NU	B	.17
Fischer & Smith	2008	246	19 (mode)	50	95.1	College	CS	Prem	C	.31
								Prem	P	.23
								Pers	C	.18
								Pers	P	.22
								SS	C	.28
								SS	P	.11
								NU	C	.34
								NU	P	.38
Fischer et al.	2007	66	19.5	0	91.1	College	CS	NU	P	.31
Gabel et al.	1997	42	15.8	100	69	Clinical	CS	SS	P	.32
Gabel et al.	1999	200	16.2	100	62	School and clinical	CS	SS	P	.17
Galen et al.	1997	140	18.5	47.1	24.3	Clinical	CS	SS	C	.35
								SS	P	.43
George et al.	2010	170	13.8	79.44	85.3	School	PR	SS	P	.36
Goldstein & Flett	2009	138	18.9	29.6		College	CS	SS	C	.16

Greene et al.	2000	724	17.8	42	82	School and college	CS	SS SS Pers	P B C	.20 .33 .35
Gullo et al.	2011	213	19.0	25.4		College	CS	SS Prem	C P	.34 .39
Gunn & Smith	2010	1843	10.87	50.1	61.6	School	CS	SS RS Prem	P P I	.29 .14 .15
Gunnarsson et al.	2008	3419	18	48		School	CS	Pers SS NU PU Prem	I I I I B	.10 .08 .20 .18 .23
Hampson et al.	2001	323	16.1	49.4		School	CS	SS	C	.39
Hasking	2006	199	14.2	53.0	91	School	CS	SS	P	.08
Henges & Marczynski	2012	109	19.6	41.3	84	College	CS	RS Prem	P C	.02 .22
Hosier & Cox	2011	111	19.9	59.5		College	CS	SS	B P	.31 .28
Jaffee & D'Zurilla	2009	307	16.7	55	73	School	CS	Prem	C	.26
James & Taylor	2007	617	19.2	48.8	73.9	College	CS	SS	C	.36
Kahler et al.	2003	868	18.7	39.9	86.6	College	CS	Prem	P	.07
Kaiser et al.	2012	525	19	48.8	81.1	College	CS	Prem NU	C C	.33 .18
Karyadi & King	2011	442	19 (median)	36.7		College	CS	NU	P	.35 .30
Katz et al.	2000	162	18.5	42	95	College	CS	PU SS	P C	.30 .41
Koposov et al.	2005	229	16.4	100	98	Incarcerated	CS	SS	P	.32
Krank et al.	2011	953	15	43.6		School	PR	Prem	I	.16
Laucht et al.	2007	303	15	47.5	99	Community	CS	SS SS	I C	.07 .36
Littlefield et al.	2009	489	18.2	46		College (51% with positive family history of alcoholism)	CS	SS Prem	I P	.34 .28
Loxton & Dawe	2001	232	16-18	0	74.9	School	PR CS	Prem SS	P P	.33 .46
Lynskey et al.	1998	913	16			Community	CS	RS SS	P C	.32 .31
MacPherson et al.	2010	257	11	55.6	48.8	Community	CS	SS	C	.24
Magid & Colder	2007	267	19	48	57	College	PR CS	SS Prem	C C	.16 .35
								Prem	P	-.02

									Pers	C	-.07
									Pers	P	.21
									SS	C	.17
									SS	P	.13
									NU	C	.11
									NU	P	.28
Magid et al.	2007	310	19.4	36	90	College	CS		Prem	C	.20
									Prem	P	.29
									SS	C	.27
									SS	P	.21
Malmberg et al.	2010	3783	13.01	49.1		School	CS		Prem	I	.14
									SS	I	.20
Martens et al.	2010	324	18.9	60.8	79.9	College	CS		NU	C	.12
									NU	P	.36
Martin et al.	2002	208	12.8	61.1	71.4	Clinical	CS		SS	C	.36
									SS	I	.38
Mason et al.	2011(first sample)	961	13.09	49	64.9	School	CS		Prem	C	.21
									Prem	B	.14
									SS	C	.38
									SS	B	.29
							PR		Prem	C	.15
									Prem	P	.23
									SS	C	.29
									SS	P	.19
	(second sample)	984	12.93	49	90.6	School	CS		Prem	C	.27
									Prem	B	.31
									SS	C	.44
									SS	B	.41
							PR		Prem	C	.22
									Prem	P	.19
									SS	C	.31
									SS	P	.24
McAdams & Donnellan	2009	385	First year college	33.7	72.8	College	PR		Prem	C	.29
									Prem	P	.22
									SS	C	.42
									SS	P	.30
Mustanski et al.	2003	2640	17			Community	PR		Pers	C	.27
									Pers	P	.26
O'Connor & Colder	2005	533	18.0	36	70.4	College	CS		RS	C	.14
									RS	P	.26
O'Connor et al.	2009	485	18.9	67.7	58	College	CS		RS	C	.12
Ohannessian & Hesselbrock	2007	249	16.7	48	62	Community	PR		Pers	B	.28
Phillips et al.	2009	391	15.7	53.3		School	CS		NU	B	.15
Pokhrel et al.	2010(first sample)	362	15.7	45	100	School	CS		SS	C	.20
	(second sample)	965	15.1	51	31	School	CS		SS	C	.20

Puente et al.	2008	450	14-18	47	100	School	CS	SS	C	.21
Quinn & Fromme	2011	1784	18.4	39	55	School	CS	Prem	C	.13
								Prem	P	.13
								SS	C	.25
								SS	P	.25
							PR	Prem	C	.14
								Prem	P	.17
								SS	C	.27
								SS	P	.29
Quinn et al.	2011	2247	17-19	36	54	School	CS	Prem	B	.05
								SS	B	.14
Robbins & Bryan	2004	300	15.3	73	23	Adjudicated	CS	Prem	C	.16
								Prem	P	.25
Romer et al.	2009	387	11.4	49	63	School	CS	Prem	C	.27
								SS	C	.21
Rossow	2008	17413	14.9	49.3	100	School	CS	Prem	P	.21
Ruchkin et al.	2002	195	16.4	100	98	Incarcerated	CS	SS	P	.24
Sargent et al.	2010	5019	11-16	51.3	62	Community	CS	SS	C	.21
									B	.25
Settles et al.	2012	1813	Fifth grade students	50.1		School	CS	Prem	P	.16
								Pers	P	.09
								NU	P	.19
Sher et al.	1995	583	18.5	47.4		College	CS	SS	C	.32
								SS	P	.33
Shillington & Clapp	2002	676	17.1	47.6	35.1	Community	CS	Prem	P	.18
Simons	2003	222	19.6	27	94	College	PR	Prem	C	.27
								Prem	P	.37
Simons & Carey	2006	543	19.9	33	94	College	CS	Prem	C	.26
								Prem	P	.38
Siviroj et al.	2012	643	15.1	47.6	0	School	CS	Pers	C	.20
								SS	C	.10
Skeel et al.	2008	100	19.2	27.2		College	PR	SS	C	.25
								SS	P	.41
Soloff et al.	2000	36	19.4	66.7	83.3	Community	CS	Prem	P	.60
								SS	P	.28
Stewart et al.	2011	97	16.8	43		Clinical	CS	Prem	C	.25
								Prem	P	.43
								SS	C	.31
								SS	P	.25
Urban et al.	2008	707	16.7	39.2		School	CS	SS	C	.48
van Beurden et al.	2005	2705	15.5	43.9		School	CS	SS	B	.23
von Knorring et al.	1987	996	18	100		Community	CS	Prem	P	.08
								Pers	P	.07
								SS	P	.05

Wagner	1993	355	16.3	65.8		School	CS	Prem	C	.16
Walton & Roberts	2004 (first sample)	118	18.6	44.1	75	College	CS	Prem	P	.27
	(second sample)	545	19.3	45.5	76	College	CS	Prem	P	.17
Wardell et al.	2012	557	18.1	33	70	College	CS	SS	P	.23
								RS	P	.14
							PR	SS	P	.20
								RS	P	.14
White et al.	2006	319	17.5	53	82	School	CS	SS	C	.26
								SS	B	.16
Wilkinson et al.	2011	1053	14.4	49.6		Community	PR	SS	C	.21
Willem et al.	2010	284	16.5	51.1		School	CS	SS	I	.25
								SS	C	.18
								SS	I	.17
								RS	C	.14
								RS	I	.17
Woicik et al.	2009 (first sample)	390	19.3	44.9		College	CS	Prem	C	.10
	(second sample)	4234	15.7	48.5		School	CS	SS	C	.29
								Prem	C	.06
								Prem	P	.24
								SS	C	.10
								SS	P	.07
Wood et al.	1995	1179	17.2	45		School	CS	Prem	C	.34
								SS	C	.35
Wray et al.	2011	1599	19.6	35	96	College	CS	RS	C	.27
							PR	RS	C	.24

Age = mean unless otherwise noted; $r = r$ value before transformation; CS = Cross-sectional; PR = Prospective; Prem = Lack of premeditation; Pers = Lack of perseverance; SS = Sensation seeking; NU = Negative urgency; PU = Positive urgency; RS = Reward sensitivity; C = Consumption; P = Problematic use; B = Binge drinking/heavy use; I = Alcohol use initiation.

Table 2.4

Meta-analyses – Cross-sectional data

	<i>k</i>	<i>N</i>	<i>r</i>	CI	<i>Z</i>	SE	<i>Q</i>	<i>I</i> ²	FSN
<i>Alcohol consumption</i>									
Lack of premeditation	26	16864	.24	.19-.28	10.43***	.02	187.84***	87%	36
Lack of perseverance	8	3245	.25	.12-.37	3.78***	.07	98.65***	93%	12
Sensation seeking	37	28392	.28	.25-.32	14.79***	.02	343.12***	90%	67
Negative urgency	8	4031	.20	.14-.25	7.24***	.03	35.73*	55%	8
Positive urgency	3	960	.27	.21-.33	8.44***	.03	1.01	0%	5
Reward sensitivity	5	3458	.17	.10-.24	4.45***	.04	17.23**	77%	4
<i>Problematic alcohol use</i>									
Lack of premeditation	23	32791	.23	.20-.26	12.97***	.02	128.77***	83%	30
Lack of perseverance	7	4270	.16	.10-.22	5.03***	.03	19.04**	68%	4
Sensation seeking	23	12046	.24	.18-.29	8.31***	.03	165.69***	87%	32
Negative urgency	10	4601	.31	.25-.36	10.83***	.03	27.04**	67%	21
Positive urgency	5	1834	.32	.28-.37	12.80***	.03	4.94	19%	11
Reward sensitivity	4	1177	.20	.10-.30	3.80***	.05	9.47*	68%	4

k = no. of studies; *N* = aggregate sample size; *r* = mean weighted effect size; CI = 95% confidence interval; *Z* = *Z*-test of the mean effect size; SE = standard error; *Q* = heterogeneity statistic; *I*² = true heterogeneity percentage; FSN = No. of studies with average effect size of 0 required to reduce the observed mean effect size to *r* = .10.

* *p* < .05 ** *p* < .01 *** *p* < .001

Table 2.5

Meta-analyses – Binge/heavy drinking

	<i>k</i>	<i>N</i>	<i>r</i>	CI	<i>Z</i>	SE	<i>Q</i>	<i>I</i> ²	FSN
Lack of premeditation	8	8296	.22	.14-.30	5.12***	.04	73.81***	91%	10
Lack of perseverance	3	955	.19	.06-.31	2.77**	.07	8.47*	76%	3
Sensation seeking	10	13474	.26	.21-.31	9.29***	.03	69.05***	87%	16
Negative urgency	3	500	.13	.07-.20	3.95***	.03	.44	0%	1
Positive urgency	1	432	.17						

k = no. of studies; *N* = aggregate sample size; *r* = mean weighted effect size; CI = 95% confidence interval; *Z* = *Z*-test of the mean effect size; SE = standard error; *Q* = heterogeneity statistic; *I*² = true heterogeneity percentage; FSN = No. of studies with average effect size of 0 required to reduce the observed mean effect size to *r* = .10.

* *p* < .05 ** *p* < .01 *** *p* < .001

Table 2.6

Meta-analyses of prospective data

	<i>k</i>	<i>N</i>	<i>r</i>	CI	<i>Z</i>	SE	<i>Q</i>	<i>I</i> ²	FSN
<i>Alcohol consumption</i>									
Lack of premeditation	7	5628	.18	.15-.21	10.94***	.02	8.47	29%	6
Lack of perseverance	4	4310	.21	.09-.33	3.28**	.06	39.21***	92%	4
Sensation seeking	9	5762	.25	.21-.28	12.55***	.02	15.32	48%	14
Negative urgency	1	293	.21						
Positive urgency	1	293	.23						
Reward sensitivity	2	2156	.20	.10-.29	3.85**	.05	4.44*	77%	2
<i>Problematic alcohol use</i>									
Lack of premeditation	6	4733	.24	.19-.30	8.06***	.03	18.71***	73%	8
Lack of perseverance	2	2933	.21	.08-.33	3.14**	.07	4.79*	79%	2
Sensation seeking	6	4292	.26	.21-.31	9.44***	.03	12.87*	61%	10
Negative urgency	1	293	.21						
Positive urgency	1	293	.26						
Reward sensitivity	0								

k = no. of studies; *N* = aggregate sample size; *r* = mean weighted effect size; CI = 95% confidence interval; *Z* = *Z*-test of the mean effect size; SE = standard error; *Q* = heterogeneity statistic; *I*² = true heterogeneity percentage; FSN = No. of studies with average effect size of 0 required to reduce the observed mean effect size to *r* = .10.

* *p* < .05 ** *p* < .01 *** *p* < .001

Moderation

Q values were significant for eight of the meta-analyses, indicating the presence of heterogeneity. For six of these, *I*² values were above 75% suggesting that most of the variation between effect sizes was systematic. Although significant heterogeneity was not a prerequisite for conducting moderator analyses, these statistics indicated that moderation effects were likely. Sample type was tested as a potential categorical moderator of effect size variation, with samples from school, college, and community populations grouped as ‘normative’ and those from clinical and incarcerated populations grouped as ‘non-normative’ (Table 7). This analysis was conducted only for lack of premeditation and sensation seeking due to limited data for the other traits. Subgroups for non-normative samples contained a small number of effect sizes (*k* < 10). Power was therefore low in these analyses, and caution is recommended when

interpreting their results. For sensation seeking, non-normative samples showed larger weighted mean effect sizes than normative samples for both alcohol consumption and problematic use, but these differences were not significant.

To examine whether the main results were being biased by college samples, sample type (college or non-college) was tested as a categorical moderator (Table 2.7). This analysis could not be carried out for positive urgency as all effect sizes pertaining to this trait were from college samples. There was a significant moderating effect on the relationship between negative urgency and problematic use, with college samples showing a stronger relationship. No other significant moderating effects of college sample were found for cross-sectional data.

Mean age of sample, percentage of sample that was male, and percentage of sample that were of white ethnicity were tested as potential continuous moderators (Table 2.8). A significant moderating effect of age on the relationship between negative urgency and problematic use was observed. However, this effect was wholly driven by the one effect size from a younger sample ($r = .19$; Settles et al., 2012). Moderation was no longer evident with this effect size removed ($\beta = -.19, p = .73$). Sex showed a significant moderating effect on the relationship between lack of premeditation and problematic use. Samples with a higher percentage of female participants showed a larger relationship. White ethnicity significantly moderated the relationship between both lack of premeditation and sensation seeking and alcohol consumption. Samples with a higher number of white participants showed stronger relationships. White ethnicity also moderated the relationship between negative urgency and problematic use, but again this appeared to be driven by one effect size (Settles et al., 2012). Moderation was no longer evident with this effect size removed ($\beta = .66, p = .28$).

Moderator analysis for effect sizes relating to binge/heavy drinking was limited by a lack of data, and was conducted for lack of premeditation and sensation seeking only. For lack of premeditation, mean effect sizes did not significantly differ between college and non-college samples, $Q(b) = .35, p = .55$. Effect sizes pertaining to college samples showed a mean r of .19 (.08-.29), and effect sizes pertaining to non-college samples showed a mean r of .23 (.14-.32). For sensation seeking, mean effect sizes did not significantly differ between college and non-college samples, $Q(b) = .74, p = .39$. Effect sizes pertaining to college samples showed a mean r of .31 (.18-.43), and effect sizes pertaining to non-college samples showed a mean r of .25 (.19-.31). Continuous moderator analysis showed a near-significant moderating effect of white ethnicity on the relationship between sensation seeking and binge/heavy drinking ($\beta = .58, p = .016$), and on the relationship between lack of premeditation and binge/heavy drinking ($\beta = .69, p = .013$).

Moderator analysis for prospective studies was also only carried out for lack of premeditation and sensation seeking. For lack of premeditation and problematic use, effect sizes pertaining to non-college samples showed a mean r of .19 (.15-.24), significantly smaller than effect sizes pertaining to college samples, which showed a mean r of .31 (.25-.37), $Q(b) = 9.06, p = .003$. No other significant moderating effects of college/non-college sample were found. For lack of premeditation and alcohol consumption, effect sizes pertaining to non-college samples showed a mean r of .24 (.16-.32), and effect sizes pertaining to college samples showed a mean r of .17 (.14-.20), $Q(b) = 2.42, p = .12$. For sensation seeking and alcohol consumption, effect sizes pertaining to non-college samples showed a mean r of .25 (.21-.29), and effect sizes pertaining to college samples showed a mean r of .23 (.15-.31), $Q(b) = .14, p = .70$. For sensation seeking and problematic use, effect sizes pertaining to non-college samples showed a mean r of .26 (.19-.32), and effect sizes pertaining to college

samples showed a mean r of .29 (.16-.40), $Q(b) = .15$, $p = .69$. For continuous moderation analysis, there was a significant moderating effect of white ethnicity on the relationship between lack of premeditation and alcohol consumption ($\beta = .94$, $p = .006$), with samples that included more white participants showing a stronger relationship. No other significant moderation effects were found.

Table 2.7

Categorical moderator subgroup analyses

		<i>k</i>	<i>N</i>	<i>r</i>	CI	<i>Q</i> (<i>w</i>)	<i>Q</i> (<i>b</i>)
<i>Alcohol consumption</i>	<i>Sample</i>						
Lack of premeditation	Normative	25	18714	.23	.19-.27	14.07	.17
	Non-normative	2	397	.20	.02-.36	.24	
	College	14	4807	.25	.19-.31	6.03	.42
	Non-college	12	12057	.22	.16-.28	7.36	
Lack of perseverance	College	5	1604	.24	.06-.41	5.94	.03
	Non-college	3	1641	.27	.04-.47	.33	
Sensation seeking	Normative	35	30194	.28	.24-.31	28.70	.84
	Non-normative	3	445	.34	.20-.47	.11	
	College	12	4129	.29	.23-.36	5.26	.08
	Non-college	25	24263	.28	.24-.32	22.06	
Negative urgency	College	7	2053	.19	.12-.26	6.05	.15
	Non-college	1	1978	.22			
Reward sensitivity	College	4	3174	.17	.09-.26	2.15	.10
	Non-college	1	284	.14			
<i>Problematic alcohol use</i>							
Lack of premeditation	Normative	19	31828	.22	.19-.26	36.81	1.05
	Non-normative	4	963	.27	.18-.36	2.57	
	College	12	4984	.23	.19-.28	25.38	.04
	Non-college	11	27807	.23	.18-.28	12.61	
Lack of perseverance	College	6	2457	.18	.10-.25	5.63	1.15
	Non-college	1	1813	.09			
Sensation seeking	Normative	17	11143	.22	.16-.28	13.95	1.62
	Non-normative	5	703	.31	.19-.43	1.43	
	College	12	4197	.23	.15-.30	6.12	.25
	Non-college	11	7849	.26	.17-.34	8.81	
Negative urgency	College	9	2788	.33	.30-.36	3.40	23.63***
	Non-college	1	1813	.19			
Reward sensitivity	College	2	746	.21	.03-.37	.44	.00
	Non-college	2	431	.20	.01-.37	1.73	

k = no. of studies; *N* = aggregate sample size; *r* = mean weighted effect size; CI = 95% confidence interval; *Q*(*w*) = heterogeneity within subgroup; *Q*(*b*) = heterogeneity between subgroups.

*** *p* < .001

Table 2.8

Continuous moderator analyses using meta-regression

		R^2	β	Z
<i>Alcohol consumption</i>				
Lack of premeditation	Age	.00	.02	.06
	% Male	.00	-.03	-.13
	% White	.31	.55	2.62**
Lack of perseverance	Age	.00	-.05	-.12
	% Male	.16	.40	1.07
	% White	.57	.76	2.44*
Sensation seeking	Age	.00	.01	.06
	% Male	.00	-.07	-.35
	% White	.26	.51	3.15**
Negative urgency	Age	.12	-.35	-.93
	% Male	.16	-.39	-1.14
	% White	.21	.46	1.02
<i>Problematic alcohol use</i>				
Lack of premeditation	Age	.02	.14	.86
	% Male	.17	-.42	-2.80**
	% White	.09	.29	1.64
Lack of perseverance	Age	.23	.48	1.31
	% Male	.00	.02	.06
	% White	.21	.46	1.15
Sensation seeking	Age	.04	.20	.90
	% Male	.07	-.27	-1.15
	% White	.07	-.26	-1.04
Negative urgency	Age	.86	.93	4.83***
	% Male	.00	.04	.08
	% White	.74	.86	4.07***

R^2 = between-study variance accounted for; β = beta coefficient; Z = Z-test of beta coefficient.

* $p < .05$ ** $p < .01$ *** $p < .001$

Discussion

This meta-analytic review sought to examine relationships between impulsivity-related personality traits and aspects of adolescent alcohol use. All traits analysed were significantly positively associated with alcohol consumption and with problematic alcohol use. Sensation seeking and positive urgency showed the largest mean associations with alcohol consumption, whilst positive and negative urgency showed the largest associations with problematic use. The data reviewed show a similar pattern to findings from older samples, which indicate that among impulsivity-like traits from the UPPS model it is sensation seeking that best predicts frequency of engaging in risky behaviours, including alcohol use, and urgency traits that best predict problematic engagement in such behaviours (Fischer & Smith, 2007; Smith et al., 2007).

Findings suggest that elevated alcohol consumption in adolescence is related to motivations for positive reinforcement. High sensation seeking adolescents are perhaps drawn to alcohol for its stimulating effects and the potentially novel and exciting experiences that may result from its use (Comeau, Stewart, & Loba, 2001), whilst those high in positive urgency may use alcohol to prolong positive emotions. These traits are associated with the tendency to overestimate the possible positive outcomes that alcohol use might afford and to downplay possible negative outcomes (Gunn & Smith, 2010; Urbán, Kökönyei, & Demetrovics, 2008). Such expectancies may lead to increased general consumption.

Sensation seeking was the trait with the largest association with binge/heavy drinking, and was also positively associated with initiation of alcohol use in samples of younger participants. This pattern of results suggests that high sensation seeking adolescents are inclined to engage in risky alcohol use characterised by early onset,

increased general use, and elevated binge drinking. Although some of these individuals may be able to keep this pattern of drinking under control by using strategies to avoid negative consequences (Magid et al., 2007), the reasonable associations found here with problematic use, both cross-sectional and prospective, suggest that the trait should not be ruled out as a risk factor for alcohol-related problems. Additionally, the weighted mean correlation between sensation seeking and alcohol consumption found here is similar to that found in a meta-analysis assessing this relationship in all available samples ($r = .26$; Hittner & Swickert, 2006), indicating that the association has high temporal stability.

Reward sensitivity showed a far smaller association with alcohol consumption than did sensation seeking. This is interesting considering the traits' conceptual overlap, but is not without precedent (Franken & Muris, 2006b). A reason for the dissimilarity may be that sensation seeking involves the desire for exceptionally thrilling and intense experiences, whereas reward sensitivity represents motivation for any type of reward, intense or otherwise, many of which may be non-problematic (Gullo & Dawe, 2008). Those high in reward sensitivity may find alcohol consumption to be merely one of many potentially rewarding activities and hence not feel the need to engage in it quite as frequently.

Positive and negative urgency showed the largest associations with problematic alcohol use, indicating that negative consequences from alcohol use are related to a tendency to engage in rash behaviour when in a heightened emotional state. This interpretation must be restricted to adolescents aged 18 and older at this point due to limited data from younger participants. One study that did look at negative urgency in relation to problematic use in young adolescents (Settles et al., 2012) found a significantly smaller association than the mean effect size observed here for older adolescents. This may indicate that negative urgency becomes more associated with

problematic alcohol use in later adolescence. However, both urgency traits were found to be positively associated with alcohol use initiation in a large sample of younger individuals (Gunn & Smith, 2010). Clearly, further investigation into these traits as potential risk factors for problematic use in adolescence is warranted.

Quite how the urgency traits might function as risk factors for older adolescents is still somewhat unclear. It has been proposed that negative urgency has a direct association with problematic use, whereas positive urgency exerts an indirect effect via increased consumption (Wray, Simons, Dvorak, & Gaher, 2012). The data reviewed appear to support this possibility, with negative urgency showing a much smaller association with typical consumption. It may be that individuals high in negative urgency do not typically use alcohol at a high level, but are more prone to negative consequences when they do drink, perhaps because they are more likely to use alcohol when already in a state of distress. Settles and colleagues (2010) have incorporated the urgency traits into the 'acquired preparedness' model of risk (Smith & Anderson, 2001), suggesting that negative urgency may predispose individuals towards considering alcohol use as a suitable response to distress, and that positive urgency may predispose individuals to acquire expectancies that alcohol use will bring about positive effects. Continued focus on these potential risk mechanisms should provide fruitful ground for further research.

No evidence of moderation by sample type when comparing samples from normative (school, college, or community) and non-normative (clinical or incarcerated) populations was found. However, there was a trend for sensation seeking to show higher associations with both alcohol use outcomes in samples from non-normative populations. Samples with a higher percentage of female participants showed a significantly larger association between lack of premeditation and problematic use, indicating that females with a reduced ability to plan ahead may be at

risk from the negative effects of alcohol. Alternatively, it is possible that the direction of influence is reversed, and that the detrimental effects of alcohol on cognitive performance, which have been found to affect females more than males (Nolen-Hoeksema, 2004), also negatively influence the capacity for forethought.

The percentage of sample that was of white ethnicity significantly moderated (made stronger) the relationships between two traits, lack of premeditation and sensation seeking, and typical alcohol consumption. This effect persisted for lack of premeditation in prospective studies, and a similar but non-significant trend was observed for both traits in relation to binge drinking. These findings suggest that white adolescents who are high in these traits could be more prone to excessive alcohol use. A caveat to this finding is that there may not have been sufficient variation in ethnicity among the samples analysed. Over 80% of studies used samples in which the majority of participants were white. Nevertheless, the finding is consistent with previous observations with regard to sensation seeking (Hittner & Swickert, 2006).

The relationship between negative urgency and problematic use was significantly moderated by age, although this was driven by one smaller effect size from a younger sample. No other significant moderating effects of age or sex were found. However, it is acknowledged that a restriction in range of mean age amongst the studies reviewed means that the presence of age moderation effects based on these data cannot be ruled out.

Analysis of potential biasing effects of college sample data indicated no significant differences between effect sizes from college and non-college samples in cross-sectional studies, although this analysis was not carried out with regard to positive urgency due to a lack of data. For prospective studies, there was a significant moderating effect of college sample on the association between lack of premeditation and problematic alcohol use, with college samples showing significantly larger effect

sizes. This finding suggests that college may be a particularly risky environment for those with an inability to consider the consequences of their actions, although it is based on only six studies and will need to be substantiated by further research.

Effect sizes for differing measures of problematic alcohol use were compared. Results did not suggest notable differences between effect sizes relating to negative consequences from alcohol use and those relating to symptoms of abuse/dependence, although for positive urgency and reward sensitivity no effect sizes for abuse/dependence symptoms were found. These findings support the idea that these outcomes may reflect a single latent factor (e.g. Hasin et al., 1994), but are by no means conclusive. Many commonly used scales of problematic alcohol use combine items assessing both of these outcomes. Clarifying the similarities and differences between them in terms of their relationships to impulsivity-related traits will require a more systematic assessment of the two outcomes individually.

Implications for intervention

Findings lend support to the use of personality-based prevention and intervention strategies. Knowledge of trait risk factors can be useful for targeting individuals most at risk, presenting information to them effectively, and offering appropriate alternatives to alcohol and substance use. These findings suggest that high sensation seeking adolescents may benefit from campaigns designed to limit their alcohol intake. Palmgreen and colleagues (1991, 2001, 2007) have studied how to frame antidrug public health communications to engage with high sensation seekers. These have been shown to be effective in reducing cannabis use (Palmgreen, Donohew, Lorch, Hoyle, & Stephenson, 2001). The production of similarly targeted announcements with the aim of reducing average quantity and frequency of alcohol consumption may be a useful intervention strategy. Another approach has been to invite high sensation

seeking adolescents for a brief group-based intervention designed to promote personality-specific coping skills (Conrod, Castellanos-Ryan, & Strang, 2010; Conrod, Castellanos-Ryan, & Mackie, 2011). This has been shown to be effective in decreasing quantity and frequency of alcohol consumed over a six month period.

Efforts to minimise problematic use, at least in older adolescents, might do well to address how individuals respond to extreme mood states. As individuals high in positive urgency report reduced levels of positive affect (Simons, Dvorak, Batién, & Wray, 2010; Wray et al., 2012), they may be less prepared to regulate their actions when experiencing a positive mood, leading to careless behaviour such as hazardous alcohol use. This could possibly be tackled by helping individuals to consider ways of maintaining positive moods that are low in risk and do not involve alcohol.

Interventions for older adolescents high in negative urgency require a greater focus on individuals' capacity to tolerate distress and manage their negative emotions (Zapolski, Settles, Cyders, & Smith, 2010). One approach that addresses such vulnerabilities is dialectical behaviour therapy (DBT; Linehan, 1993), which aims to teach individuals skills in affect regulation. DBT has been successfully employed to reduce drug abuse and treat binge eating disorder in adult women (Linehan et al., 1999; Telch, Agras, & Linehan, 2001), and could feasibly be adapted into a prevention approach for at-risk adolescents.

Limitations and future directions

The generalisability of findings is limited by a lack of data for a number of the traits analysed. With regard to positive and negative urgency, only one study assessed these traits prospectively (Cyders et al., 2009), and zero studies were found to have assessed positive urgency and the two primary alcohol use outcomes in adolescents aged under 18. A priority for further study, then, is to investigate the urgency traits and

alcohol use in younger cohorts. Similarly, the lack of data pertaining to trait reward sensitivity is disappointing, and suggests that previous research may have neglected the potential influence of this trait on adolescent alcohol use. Considering the likely role of dysregulated reward processing in addictive behaviour (Yacubian & Büchel, 2009), future studies may benefit from including psychometric markers of reward reactivity in their analyses.

There was a bias towards data from older participants, with 46% of samples analysed having a mean age between 18.0 and 19.9. This statistic is perhaps indicative of the difficulties in conducting alcohol-related research with younger individuals and the tendency of researchers to sample from the college undergraduate population. Although mean age was generally not found to be a significant moderator, it should be acknowledged that these older samples would have often included participants over the age range specified and that this may affect the degree to which results can be generalised to younger adolescents. Similarly, whilst data from college and non-college samples were on the whole very similar, it must be emphasised that any interpretation of these findings recognises the limited information currently available for non-college samples.

A further limitation was the inclusion of a wide range of impulsivity and alcohol use measures, which likely introduced a fair amount of heterogeneity between effect sizes. Whilst an effort was made to ensure that all included measures were consistent with the trait and alcohol use categorisations specified, and that analyses accounted for the diversity in effect sizes across studies by employing a random effects model, the observed heterogeneity may limit the interpretability of these findings.

The associations between traits and alcohol use found here are mostly small to moderate using standard conventions (Cohen, 1988), and a comprehensive understanding of individual differences in adolescent alcohol use requires

consideration of numerous other factors. A relatively unexplored question is how expression of these traits might influence an individual's likelihood of exposure to additional risk factors that further influence alcohol use. For instance, those high in sensation seeking are more likely to seek out peers that endorse and promote excessive drinking (Yanovitzky, 2007), and would therefore be likely to frequently consume alcohol when in the company of these peers. Identification of environmental factors that moderate relationships between traits and alcohol use is much needed.

The present findings may also inform future experimental work. Cyders et al. (2010) have shown that trait positive urgency is a predictor of alcohol consumption when participants are in an experimentally-induced positive mood. This work could be expanded upon in adolescent samples by also considering how trait sensation seeking moderates the effect of certain states, such as an appetitively motivated 'seeking' state (Alcaro & Panksepp, 2011), on alcohol consumption.

Conclusion

This review has shown that separable impulsivity-related traits show different patterns of association with alcohol use outcomes in adolescence. General alcohol consumption is associated with a tendency to seek out exciting experiences and with an inclination to behave impulsively when in a positive mood. Problematic use appears to be linked to both positive and negative forms of mood-based rash action, although this finding is yet to be confirmed in younger adolescent samples. Findings are in line with adult data, and may help to inform novel methods of intervention.

Chapter 3

Impulsivity and problematic substance use in adolescence: Direct effects of urgency traits and moderation of perceived peer use

Overview

This chapter begins with a summary of studies that have assessed impulsivity-related traits and cannabis use in adolescent samples. It then goes on to report a study of 270 adolescent sixth form students. These participants completed self-report measures of impulsivity-related traits, their alcohol and cannabis use, problematic use, and perceived peer use. Zero-inflated negative binomial regression models indicated that positive and negative urgency accounted for significant variance in problematic alcohol and cannabis use scores, even after accounting for non-urgency impulsivity traits and typical substance consumption. Furthermore, both urgency traits moderated the positive association between perceived peer alcohol use and individual problematic use. Results indicate that the urgency traits show a direct association with problematic substance use in adolescence, and that high urgency adolescents who believe their peers drink high levels of alcohol may be at increased risk of problematic alcohol use.

Introduction

Impulsivity and adolescent cannabis use

In contrast to the literature focusing on alcohol reviewed in the previous chapter, the amount of articles examining impulsivity-related traits and cannabis use in adolescent samples is small. Furthermore, available data is highly heterogeneous due to substantial variation in study design and measures employed. Meta-analysis is therefore not an appropriate tool to summarise this literature. Nonetheless, existing evidence in this area will be informative for the study reported in this chapter and for the thesis more generally. Thus, the first part of this chapter provides a narrative overview of relevant studies, presented with reference to the multi-component approach to impulsivity outlined previously. The studies included in this overview were selected using similar criteria to the literature search for studies relating to alcohol.

Sensation seeking is by far the most studied impulsivity-related trait in relation to adolescent cannabis use, and is commonly found to be heightened in adolescents who have initiated cannabis use compared to those who have not (Andrucci et al., 1989; Donohew et al., 2000; Malmberg et al., 2010; Martin et al., 2002; Teichman et al., 1989). Furthermore, adolescents who report using both alcohol and cannabis appear to exhibit higher sensation seeking than those who report only alcohol use (Shillington & Clapp, 2002). The trait has also shown to be positively associated with intention to use cannabis in the future (Hoyle et al., 2002; Yanowitzky, 2005), although not with specific motives for use (Comeau et al., 2001).

Sensation seeking consistently shows positive associations with typical cannabis use in cross-sectional research, with effect sizes ranging from small to moderate (Desrichard & Denarie, 2005; Hampson, Andrews, & Barckley, 2008; Hoyle et al.,

2002; Jaffee & D’Zurilla, 2009; Zuckerman, 1994). Data from prospective studies suggest that heightened sensation seeking is also predictive of later cannabis use. In a two-year study of over 400 adolescents, Donohew et al. (1999) found that sensation seeking assessed in the eighth grade was moderately associated with cannabis use assessed two years later, whilst Crawford et al. (2003) found that sensation seeking assessed in middle school strongly predicted increases in cannabis use throughout middle school and high school.

A limitation of much of this research is that sensation seeking has often been operationalised broadly. This is important in relation of the UPPS framework. Sensation seeking in the UPPS model is best conceptualised as the thrill and adventure seeking component of Zuckerman’s (1971) scales. Studies that have considered separate facets of sensation seeking have tended to find that thrill and adventure seeking is less strongly associated with cannabis use than other facets, with the disinhibition facet showing much larger effects (Andrucci et al., 1989; Kopstein, Crum, Celentano, & Martin, 2001). Disinhibition reflects the desire for sensations that may go against social rules, and loads similarly on both the sensation seeking and lack of perseverance factors of the UPPS model (Whiteside & Lynam, 2001).

Very little research has been conducted with regard to facets of impulsivity other than sensation seeking, and the evidence that does exist is inconclusive. Ernst et al. (2006) found no differences in lack of premeditation between adolescents who had initiated cannabis and those who had not. Jaffee and D’Zurilla (2009) found a modest association between a scale reflecting lack of premeditation and typical cannabis use ($r = .15$) in a sample of high school students. A similar association was found by Simons and Carey (2006), who showed this effect to be stable over six months. In addition, these authors tested the correlation between lack of premeditation and problematic

cannabis use, finding that the effect size fell from .14 to .04 over the same six month period.

Only one piece of research has assessed urgency alongside cannabis use in an adolescent sample (Kaiser, Milich, Lynam, & Charnigo, 2012). This study of first year undergraduates found a positive association between negative urgency and weekly cannabis use ($r = .16$). Also available, however, are studies using measures that show parallels with urgency. Donohew et al. (2000) assessed decision making style and cannabis use in 2949 ninth grade students, finding that those endorsing a tendency towards affect-based decision making were more likely to be cannabis users than those with a rational decision making style. Simons and Carey (2002) assessed the ability to control aggressive and benign impulses in college students (mean age 18.6) along with cannabis use and problematic use. This measure of impulsivity showed a larger association with problematic use ($r = .28$) than with typical use ($r = .16$).

There is a dearth of research examining differential relationships between separate impulsivity-related traits and cannabis use, although two studies employing the Substance Use Risk Profile Scale (Woicik et al., 2009) provide some indication of differences between sensation seeking and an impulsivity construct that reflects lack of premeditation. Malmberg et al. (2010) found that sensation seeking was a stronger concurrent predictor of cannabis use than lack of premeditation in a sample of nearly 3800 11-15 year olds, whilst Krank et al. (2011) found sensation seeking and impulsivity to show similar concurrent relationships with cannabis use in a sample of 13-15 year olds, with sensation seeking being a better predictor of use one year later.

In sum, these findings indicate that sensation seeking, considered broadly, is reliably associated with aspects of adolescent cannabis use and is perhaps a better indicator of risk than lack of premeditation. However, aspects of impulsivity other than sensation seeking have received scant attention. The remainder of this chapter aims to

address this problem by assessing the impulsivity-related traits specified by the UPPS model alongside aspects of cannabis use in an adolescent sample.

Urgency and problematic substance use

Negative and positive urgency have been identified as particularly risky traits for problematic substance use. Theoretically, these traits neatly combine two aspects of behaviour believed to be more prominent in those at heightened risk for substance use disorder: the inability to control one's actions and the inability to regulate one's emotions (Tarter et al., 2003). Empirically, negative urgency has been shown to relate to problematic alcohol use and the number of other illicit substances tried (Fischer & Smith, 2008; Kaiser et al., 2012), and has been found to be elevated in substance dependent individuals (Verdejo-García, Bechara, Recknor, & Pérez-García, 2007). Positive urgency has been found to predict alcohol quantity consumed and problematic use over one year (Cyders, Flory, Rainer, & Smith, 2009), as well as increases in illegal drug use and risky sexual behaviour (Zapolski, Cyders, & Smith, 2009). The meta-analysis of impulsivity-related traits and adolescent alcohol use reported in Chapter 2 found that positive and negative urgency showed the largest associations with measures of problematic drinking.

A limitation to this growing body of evidence is that much of the data have been collected from samples aged over 18. Alcohol and cannabis use are often initiated before this age (Kosterman et al., 2000), and use of these substances can have detrimental effects on behavioural control and emotion regulation, the psychological underpinnings of the urgency traits (Cyders & Smith, 2008; Fox, Hong, & Sinha, 2008). The review presented in Chapter 2 highlighted a dearth of research examining the urgency traits alongside alcohol use in samples younger than college age. One study that did use a younger sample found that negative and positive urgency were the

UPPS traits most associated with onset of alcohol use in 9-13 year olds (Gunn & Smith, 2010). It therefore seems necessary to examine these traits alongside a broader array of alcohol and cannabis use measures in an adolescent sample.

The factor structure of the UPPS model has been confirmed in adolescents and preadolescents (d'Acremont & Van der Linden, 2005; Zanolski, Stairs, Settles, Combs, & Smith, 2010). Age differences in urgency trait expression have not yet been explicitly tested, yet Cyders and Smith (2008) posit that the urgency traits may be uniquely elevated during adolescence, a contention supported by a range of evidence. First, adolescents are likely to experience emotions at higher intensity than children and adults, and to experience extreme moods more frequently (Arnett, 1999). Second, adolescents have been found to show a reduced capacity to regulate their emotions, and a heightened propensity to have their decision making disrupted by heightened emotional states (Figner, Mackinlay, Wilkening, & Weber, 2009; Spear, 2011). Third, other impulsivity-related traits have been shown to be elevated in adolescents compared to adults (Steinberg et al., 2008). Finally, adolescent neurodevelopment is characterised by a pattern of elevated activity in subcortical brain areas responsible for socio-emotional processing, and immaturity of frontal areas responsible for cognitive control (Casey & Jones, 2010; Gladwin et al., 2011; Steinberg, 2008). This neurobiological profile is thought to underpin the tendency of many adolescents to engage in risk-taking behaviours without thinking of potential consequences (Galvan et al., 2006), and indicate that adolescents may be predisposed towards highly 'urgent' behaviour. Associations between the urgency traits and problematic substance use could thus be more pronounced among adolescents.

Urgency as a moderator

In addition to establishing direct relationships between the urgency traits and substance use outcomes, a number of studies have begun to investigate how these traits might moderate more proximal risk factors. Karyadi and King (2011) found that heightened positive urgency strengthened the relationship between depressive symptoms and negative consequences from alcohol use, and Burton, Pedersen, and McCarthy (2012) recently found that individuals high in the urgency traits showed a stronger relationship than low urgency individuals between positive implicit associations about alcohol use and actual alcohol use. To build upon these interesting findings, the present enquiry considered whether the urgency traits had a moderating effect on the association between perceived peer substance use and individual problematic use.

Peer substance use is perhaps the most salient environmental influence on individual use during adolescence (Swadi, 1999). Affiliation with substance using peers is consistently associated with elevated individual substance use in adolescents (Chassin, Curran, Hussong, & Colder, 1996; Cleveland, Feinberg, Bontempo, & Greenberg, 2008; Jenkins, 1996), and perceived peer alcohol use prospectively predicts individual alcohol use initiation and problematic drinking (Cardenal & Adell, 2000; Trucco, Colder, & Wieczorek, 2011). The social psychology literature provides a number of theories that help to explain this phenomenon. For example, the theory of planned behaviour (Ajzen, 1988) posits that social norms are one of three informational sources that influence intentions to engage in certain behaviours. Similarly, a social learning approach (Bandura, 1977) would suggest that the association between individual and peer substance use is due to a process of modelling, whereby individuals learn and imitate the behaviour of close acquaintances. These processes seem pertinent to adolescence. The adolescent brain is particularly

responsive to social cues, showing heightened response to the rewarding aspects of social interaction as well as to the punishment of social rejection (Masten et al. 2009; Pfeifer et al., 2011). It has been speculated that post-pubertal adolescents become more reactive to the affective information provided by social stimuli, but that the ability to regulate this reactivity matures more gradually (Nelson, Liebenluft, McClure, & Pine, 2005). Acting in contrast to social norms during this period is likely to be extremely challenging, perhaps especially so for impulsive individuals. Impulsivity measured by the Barratt Impulsiveness Scale (Patton, Stanford, & Barratt, 1995) shows a negative correlation with self-reported resistance to peer influence (Steinberg & Monahan, 2009).

As yet, no studies have examined whether individual differences in the urgency traits are associated with perceived social norms regarding substance use. However, there is some evidence that individuals in a positive mood are prone to using normative information to guide their judgements (Armitage, Conner, and Norman, 1999; Forgas, 1995). A predisposition to act without thinking when in a heightened emotional state may exacerbate this process. Given the emotional salience of peer approval and rejection during adolescence, individuals high in urgency traits may be more inclined to use perceived peer norms to direct their behaviour when in extreme mood states, and less likely to exercise constraint. Such a process could become particularly dangerous in high urgency individuals who perceive that their peers condone and encourage the use of alcohol and cannabis, as normative information could be used to guide substance use behaviour at the expense of considering potential negative consequences.

The current study

The aims of this study are: (a) to examine associations between impulsivity-related traits and aspects of alcohol and cannabis use in a sample of adolescents younger than college age; (b) to test whether the urgency traits account for unique variance in problematic alcohol and cannabis use; and (c) to test whether the urgency traits moderate relationships between perception of peer substance use and problematic use. It is hypothesised that the urgency traits will be positively associated with problematic alcohol and cannabis use in this younger sample, and that they will account for unique variance in problematic use scores after accounting for other impulsivity-related traits and typical levels of use. For the moderation analyses, it is predicted that high urgency adolescents would show stronger associations between perception of peer substance use and own problematic use than low urgency adolescents.

Method

Participants

Participants were 270 sixth form students from two schools in east London, United Kingdom. The sample was 73% female and ranged in age from 16-18 with a mean of 16.79 (SD = .54). Seventy two participants were aged 16, 179 were aged 17, 14 were aged 18, and five did not report their age. Data regarding ethnicity and socioeconomic status were not recorded. However, the schools are from ethnically diverse areas and this is represented in their overall student body. One school reported that around 80% of its students are from minority ethnic groups. The majority of participants ($n = 228$) were recruited from this school. The second reported that around half of its students are White British. Forty two participants were recruited from this school.

Procedure

The study was approved by the Goldsmiths, University of London, Psychology Department Ethics Committee. Twenty schools in the London area were contacted with information about the study and a request for participation. Representatives from the humanities departments of two schools agreed for their students to take part. Teachers from participating schools were provided with consent forms for students to give to their parents/guardians. A passive consent procedure was used whereby parents/guardians were informed about the study and given the option to exclude their children from participation. One individual was excluded.

Questionnaires were administered in groups of around 20 during class time under test conditions with the researcher and a teacher present. Participants gave written assent prior to completing the questionnaires. Once all participants in a group had completed the questionnaires the group was debriefed and given the opportunity to ask questions about the study. Participants were given relevant website links to visit if the study had led them to become concerned about their substance use.

Measures

Impulsivity

The UPPS-P Impulsive Behaviour Scale (Cyders et al. 2007; Whiteside & Lynam, 2001) is a 59 item measure assessing five facets of impulsivity. Items are assessed using a four point Likert-type response format, from 1 = *I agree strongly* to 4 = *I disagree strongly*, with the majority of items being reverse coded. The scales have been shown to display good convergent and discriminant validity (Smith et al., 2007). For the present study the mean response for each facet was calculated, giving a score between 1 and 4, where 4 indicates higher trait expression. The alpha reliabilities in the

present sample were: lack of premeditation = .84, lack of perseverance = .77, sensation seeking = .86, negative urgency = .83, positive urgency = .90.

Alcohol use

Typical alcohol consumption was assessed with two items, adapted from the Alcohol Use Disorders Identification Test (Babor, Higgins-Biddle, Saunderson, & Monteiro, 2001): *How often do you have a drink containing alcohol?* and *How many drinks containing alcohol do you have on a typical day when you are drinking?* Participants were asked to consider their responses with regard to the past year. Five response options were provided for each question, ranging from *Never* (0) to *4 or more times per week* (4), and *1 or 2 drinks* (0) to *10 or more drinks* (4), respectively. In line with previous research (Sobell & Sobell, 2003), the product of these two item scores was computed to give a continuous score between 0 and 16.

Perceived peer alcohol use was assessed using five questions. The content of this scale reflected both descriptive norms, assessed with the items: *How many of your friends do you think have had any alcohol to drink in the last 30 days?*; *How many of your friends would you estimate get drunk at least once a week?*; *When your close friends drink, how much, on average, does each person drink?*; and injunctive norms, assessed with the items: *How do your friends feel about drinking alcohol?*; and *How do your friends feel about getting drunk?* Five response options were provided for each question, ranging from *None* (0) to *7 or more* (4) for the first two questions, *1 or 2 drinks* (0) to *10 or more drinks* (4) for the third question, and *They all disapprove* (0) to *They all approve* (4) for the fourth and fifth questions. To clarify the factor structure of these five items, an exploratory factor analysis with maximum likelihood extraction and direct oblimin rotation was conducted. One factor was extracted, which accounted for 61.05% of the total variance. It was therefore feasible to combine scores of the five

items, summing them for one continuous score between 0 and 20. The alpha reliability for this scale was .84.

Cannabis use

Typical cannabis consumption was assessed with the item *How often do you smoke cannabis?* Participants were asked to consider their response with regard to the past year. Five response options were provided, ranging from *Never* (0) to *4 or more times per week* (4).

Perceived peer cannabis use was assessed using four questions. As with perceived alcohol use, item content reflected descriptive norms: *How many of your friends do you think have used cannabis in the last 30 days?*; *How many of your friends would you estimate use cannabis at least once a week?*; *When your close friends smoke cannabis, how much, on average, does each person smoke?*, with ‘cannabis cigarettes’ as the quantity unit; and injunctive norms: *How do your friends feel about smoking cannabis?* Five response options were provided for each question, following a similar format to the alcohol use questions. An exploratory factor analysis of these four items extracted one factor, which accounted for 77.81% of the variance. Scores for the four items were summed for a continuous score between 0 and 16. The alpha reliability for this measure was .90.

Problematic alcohol use

Problematic drinking was assessed using the 18-item Rutgers Alcohol Problem Index (RAPI; White & Labouvie, 1989; White & Labouvie, 2000). Items on the RAPI ask about negative consequences experienced from drinking alcohol during the past year. Sample items include *Neglected your responsibilities*, *Felt that you had a problem with alcohol*, and *Felt physically or psychologically dependent on alcohol*. It

is scored using a four point Likert-type format ranging from *None* (0) to *More than 5 times* (3). Item scores were summed, giving a continuous score ranging from 0 to 54. The RAPI has been found to have strong predictive validity, with scores predicting diagnosis for alcohol dependence seven years after administration (Dick, Aliev, Viken, Kaprio, & Rose, 2011). The alpha reliability for the RAPI in this sample was .84.

Problematic cannabis use

Problematic cannabis use was assessed using the short form of the Cannabis Problems Questionnaire for Adolescents (CPQ-A-S; Proudfoot, Vogl, Swift, Martin, & Copeland, 2010), a 12 item scale with a yes/no response format. One point is scored for each item marked yes. The CPQ-A-S items ask whether respondents have experienced situations that can result from excessive cannabis use, such as passing out or feeling paranoid after a smoking session, during the past three months. Item scores were summed for a continuous score ranging from 0 to 12. Proudfoot et al. (2010) found this scale to have good convergent validity. The alpha reliability for the CPQ-A-S in this sample was .71.

Data analysis

Data were analysed using IBM SPSS version 19 and R version 3.0.0 with the *pscl* (Jackman, 2008; Zeileis, Kleiber, & Jackman, 2008) and *MASS* (Venables & Ripley, 2002) packages. An alpha level of $p = .05$ was used for significance testing. Missing value analysis established that no impulsivity-related trait scores were missing more than 5%. To maximise the amount of data that could be used, missing values for trait scores were imputed using expectation maximisation. Three univariate outliers were identified. These appeared to be extreme scores and were Winsorised. One multivariate outlier showed extreme scores on a number of variables and was removed from

analysis. Age was strongly restricted in range and was not included in regression analyses.

Results

The percentage of participants who reported ever using alcohol in this sample was 44.4%, less than is observed in the general British population for similarly aged children (Fuller, 2012). The percentage of participants who reported ever using cannabis was 20.7%. This is comparable to UK population data, which indicate that 17.1% of 16-24 year olds in the UK reported past year cannabis use (Smith & Flatley, 2011). Independent *t*-tests showed that participants from School 2 had significantly higher mean perception of peer alcohol use scores ($M = 9.17$, $SD = 4.10$) than those from School 1 ($M = 7.42$, $SD = 4.52$), $t(236) = 2.30$, $p = .02$. No other significant differences between schools were found.

Descriptive statistics and bivariate correlations are presented in Table 3.1. The means and standard deviations presented were calculated using data from all participants, including those with zero scores on alcohol and cannabis measures. Amongst alcohol users only, the mean score for typical consumption was 2.59 ($SD = 2.45$) and for problematic use was 3.93 ($SD = 5.26$), indicating that the alcohol users in this sample drank at modest levels with a low prevalence of negative consequences over the past year. Amongst cannabis users only, the mean score for cannabis use frequency was 1.15 ($SD = 1.15$), and for problematic use was 2.13 ($SD = 2.30$), indicating that cannabis users in this sample used cannabis monthly or less on average and had experienced around two negative consequences from use in the past three months. Correlations between trait scores and substance use measures were analysed for the whole sample and for users only. This analysis revealed a substantially

increased correlation between positive urgency and problematic alcohol use in alcohol users ($r = .39, p < .001$), and between positive urgency and problematic cannabis use in cannabis users ($r = .35, p = .01$).

Negative and positive urgency scores showed a considerable intercorrelation, as is consistently found (Curcio & George, 2011; Simons, Dvorak, Batien, & Wray, 2010; Zapolski et al., 2010). Combining the two scores into a single urgency facet was considered, yet potentially important differences in their correlations to problematic use scores, particularly problematic alcohol use, were noted. The difference between the negative urgency-problematic alcohol use and positive urgency-problematic alcohol use correlations was tested using Steiger's z -Test (Steiger, 1980). The difference approached significance for the entire sample ($z = 1.91, p = .06$), and was significant for alcohol users only ($z = 2.89, p = .003$).

Due to a large proportion of zero scores, substantial skewness and kurtosis were observed for problematic alcohol use scores ($S = 3.15, K = 10.62$) and problematic cannabis use scores ($S = 3.41, K = 11.69$). The distributions for both variables approximated a negative binomial distribution with the exception of a large number of zero values. Zero-inflated negative binomial (ZINB) regression was therefore selected as the method of analysis for these data (Atkins & Gallop, 2007; Lewis et al., 2010; Simons, Neal, & Gaher, 2006). A ZINB regression model is a two-component mixture model that is capable of handling excess zero values. A negative binomial regression model is fit to the data, and excess zeros are simultaneously modelled with a logistic regression. The logistic portion of the model predicts zero scores that exceed the amount expected in a negative binomial distribution. The count portion of the model predicts values on the distribution and includes positive integers and zero.

One of the assumptions of the ZINB model is that the underlying distribution is made up of count data. Scores on the RAPI measure are not true count data as response

choices are ordinal, i.e. 'None', '1-2 times', '3-5 times', and 'More than 5 times'.

However, as Light et al. (2011) observe, RAPI scores do share certain properties with count distributions, namely that the data is non-negative with skewed integer values.

Light et al. (2011) modelled RAPI data with seven types of regression model, including Ordinary Least Squares with and without transformation, and Poisson and negative binomial models with and without zero-inflation. ZINB models were found to fit their data best. The same conclusion was drawn from the present data, as is reported below. Nevertheless, caution is suggested when interpreting the reported incident rate ratios for RAPI data. These ratios reflect how individual RAPI scores change as a function of predictor variables. Due to the nature of the RAPI, this is not necessarily identical to an increased count of problematic use symptoms.

Problematic alcohol use

Two ZINB regression analyses were conducted using problematic alcohol use as the criterion variable, with separate models for negative and positive urgency due to their high intercorrelation (Table 3.2). Gender, lack of premeditation, lack of perseverance, sensation seeking, negative or positive urgency, typical alcohol use, and perceived peer alcohol use were entered as predictors at step 1. These variables were mean-centred for this analysis. The product term of negative or positive urgency and perceived peer use was entered at step 2. For the logistic portion of each model, typical alcohol use was not included as a predictor as the majority of participants reporting no alcohol use also reported no problematic use. As previously reported by Lewis et al. (2010), including a typical use score in a logistic regression of problematic use can lead to problems with separation, whereby one variable perfectly predicts the outcome, leading to unstable coefficients. For both ZINB models, a likelihood ratio test of

overdispersion was significant, $\chi^2(15) = 988.15, p < .001$, suggesting that negative binomial models were preferable over Poisson models.

The likelihood ratio for the negative urgency ZINB model was $\chi^2(15) = 97.33, p < .001$, indicating that the model was significant. The Vuong non-nested test supported the use of a zero-inflated model over a standard negative binomial model, $z = 5.81, p < .001$. For the logistic portion of this model, excess zero scores were significantly predicted by low perceived peer alcohol use and low lack of premeditation. For the count portion of the model, increased problematic alcohol use scores were significantly predicted by alcohol consumption and by negative urgency. The interaction term of negative urgency and perceived peer use was significant. Simple slopes analysis indicated that at -1 standard deviation of negative urgency scores the slope of the relationship between perceived peer alcohol use and problematic alcohol use was $b = -.11, SE b = .05, z = -2.21, p = .03$ (incident rate ratio = 0.90, 95% CI = 0.82-0.99), and at +1 standard deviation of negative urgency scores the slope was $b = .10, SE b = .05, z = 1.93, p = .05$ (incident rate ratio = 1.11, 95% CI = 1.00-1.23). These relationships are displayed in Figure 3.1.

The likelihood ratio for the positive urgency ZINB model was $\chi^2(15) = 108.93, p < .001$, indicating that the model was significant. The Vuong test supported the use of a zero-inflated model over a standard negative binomial model, $z = 6.12, p < .001$. For the logistic portion of this model, excess zero scores were significantly predicted by low perceived peer alcohol use and low lack of premeditation. For the count portion of the model, increased problematic alcohol use scores were significantly predicted by alcohol consumption and by positive urgency. The interaction term of positive urgency and perceived peer use was significant. Simple slopes analysis indicated that at -1 standard deviation of positive urgency scores the slope of the relationship between perceived peer alcohol use and problematic alcohol use was $b = -.10, SE b = .05, z = -$

2.08, $p = .04$ (incident rate ratio = 0.90, 95% CI = 0.82-0.99), and at +1 standard deviation of positive urgency scores the slope was $b = .15$, $SE\ b = .06$, $z = 2.55$, $p = .01$ (incident rate ratio = 1.16, 95% CI = 1.04-1.30). These relationships are displayed in Figure 3.2.

The beta values of positive and negative urgency in the count portions of these models were compared with the z -test advocated by Paternoster, Brame, Mazerolle, and Piquero (1998). This revealed no significant difference, $z = .33$, $p = .74$. The interaction terms in the count portions of the models were also compared, with no significant difference found, $z = 1.00$, $p = .32$.

Lack of premeditation was found to be a significant negative predictor of problematic alcohol use in the count portion of these two models, in contrast to the positive bivariate correlation observed between these variables. This appeared to be due to a suppression effect (MacKinnon, Krull, & Lockwood, 2000). Lack of premeditation was highly correlated with lack of perseverance and the urgency traits. In a model with these traits removed, lack of premeditation showed a non-significant positive association with problematic use scores ($b = 0.07$, $SE\ b = 0.23$, $z = 0.29$, $p = .77$).

Table 3.1

Bivariate correlations and descriptive statistics

	1	2	3	4	5	6	7	8	9	10	11	12
1. Gender ^a	-											
2. Lack of premeditation	.06	-					.13	.24**	.17	.10	.08	-.08
3. Lack of perseverance	-.07	.44***	-				.09	.03	.03	.02	.06	.01
4. Sensation seeking	.22***	.07	-.26***	-			.06	.08	.19*	.01	.01	.10
5. Negative urgency	-.17**	.31***	.22***	.18**	-		.04	-.07	.19*	-.06	.05	.28*
6. Positive urgency	.05	.41***	.26***	.35***	.69***	-	.07	.11	.39***	.04	.04	.35**
7. Perceived peer alcohol use	.17**	.22***	.05	.04	.09	.03	-					
8. Alcohol consumption	.09	.22***	.03	.06	-.01	.06	.48***	-				
9. Problematic alcohol use	.07	.17**	.03	.13*	.14*	.23***	.38***	.59***	-			
10. Perceived peer cannabis use	.26***	.21**	.03	.11	.12*	.09	.41***	.31***	.31***	-		
11. Cannabis use frequency	.22***	.19**	.09	.11	.13*	.13*	.27***	.27***	.41***	.60***	-	
12. Problematic cannabis use	.25***	.13*	.06	.15*	.20**	.22***	.12	.13*	.35***	.59***	.67***	-
Mean		2.00	2.19	2.75	2.36	1.95	6.80	1.15	1.74	3.44	.23	.44
SD		.47	.45	.64	.53	.55	4.90	2.08	4.01	4.23	.68	1.35

Data for full sample are presented below the diagonal ($N = 269-270$); Data for alcohol users only (columns 7-9, $n = 118-120$) and cannabis users only (columns 10-12, $n = 53-56$) are presented above the diagonal; Gender coded as female = 0, male = 1.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 3.2

Zero-inflated negative binomial regression analysis – Problematic alcohol use

Variable	B	SE b	Z	Estimate	95% C.I.
Negative urgency					
Logistic					
<i>Step 1</i>					
Gender	0.04	0.45	0.10	1.04	0.43-2.54
Lack of premeditation	-0.93	0.45	-2.05*	0.40	0.16-0.96
Lack of perseverance	0.57	0.50	1.15	1.77	0.67-4.72
Sensation seeking	0.24	0.33	0.74	1.27	0.67-2.42
Negative urgency	-0.09	0.41	-0.23	0.91	0.41-2.02
Perceived peer alcohol use	-0.36	0.08	-4.71***	0.70	0.60-0.81
<i>Step 2</i>					
Negative urgency x perceived peer alcohol use	0.09	0.12	0.78	1.10	0.87-1.39
Count					
<i>Step 1</i>					
Gender	-0.21	0.28	-0.78	0.80	0.47-1.39
Lack of premeditation	-0.25	0.23	-1.05	0.78	0.49-1.24
Lack of perseverance	0.33	0.37	0.89	1.39	0.67-2.88
Sensation seeking	0.35	0.19	1.87	1.42	0.98-2.04
Negative urgency	0.59	0.25	2.37*	1.81	1.11-2.96
Alcohol consumption	0.18	0.06	3.17***	1.19	1.07-1.33
Perceived peer alcohol use	0.00	0.04	0.98	1.00	0.92-1.09
<i>Step 2</i>					
Negative urgency x perceived peer alcohol use	0.17	0.06	2.63**	1.19	1.04-1.35
Positive urgency					
Logistic					
<i>Step 1</i>					
Gender	0.12	0.22	0.29	1.12	0.51-2.47
Lack of premeditation	-1.00	0.43	-2.31*	0.37	0.16-0.86
Lack of perseverance	0.36	0.45	0.80	1.43	0.59-3.50
Sensation seeking	0.05	0.31	0.15	1.05	0.57-1.93
Positive urgency	0.25	0.38	0.65	1.28	0.60-2.73
Perceived peer alcohol use	-0.32	0.06	-5.50***	0.73	0.65-0.81
<i>Step 2</i>					
Positive urgency x perceived peer alcohol use	0.13	0.11	1.21	1.14	0.92-1.40
Count					
<i>Step 1</i>					
Gender	-0.14	0.12	-1.19	0.76	0.48-1.20
Lack of premeditation	-0.41	0.20	-2.03*	0.66	0.45-0.99
Lack of perseverance	0.03	0.31	.10	1.03	0.56-1.90
Sensation seeking	0.05	0.18	0.31	1.06	0.75-1.49
Positive urgency	0.94	0.22	4.34***	2.57	1.68-3.93
Alcohol consumption	0.12	0.04	2.86**	1.13	1.04-1.22
Perceived peer alcohol use	0.03	0.04	0.80	1.03	0.96-1.10
<i>Step 2</i>					
Positive urgency x perceived peer alcohol use	0.20	0.07	2.67**	1.22	1.06-1.42

Estimate = odds ratios for excess zeros are presented for logistic portions of the models and incidence rate ratios are presented for count portions of the models; Gender coded as female = 0, male = 1.

* $p < .05$. ** $p < .01$. *** $p < .001$.

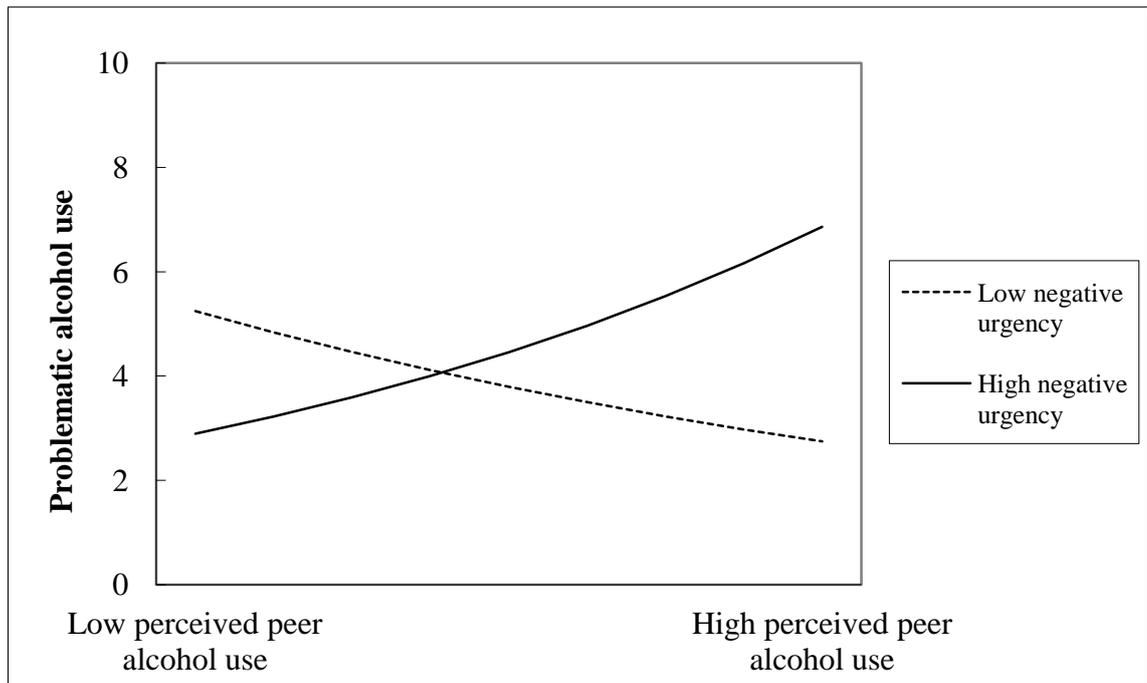


Figure 3.1. Moderation effect of negative urgency on the relationship between perceived peer alcohol use and problematic alcohol use.

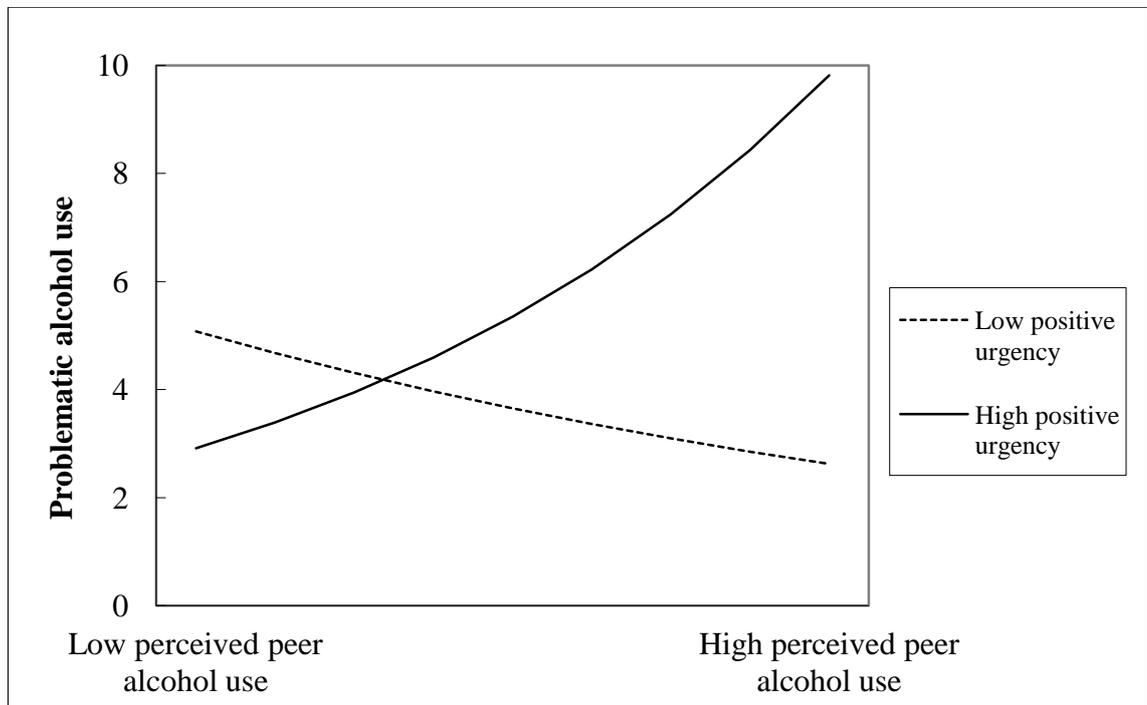


Figure 3.2. Moderation effect of positive urgency on the relationship between perceived peer alcohol use and problematic alcohol use.

Problematic cannabis use

Two further ZINB regression analyses were conducted using problematic cannabis use as the criterion variable, with separate models for negative and positive urgency (Table 3.3). Gender, lack of premeditation, lack of perseverance, sensation seeking, negative or positive urgency, cannabis use frequency, and perceived peer cannabis use were entered as predictors at step 1. The product term of negative or positive urgency and perceived peer use was entered at step 2. For the logistic portion of each model, cannabis use frequency was not included as a predictor as the majority of participants reporting no cannabis use also reported no problematic use. For both models, a likelihood ratio test of overdispersion was significant, $\chi^2(15) = 273.97, p < .001$, suggesting that negative binomial models were preferable over Poisson models.

The likelihood ratio for the negative urgency ZINB model was $\chi^2(15) = 140.46, p < .001$, indicating that the model was significant. The Vuong test supported the use of a zero-inflated model over a standard negative binomial model, $z = 6.24, p < .001$. For the logistic portion of this model, excess zero scores were significantly predicted by low perceived peer cannabis use only. For the count portion of the model, increased problematic cannabis use scores were significantly predicted by negative urgency and by lack of perseverance. The interaction term of negative urgency and perceived peer use was not significant.

The likelihood ratio for the positive urgency ZINB model was $\chi^2(15) = 125.65, p < .001$, indicating that the model was significant. The Vuong test supported the use of a zero-inflated model over a standard negative binomial model, $z = 5.59, p < .001$. For the logistic portion of this model, excess zero scores were significantly predicted by low perceived peer cannabis use only. For the count portion of the model, increased problematic cannabis use scores were significantly predicted by positive urgency. The interaction term of positive urgency and perceived peer use was not significant.

The beta values of positive and negative urgency in the count portions of these two models were compared, revealing no significant difference, $z = 1.62, p = .11$. Lack of premeditation was found to be a significant negative predictor of problematic cannabis use in the count portion of these two models. As with problematic alcohol use, a reduced model excluding lack of perseverance and the urgency traits was fitted to test for suppression effects. In this model lack of premeditation showed a non-significant negative association with problematic cannabis use ($b = -0.43, SE b = 0.25, z = -1.74, p = .08$).

Table 3.3

Zero-inflated negative binomial regression analysis – Problematic cannabis use

Variable	<i>b</i>	SE <i>b</i>	<i>z</i>	Estimate	95% C.I.
Negative urgency					
Logistic					
<i>Step 1</i>					
Gender	0.81	0.84	0.96	2.24	0.42-11.73
Lack of premeditation	-1.04	0.77	-1.36	0.35	0.08-1.59
Lack of perseverance	0.01	0.83	0.01	1.01	0.20-5.13
Sensation seeking	-0.94	0.61	-1.56	0.39	0.11-1.27
Negative urgency	0.10	0.12	0.91	1.11	0.21-5.89
Perceived peer cannabis use	-0.71	0.15	-4.63***	0.49	0.36-0.66
<i>Step 2</i>					
Negative urgency x perceived peer cannabis use	-2.33	1.48	-1.57	0.10	0.01-1.77
Count					
<i>Step 1</i>					
Gender	0.40	0.24	1.66	1.50	0.92-2.41
Lack of premeditation	-0.70	0.24	-2.91**	0.50	0.31-0.80
Lack of perseverance	0.82	0.30	2.74**	2.28	1.27-4.10
Sensation seeking	0.35	0.22	1.60	1.41	0.92-2.16
Negative urgency	1.06	0.24	4.35***	2.88	1.79-4.64
Cannabis use frequency	-0.04	0.09	-0.43	0.96	0.80-1.15
Perceived peer cannabis use	0.08	0.05	1.64	1.09	0.98-1.20
<i>Step 2</i>					
Negative urgency x perceived peer cannabis use	-0.40	0.27	-1.49	0.67	0.39-1.14
Positive urgency					
Logistic					
<i>Step 1</i>					
Gender	0.61	0.84	0.73	1.85	0.36-9.60
Lack of premeditation	-1.23	1.08	-1.14	0.29	0.03-2.42
Lack of perseverance	-0.29	0.85	-0.34	0.74	0.14-3.99
Sensation seeking	-0.90	0.76	-1.18	0.41	0.09-1.82
Positive urgency	-1.21	0.76	-1.60	0.30	0.07-1.33
Perceived peer cannabis use	-0.80	0.23	-3.49***	0.45	0.28-0.70
<i>Step 2</i>					
Positive urgency x perceived peer cannabis use	0.54	0.91	0.59	1.71	0.29-10.17
Count					
<i>Step 1</i>					
Gender	0.13	0.24	0.54	1.14	0.18-3.84
Lack of premeditation	-0.76	0.27	-2.82**	0.47	0.28-0.79
Lack of perseverance	0.45	0.29	1.54	1.57	0.89-2.78
Sensation seeking	0.13	0.26	0.50	1.14	0.69-1.89
Positive urgency	0.51	0.24	2.09*	1.66	1.03-2.68
Cannabis use frequency	0.12	0.09	1.33	1.13	0.94-1.34
Perceived peer cannabis use	0.02	0.05	0.50	1.02	0.93-1.12
<i>Step 2</i>					
Positive urgency x perceived peer cannabis use	0.02	0.20	0.09	1.02	0.69-1.49

Estimate = odds ratios for excess zeros are presented for logistic portions of the models and incidence rate ratios are presented for count portions of the models; Gender coded as female = 0, male = 1.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Discussion

This study aimed to determine how the five impulsivity-related personality traits specified by the UPPS framework were associated with aspects of alcohol and cannabis use in an adolescent sample. A particular focus was given to negative and positive urgency, traits that have previously been shown to relate to problematic alcohol and substance use in older samples.

Of the five UPPS traits, lack of premeditation showed the largest correlation with typical alcohol consumption and with perceived peer alcohol use. Positive urgency showed the largest correlation with problematic alcohol use. This association was substantially larger when the analysis was limited to participants who were alcohol users. Both urgency traits were found to explain a significant amount of variance in problematic alcohol use scores, even after accounting for non-urgency traits and typical consumption. These findings indicate direct associations between the urgency traits and problematic alcohol use that are not explainable by increased levels of consumption. This is in line with the observation that urgency traits show stronger relationships with problematic use measures than with typical consumption in older samples (Curcio & George, 2011; Kaiser et al., 2012; Simons et al., 2010), and suggest that the urgency traits may be psychological characteristics that help to distinguish problematic alcohol users from typical, non-problematic users (Colder & Chassin, 1999). However, the finding is somewhat inconsistent with data from college age participants, which show an indirect effect of positive urgency on problematic use through heightened alcohol consumption (Wray, Simons, Dvorak, & Gaher, 2012). It may be that high urgency adolescents are particularly susceptible to negative consequences at relatively low levels of typical consumption, perhaps as a

consequence of failing to consider the possible dangerous outcomes that can result from alcohol use (Van Hoof, Van den Boom, & De Jong, 2011).

Both urgency traits moderated the relationship between perceived peer alcohol use and individual problematic use, making it stronger. This is a novel finding. Prior research has established a link between perceived drinking norms and problematic use (Beck & Treiman, 1996; Cardenal & Adell, 2000; Martino, Ellickson, & McCaffrey, 2009), yet there has been limited consideration of dispositional factors that might exacerbate this link. The present data suggest that adolescents high in urgency may be particularly likely to show a link between the perceived drinking norms of their peers and their own problematic use. Interestingly, the urgency traits were not significantly associated with perception of peer alcohol use, suggesting that the observed interaction effect is unlikely to be the result of high urgency individuals socialising with more alcohol-using peers or overestimating peer drinking norms.

Urgency appears to reflect a tendency to rely on affective input to guide behaviour, at least when in a heightened mood state. High urgency individuals may be more inclined to use the 'affect heuristic' (Slovic, Finucane, Peters, & MacGregor, 2002), i.e. to make decisions based on the affective valence of representations associated with those decisions. Phillips, Hine, and Marks (2009) found that adolescents with high negative urgency scores showed a stronger relationship than those with low scores between their affective associations about drinking alcohol and self-reported binge drinking. As social stimuli appear to activate a strong emotional response in adolescence (Nelson et al., 2005), normative information about alcohol use could act as one such affective association. Those who perceive high peer use may use this information as a positively valenced affective influence on their decision to consume alcohol. This, combined with a reduced tendency to control behaviour when in extreme mood states, may spur dangerous alcohol use in high urgency adolescents.

Lack of premeditation was the trait with the largest correlation with cannabis use frequency and with perception of peer use, suggesting that both using cannabis and believing that cannabis use is normative are associated with a tendency to engage in behaviour without adequate forethought. Sensation seeking did not show large correlations with these variables. As was noted in the introduction to this chapter, it is possible that the aspect of sensation seeking reflected in the UPPS scale, that of thrill and adventure seeking, is not particularly related to typical cannabis use in adolescents.

Both urgency traits showed significant positive correlations with cannabis use frequency, and both explained significant variance in problematic cannabis use scores when controlling for other impulsivity-related traits and typical cannabis use. This is the first time that these relationships have been identified in an adolescent sample. These findings contribute to previous evidence of a positive relationship between urgency and cannabis use (Kaiser et al., 2012; Lynam & Miller, 2004), and support the possibility that difficulties with affect regulation are related to experiencing negative consequences from using cannabis (Simons & Carey, 2002). No evidence of interaction effects between the urgency traits and perceived peer cannabis use on problematic use were found in this sample.

Limitations

This study was cross-sectional in nature, so these data do not confirm that the urgency traits are risk factors for problematic substance use in adolescence. Variables can only be considered risk factors once they are found to precede and reliably predict the outcome under investigation (Kraemer et al., 1997). Although the urgency traits have been shown to longitudinally predict problematic alcohol use and illegal substance use in older samples (Cyders et al., 2009; Zapski, Cyders, & Smith, 2009), such prospective relationships are still to be confirmed in adolescents.

Generalisation of these findings is somewhat limited by the high number of females in the present sample. This overrepresentation is reflective of humanities subjects in UK sixth forms (Department for Education and Skills, 2007), but may indicate a sampling bias in that representatives from humanities departments may have been more likely than those from other departments to respond to requests for participation in a psychological study. Additionally, the lack of data for participant ethnicity precluded comparisons being made between ethnic groups. Differences in substance use behaviour between ethnic groups have been found at this age, with white adolescents reporting higher levels of heavy alcohol use and cannabis use than their African American peers in the US (Johnston, O'Malley, Bachman, & Schulenberg, 2012), and higher past week alcohol use than their black and Asian peers in England (Fuller, 2012). Data on socioeconomic status were also not collected. Future research could investigate how the relationships observed here are affected by ethnicity and sociocultural factors.

A further limitation was the sole use of self-report when assessing peer substance use. Numerous studies have reported the tendency of young people, mainly college students, to have an exaggerated perception of their peers' substance use (see Perkins, 2002). Obtaining reports from participants' friends on their actual alcohol and cannabis use in order to verify whether individual reports are accurate would be a useful addition in future work.

Finally, the analysis model used was not entirely appropriate for RAPI data, despite being the best fitting option (Light et al., 2011). It is recommended that researchers using substance use measures with samples in which a high number of zero values are expected show careful consideration in selecting suitable methods of assessment and analysis. One possible remedy would be to modify response options for the RAPI and similar scales so that scores reflect a true count distribution.

Future directions

Further investigation into how heightened urgency increases risk for problematic substance use is warranted. The present findings suggest that adolescents high in urgency traits may be particularly susceptible to certain social factors influencing dangerous drinking behaviour, perhaps because of these factors' affective salience. Authors have emphasised the role of affect in decision making under risk generally (Loewenstein, Weber, Hsee, & Welch, 2001), and in progression towards substance dependence specifically (Murphy, Taylor, & Elliott, 2012). Investigating potential errors and biases in the decision making of high urgency adolescents and how these might come about in certain emotional states or social contexts is therefore encouraged.

Additionally, examining interactions between urgency and perceived peer behaviour in relation to other substances such as nicotine may yield interesting results. Urgency traits have been found to relate to nicotine dependence and craving in college students (Billieux, Van der Linden, & Ceschi, 2007; Spillane, Smith, & Kahler, 2010), but it has yet to be shown whether these traits have any moderating influence on peer-related risk factors for problematic smoking.

Conclusion

These findings indicate that negative and positive urgency are the elements of trait impulsivity most related to problematic alcohol and cannabis use in adolescence. These appear to be direct effects, not fully explained by increased use frequency. Additionally, this study extends the literature by highlighting moderating effects of the urgency traits on the relationship between perceived peer alcohol use and individual problematic use.

Chapter 4

Impulsivity and peer influences on substance use in late adolescence: A prospective study

Overview

This chapter describes a three month prospective study of late-adolescent college students (aged 18-21). The primary aim of the study was to test whether the moderating effect of urgency on the relationship between perceived peer alcohol use and own problematic use reported in the previous chapter replicated in an older sample and to assess whether the effect persisted longitudinally. Results showed that urgency significantly predicted concurrent and prospective problematic alcohol use, and significantly predicted concurrent problematic cannabis use. The moderation effect was replicated with regard to problematic alcohol use measured concurrently, but not prospectively. Potential moderation effects were also tested for problematic cannabis use but were not found. A further aim of the study was to investigate whether impulsivity-related personality traits predicted the selection of new substance-using friends. Multiple regression analysis indicated a concurrent and prospective association between lack of premeditation and new cannabis-using friends.

Introduction

In the previous chapter, the urgency traits were found to moderate the relationship between perceived peer alcohol use and own problematic use, making it stronger. It is possible that such an effect extends into later adolescence. Peer substance use is still linked to individual use in this age group. Although resistance to peer influence increases from age 14 to 18 (Steinberg & Monahan, 2007), individuals aged 18 and over are likely to report similar levels of substance use as their friends (Dennhardt & Murphy, 2013), and peer substance use prospectively predicts individual use into young adulthood (Andrews, Tildesley, Hops, & Li, 2002). Perceived peer alcohol and substance use is positively associated with individual use and problematic use in recent high school graduates (Wood, Read, Mitchell, & Brand, 2004) and in college students (Lewis & Clemens, 2008; Taylor, 2006; Thombs, Beck, & Pleace, 1993). Indeed, perceived peer norms may be especially influential on substance use during the first year at college, as individuals make new acquaintances and modify their behaviour to their social surroundings (Borsari, Murphy, & Barnett, 2007).

College students may be prone to overestimate the substance use norms of their new peers, and to wrongfully assume that their own substance use is less than that of the average student (Perkins, Meilman, Leichliter, Cashin, & Presley, 1999). This 'pluralistic ignorance' may cause dissonance in some individuals, motivating them to increase their substance use (Prentice & Miller, 1993). Individuals high in trait urgency may be more likely to modify their substance use in response to pluralistic ignorance. As noted in the previous chapter, social stimuli such as perceived norms may be an affective input for individuals considering whether to engage in substance use. High urgency individuals who perceive high levels of peer use may be inclined to use this

information to direct their own substance use behaviour, particularly when in heightened mood states.

Peer selection

It is important to note that the development of normative beliefs is likely to be dependent on the company an individual chooses to keep. Peer influence is a two-stage process of selection followed by socialisation (Urberg, Luo, Pilgrim, & Degirmencioglu, 2003). Before influence can take place, individuals must first choose peers with which to affiliate. Research suggests that peer selection tends to be homophilic, i.e. individuals select friends who possess similar characteristics to themselves (Gifford-Smith & Brownell, 2003), yet even very similar friends are likely to differ on multiple characteristics, offering scope for reciprocal influence (Urberg et al., 2003). Indeed, Kandel (1978) found that homophily between dyads increases after friendships are formed.

Individual differences in personality are likely to influence the selection of friends and the cultivation of peer relationships (Caspi, Roberts, & Shiner, 2005), and may do so to a greater degree during periods of transition such as the move to college (Littlefield & Sher, 2010). Affiliation with friends who share similar characteristics may reinforce pre-existing behavioural tendencies (Caspi et al., 2005), an example of person-environment correlation (Buss, 1984).

Applying these ideas to substance use, peer cluster theory (Oetting & Beauvais, 1986, 1987) suggests that adolescents with predisposing risk factors for substance use are likely to select and associate with individuals who display similar characteristics or who have already initiated substance use. These friendship clusters then reinforce attitudes and beliefs about substance use, promoting use amongst group members. An extension of peer cluster theory, primary socialisation theory (Oetting, Deffenbacher,

& Donnermeyer, 1998), posits that individual characteristics generally only relate to substance use through their influence on how the individual responds to socialisation sources. Evidence for these theories has been put forward by Donohew et al. (1999), who found that individual sensation seeking was predictive of peer sensation seeking and perceived peer alcohol and cannabis use, which in turn predicted own use.

Peer cluster and primary socialisation theories were developed with regard to younger adolescents but can certainly also be applied to late adolescents, particularly those in the transition to college where new friendships are likely to be made. In a study using two samples of first year undergraduates, Kahler, Read, Wood, and Palfai (2003) found that an association between impulsive sensation seeking and alcohol use was mediated by two social factors likely to encourage alcohol use – friend’s approval of alcohol use and involvement with Greek fraternities, where alcohol use tends to be condoned and encouraged. These authors explained their findings by suggesting that high sensation seekers might be more likely to seek out social environments that promote alcohol use when they begin college. Building upon this cross-sectional evidence with prospective data, a large study of over 3000 incoming college students found that individuals high in impulsivity/novelty seeking and in pre-college drinking were likely to select into Greek fraternities at college, perhaps in an effort to continue their own pre-college drinking habits (Park, Sher, Wood, & Trull, 2009).

Other studies have looked at the broader issue of how traits might relate to affiliation with deviant, or antisocial, peers. Low self-control predicts selection into deviant peer groups, which in turn increases the likelihood of substance use (Chapple, 2005). In a study of over 5000 12-18 year olds, Yanovitzky (2005) found sensation seeking to be positively associated with affiliation with deviant peers and with pro-substance discussions with peers. These two social variables also mediated the relationship between sensation seeking and the intention to use cannabis. Similar

results were obtained by Hampson, Andrews, and Barckley (2008), who found that adolescents high in sensation seeking were more likely to develop a positive view of cannabis use and to associate with deviant peers over a three year period. Again, the association with deviant peers was found to mediate the relationship between sensation seeking and own cannabis use.

To date, no studies have assessed trait impulsivity alongside a measure of new substance-using friends made during college. The current study will attempt to address this gap in the literature by assessing the impulsivity-related traits of the UPPS framework alongside measures of how many new alcohol- and cannabis-using friends individuals have made at two time points in their first year at college.

Urgency as a risk factor

The quantitative review and empirical study described in Chapters 2 and 3 provide firm evidence that the urgency traits are linked with problematic substance use in adolescence. However, this evidence is not strong enough to class urgency as a risk factor. A key step in identifying risk factors is to determine whether prospective relationships exist between the variable and outcome of interest. To date, only a small number of studies have examined prospective relationships between the urgency traits and substance use outcomes. Positive urgency has been found to predict alcohol-related problems and typical quantity of alcohol consumed over the first year of university (Cyders et al., 2009). It has also been shown to predict illegal drug use, measured as a composite including cannabis alongside other drugs, in a sample of first year college undergraduates (Zapolski, Cyders, & Smith, 2009). Most recently, Smith, Guller, and Zapolski (2013) found that relationships between urgency, analysed as a combination of positive and negative facets, showed stable relationships with drinking and smoking frequency over one year in a sample of preadolescent schoolchildren.

These findings are promising, but there is clearly a need for further study. Thus, the present study seeks to contribute to the literature by reporting prospective relationships between the urgency traits and measures of problematic alcohol and cannabis use, and to assess whether interaction effects between urgency and perceived peer substance use on problematic use might persist over a three month period.

Aims and hypotheses

This study has three aims. The first is to further explore the moderating effect of urgency on the relationship between perceived peer substance use and own problematic use that was found in Chapter 3 by testing whether this effect is present in an older sample and whether it is stable over three months. It is predicted that an interaction will be found with regard to alcohol, and a tentative prediction is made that this effect will also apply to problematic cannabis use. The second aim is to add to the growing evidence base identifying urgency as a risk factor for problematic substance use by testing whether the urgency traits predict problematic alcohol and cannabis use over a three month period. It is predicted that the urgency traits will be positively associated with these variables concurrently and prospectively. The final aim is to investigate whether impulsivity-related traits are associated concurrently or prospectively with the selection of new substance-using friends. This is an exploratory research question and no specific prediction is made.

Method

Participants

One hundred and one first year university undergraduates (75 female) with an age range of 18-21 ($M = 18.89$, $SD = .97$) completed the first wave of the study. Fifty six of these participants (42 female) were successfully followed up after three months. Participants were recruited using online message forums and through emails sent via departmental offices of six universities in the London area, and were offered entry into a £50 prize draw in return for participation.

Measures

Impulsivity

The UPPS-P Impulsive Behaviour Scale was used to measure the five facets of impulsivity. Cronbach's alpha values in the present sample were: lack of premeditation = .88, lack of perseverance = .87, sensation seeking = .85, negative urgency = .90, positive urgency = .95.

Alcohol

Typical alcohol consumption was assessed with the same two items reported in Chapter 3. These items were multiplied for a continuous score between 0 and 16. The test-retest correlation was $r = .69$.

Perceived peer alcohol use was assessed with the same measure reported in Chapter 3. Exploratory factor analysis with maximum likelihood extraction was used to assess the feasibility of combining items assessing descriptive and injunctive norms

into one scale. Only one factor with an eigenvalue greater than 1.0 was extracted. This factor explained 47.01% of the variance. Items were thus summed for a score ranging from 0-20. Cronbach's alpha was .80 at time 1 and .63 at time 2, with a .79 test-retest correlation.

Problematic alcohol use was assessed using the 18-item Rutgers Alcohol Problem Index (RAPI; White & Labouvie, 1989; White & Labouvie, 2000). At time 1, participants were asked to respond in relation to the past year; at time 2 they were asked to respond in relation to the past three months. Cronbach's alpha for the RAPI in this sample was .92 at time 1 and .90 at time 2. The test-retest correlation was $r = .69$.

Cannabis

Typical cannabis use was assessed with the items *How often do you smoke cannabis?* and *When you smoke cannabis, how much, on average, do you smoke?* Five response options were provided for each item, ranging from *Never* (0) to *4 or more times per week* (4), and one (0) to five (4) cannabis cigarettes, respectively. As with alcohol use, the product of these items was calculated, giving a continuous score from 0-16. Scores showed a test-retest correlation of .90.

Perceived peer cannabis use was assessed with the same measures reported in Chapter 3. As with perceived alcohol use, results from an exploratory factor analysis supported combining items reflecting descriptive and injunctive norms. One factor with an eigenvalue greater than 1.0 was extracted. This factor explained 58.74% of the variance. Items were summed for a score ranging from 0-16. Cronbach's alpha was .83 at time 1 and .81 at time 2, with a .79 test-retest correlation.

Problematic cannabis use was assessed with the short form of the Cannabis Problems Questionnaire for Adolescents (CPQ-A-S; Proudfoot, Vogl, Swift, Martin, &

Copeland, 2010). Cronbach's alpha was .84 at time 1 and .91 at time 2. The test-retest correlation was $r = .71$.

New substance-using friends

At both time points, participants were asked *In the past three months, how many people who use alcohol/cannabis have you become friends with?* (one item for each substance). Five response options were provided, ranging from *None* (0) to *7 or more* (4). The test-retest correlation for new alcohol-using friends was .45, and for new cannabis-using friends was .66.

Procedure

The study was approved by the Goldsmiths, University of London, Psychology Department Ethics Committee. Initial recruitment took place in January 2012, approximately three months after participants began their university course. Measures were completed online through the Unipark/Questback survey website (<http://www.unipark.org.uk>). Participants completed a consent form prior to beginning the questionnaires, and were given the opportunity to email the researcher with any questions about the study. Three months after completing the time 1 (T1) measures, participants were emailed a link to complete time 2 (T2) questions. Those who did not complete these measures on first request were emailed with reminders each week for four weeks. Debrief information was emailed to all participants after this period.

Results

Data screening

Data were analysed using IBM SPSS version 19 and R version 3.0.0 with the *pscl* (Jackman, 2008; Zeileis, Kleiber, & Jackman, 2008) and *MASS* (Venables & Ripley, 2002) packages. Inspection of standardised scores revealed three participants to have extreme T1 RAPI scores ($z > 3.29$). These scores were Winsorised. No multivariate outliers were found. All variables had less than 5% of missing values. Missing trait scores were imputed using expectation maximisation. Some modest departures from normality were observed for typical alcohol and cannabis use scores, which were positively skewed, and perceived peer alcohol use scores, which were negatively skewed (skewness values slightly over 1.0). These variables were square-root transformed and analyses were conducted using both transformed and non-transformed variables. No substantial differences in results were observed. Analyses using non-transformed data are reported.

Attrition

Independent *t* tests were conducted to assess differences in trait, alcohol use, and cannabis use scores between participants that were followed up and those that were not. Participants who completed the follow-up measures showed significantly lower positive urgency scores ($M = 2.00$, $SD = .61$) than participants who did not ($M = 2.34$, $SD = .67$), $t(94) = 2.61$, $p = .01$. No other significant differences were found.

Descriptive statistics and correlations

The percentage of participants in this sample who reported ever using alcohol was 94%, whilst for cannabis use the percentage was 67%. Bivariate correlations for T1 measures are presented in Table 4.1 along with means and standard deviations. Lack of premeditation was the only trait to show a significant correlation with perceived peer alcohol use and typical alcohol consumption, and showed the largest association with problematic alcohol use. Sensation seeking showed significant positive associations with all cannabis variables, yet not with alcohol variables. The urgency traits were significantly associated with problematic alcohol use only.

Differences between T1 and T2 substance use scores amongst follow-up participants were compared using paired samples *t*-tests (Table 4.2). Alcohol consumption and problematic alcohol use were significantly lower at T2. No other significant differences were found. Table 4.3 shows prospective associations between trait scores and T2 substance use measures. Both urgency traits showed substantial associations with T2 problematic alcohol use. Positive urgency was the only trait score significantly associated with T2 problematic cannabis use.

Concurrent prediction of problematic substance use by urgency

Substantial skewness and kurtosis were observed for RAPI scores at T1 ($S = 1.79$, $K = 2.79$) and at T2 ($S = 1.45$, $K = 1.78$), and for CPQ scores at T1 ($S = 1.62$, $K = 2.26$) and T2 ($S = 1.92$, $K = 2.91$). Inspection of histograms revealed a large amount of zero values for these variables. As with data presented in Chapter 3, zero-inflated negative binomial (ZINB) regression was selected as the appropriate method of analysis. This decision was verified using three tests. First, the likelihood ratio statistic was used to test the fit of the model. Second, the Vuong test for non-nested models was used to assess whether zero-inflated models were preferable over standard

negative binomial models. Finally, the overdispersion was used to assess whether negative binomial models were preferable over Poisson models. Results of these tests, reported in Tables 4.3 to 4.6, supported the use of ZINB models for all but one of these analyses. In the ZINB regression model for T1 RAPI data, substantially inflated standard errors were observed for coefficients in the logistic portion of the model. A zero-inflated Poisson (ZIP) regression model was fitted as an alternative. This model showed good fit to the data and standard errors were no longer inflated.

Negative and positive urgency items were summed and averaged into a unitary score for these analyses, as separate scores showed almost identical correlations with T1 alcohol and cannabis variables (all within .05). A hierarchical regression procedure was employed, with all predictor variables mean-centred. Gender, substance (alcohol or cannabis) use frequency, perceived peer use, and UPPS trait scores were entered at step 1. The product term of urgency and perceived peer use was entered at step 2.

Alcohol

Results of the ZIP model for T1 problematic alcohol use are presented in Table 4.4. For the logistic portion of the model, excess zero scores were significantly predicted by low perceived peer alcohol use only. For the count portion of the model, increased problematic alcohol use scores were significantly predicted by typical alcohol use and by urgency. The interaction term of urgency and perceived peer use was significant ($p = .02$). Simple slopes analysis indicated that at low levels of urgency (-1 SD) the slope of the relationship between perceived peer alcohol use and problematic alcohol use was $b = -.04$, $SE\ b = .02$, $z = -1.69$, $p = .09$, and at high levels of urgency (+1 SD) the slope was $b = .02$, $SE\ b = .02$, $z = 1.50$, $p = .13$. These relationships are displayed in Figure 4.1.

Lack of premeditation was found to be a significant negative predictor of problematic alcohol use in the count portion of this model, in contrast to the positive bivariate correlation observed between these variables. As was found in the analysis reported in Chapter 3, this appeared to be due to a suppression effect. Lack of premeditation was highly correlated with lack of perseverance and with urgency in this sample. In a model with these traits removed, lack of premeditation showed a non-significant negative association with problematic use scores ($b = -0.14$, $SE\ b = 0.09$, $z = -1.63$, $p = .10$).

Table 4.1

Bivariate correlations and descriptive statistics for T1 measures

	1	2	3	4	5	6	7	8	9	10	11	12
1. Gender	-											
2. Lack of premeditation	.02	-										
3. Lack of perseverance	.08	.46***	-									
4. Sensation seeking	.22*	.23*	-.06	-								
5. Negative urgency	-.14	.51***	.25*	.12	-							
6. Positive urgency	-.07	.47***	.24*	.19	.79***	-						
7. Perceived peer alcohol use	.11	.24*	.15	.03	.11	.06	-					
8. Alcohol consumption	.20*	.44**	.17	.17	.15	.14	.47***	-				
9. Problematic alcohol use	.08	.23*	.06	.13	.20*	.20*	.31**	.53***	-			
10. Perceived peer cannabis use	.30**	.24*	.22*	.21*	.05	.08	.52***	.36***	.51***	-		
11. Cannabis use	.25*	-.02	.09	.25*	-.10	-.06	.08	.22*	.47***	.54***	-	
12. Problematic cannabis use	.20*	.18	.10	.21*	.17	.19	.21*	.27**	.41***	.56***	.52***	-
Mean		2.06	2.22	2.87	2.56	2.13	13.90	3.57	6.75	7.04	1.14	1.75
SD		.51	.56	.59	.63	.66	4.76	3.39	8.30	4.50	3.25	2.48

N = 101; Gender coded as female = 0, male = 1.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4.2

Differences between T1 and T2 substance use scores in follow-up sample

	Time 1 Mean (SD)	Time 2 Mean (SD)	<i>t</i> (<i>df</i> =55)
Perceived peer alcohol use	14.80 (3.79)	14.48 (3.30)	-1.03
Alcohol consumption	3.55 (3.10)	2.88 (2.53)	-2.23*
Problematic alcohol use	7.21 (8.20)	5.45 (5.95)	-2.23*
Perceived peer cannabis use	7.43 (4.20)	7.14 (4.14)	-.79
Cannabis use	1.27 (3.58)	1.05 (3.12)	-1.05
Problematic cannabis use	1.70 (2.43)	1.89 (3.12)	.66

n = 56.* *p* < .05.

Table 4.3

Prospective correlations between T1 trait scores and T2 substance use variables

	Perceived peer alcohol use	Alcohol consumption	Problematic alcohol use	Perceived peer cannabis use	Cannabis use	Problematic cannabis use
Lack of premeditation	.21	.29*	.31*	.14	.03	.02
Lack of perseverance	.01	.18	.06	.10	.06	-.04
Sensation seeking	.11	-.11	-.04	.15	.20	.07
Negative urgency	.15	.28*	.51***	-.06	.13	.16
Positive urgency	.04	.23	.53***	.07	.26	.28*

n = 56.* *p* < .05. ** *p* < .01. *** *p* < .001.

Table 4.4

ZIP regression with T1 RAPI scores as outcome

Variable	<i>b</i>	SE <i>b</i>	<i>z</i>	Estimate	95% C.I.
Logistic					
<i>Step 1</i>					
Gender	0.02	0.48	0.03	1.02	0.40-2.59
Perceived peer alcohol use	-0.35	0.09	-3.94***	0.71	0.59-0.84
Urgency	-0.76	0.82	-0.93	0.47	0.09-2.33
Lack of premeditation	-1.49	1.14	-1.31	0.23	0.02-2.11
Lack of perseverance	-1.07	0.90	-1.19	0.34	0.06-1.99
Sensation seeking	-0.48	0.67	-0.72	0.62	0.17-2.29
<i>Step 2</i>					
Urgency x perceived peer alcohol use	0.16	0.18	0.90	1.18	0.83-1.67
Count					
<i>Step 1</i>					
Gender	-0.05	0.05	-0.99	0.95	0.87-1.05
Alcohol consumption	0.13	0.01	11.29***	1.14	1.12-1.17
Perceived peer alcohol use	0.01	0.01	0.58	1.01	0.98-1.03
Urgency	0.34	0.07	4.58***	1.41	1.22-1.63
Lack of premeditation	-0.37	0.11	-3.20**	0.69	0.55-0.87
Lack of perseverance	-0.11	0.08	-1.29	0.89	0.76-1.06
Sensation seeking	-0.08	0.07	1.15	1.09	0.94-1.25
<i>Step 2</i>					
Urgency x perceived peer alcohol use	0.05	0.02	2.39*	1.05	1.01-1.10
Likelihood ratio: $\chi^2(15) = 217.73, p < .001$					
Vuong test: $z = 4.02, p < .001$					

Estimate = odds ratios for excess zeros are presented for logistic portions of the models and incidence rate ratios are presented for count portions of the models; Gender coded as female = 0, male = 1.

* $p < .05$. ** $p < .01$. *** $p < .001$.

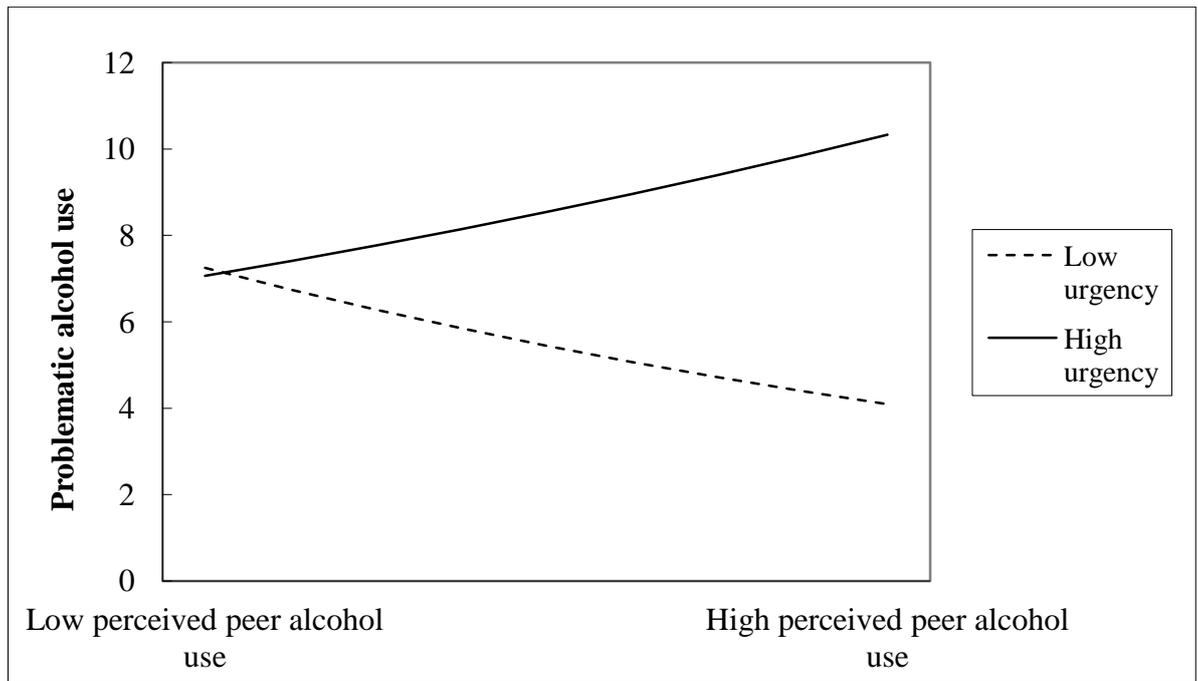


Figure 4.1. Moderation effect of urgency on the relationship between perceived peer alcohol use and concurrent problematic alcohol use.

Cannabis

Results of the ZINB model for T1 problematic cannabis use are presented in Table 4.5. For the logistic portion of the model, excess zero scores were significantly predicted by low perceived peer cannabis use only. For the count portion of the model, increased problematic cannabis use scores were significantly predicted by urgency and by typical cannabis use. The interaction term of urgency and perceived peer use was not significant.

Table 4.5

ZINB regression with T1 CPQ scores as outcome

Variable	<i>b</i>	SE <i>b</i>	<i>z</i>	Estimate	95% C.I.
Logistic					
<i>Step 1</i>					
Gender	-0.60	0.48	-1.25	0.55	0.21-1.40
Perceived peer cannabis use	-0.35	0.09	-3.80***	0.70	0.59-0.84
Urgency	0.18	0.65	0.28	1.20	0.34-4.28
Lack of premeditation	-0.19	0.70	-0.27	0.83	0.21-3.24
Lack of perseverance	0.17	0.65	0.26	1.18	0.33-4.20
Sensation seeking	0.40	0.56	0.71	1.49	0.50-4.45
<i>Step 2</i>					
Urgency x perceived peer cannabis use	0.33	0.20	1.64	1.39	0.94-2.07
Count					
<i>Step 1</i>					
Gender	-0.08	0.11	-0.72	0.92	0.74-1.15
Cannabis use	0.05	0.02	1.92	1.05	1.00-1.10
Perceived peer cannabis use	0.04	0.03	1.32	1.04	0.98-1.11
Urgency	0.52	0.20	2.61**	1.68	1.14-2.49
Lack of premeditation	0.04	0.24	0.15	1.04	0.65-1.67
Lack of perseverance	-0.11	0.19	-0.57	0.90	0.62-1.30
Sensation seeking	0.25	0.20	1.27	1.29	0.87-1.90
<i>Step 2</i>					
Urgency x perceived peer cannabis use	-0.02	0.05	-0.37	0.98	0.88-1.09
Likelihood ratio: $\chi^2(15) = 63.98, p < .001$					
Vuong test: $z = 4.98, p < .001$					
Test of overdispersion: $\chi^2(15) = 118.06, p < .001$					

Estimate = odds ratios for excess zeros are presented for logistic portions of the models and incidence rate ratios are presented for count portions of the models; Gender coded as female = 0, male = 1.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Prospective prediction of problematic substance use by urgency

Non-urgency UPPS traits were not included in models of prospective data due to the reduction in power as a result of the reduced follow-up sample. Hierarchical regression models were again used, with all predictor variables mean-centred for analysis. Gender, substance use frequency, T1 perceived peer use, urgency, and T1 problematic use were entered at step 1. The product term of urgency and T1 perceived

peer use was entered at step 2. T1 use and problematic use were entered only for the count portion of these models, to avoid issues of separation.

Table 4.6

ZINB regression with T2 RAPI scores as outcome

Variable	<i>b</i>	SE <i>b</i>	<i>z</i>	Estimate	95% C.I.
Logistic					
<i>Step 1</i>					
Gender	-0.02	0.46	-0.05	0.98	0.39-2.43
T1 Perceived peer alcohol use	-0.23	0.10	-2.23*	0.79	0.65-0.97
Urgency	-1.11	0.77	-1.44	0.33	0.07-1.49
<i>Step 2</i>					
Urgency x perceived peer alcohol use	0.15	0.21	0.71	1.16	0.77-1.76
Count					
<i>Step 1</i>					
Gender	0.14	0.09	1.52	1.15	0.96-1.36
T1 Alcohol consumption	-0.04	0.03	-1.46	0.96	0.90-1.02
T1 Perceived peer alcohol use	0.02	0.03	0.55	1.02	0.96-1.08
T1 Problematic use	0.06	0.01	5.28***	1.06	1.04-1.08
Urgency	0.58	0.17	3.30***	1.78	1.26-2.51
<i>Step 2</i>					
Urgency x perceived peer alcohol use	0.02	0.05	0.64	1.02	0.93-1.12
Likelihood ratio: $\chi^2(10) = 51.57, p < .001$					
Vuong test: $z = 5.16, p < .001$					
Test of overdispersion: $\chi^2(10) = 186.84, p < .001$					

Estimate = odds ratios for excess zeros are presented for logistic portions of the models and incidence rate ratios are presented for count portions of the models; Gender coded as female = 0, male = 1.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Alcohol

Results of the ZINB model for T2 problematic alcohol use are presented in Table 4.6. For the logistic portion of the model, excess zero scores were significantly predicted by low perceived peer alcohol use only. For the count portion of the model, increased problematic alcohol use scores were significantly predicted by urgency and by T1 problematic use. The interaction term of urgency and perceived peer use was not significant.

Cannabis

Negative and positive urgency showed dissimilar correlations with T2 cannabis use and problematic cannabis use, with positive urgency showing coefficients over .10 larger. It was therefore decided to fit separate models for negative and positive urgency (Table 4.7). The negative urgency model was tested first. For the logistic portion of this model, there were no variables that significantly predicted excess zero scores. For the count portion of the model, only T1 problematic cannabis use scores significantly predicted T2 scores. The interaction term of negative urgency and perceived peer use was significant. Simple slopes analysis indicated that at low levels of negative urgency (-1 SD) the slope of the relationship between perceived peer cannabis use and problematic cannabis use was $b = -.18$, $SE\ b = .08$, $z = -2.41$, $p = .02$, and at high levels of negative urgency (+1 SD) the slope was $b = .09$, $SE\ b = .07$, $z = 1.18$, $p = .23$. As shown in Figure 4.2, data suggested that individuals with a combination of low negative urgency and low perceived peer cannabis use showed higher problematic cannabis use scores, a result that is not in line with the hypothesis. However, as only 16 participants out of 56 scored above 1 on this variable, it is probable that this result is an artifact caused by low variation in problematic cannabis use scores.

The positive urgency model showed a similar pattern. For the logistic portion of this model, none of the variables tested significantly predicted excess zero scores. For the count portion of the model, only T1 problematic cannabis use scores significantly predicted T2 scores. The interaction term of positive urgency and perceived peer use approached significance ($p = .05$).

Table 4.7

ZINB regression with T2 CPQ scores as outcome

Variable	<i>b</i>	SE <i>b</i>	<i>z</i>	Estimate	95% C.I.
<i>Negative urgency model</i>					
Logistic					
<i>Step 1</i>					
Gender	-0.40	1.19	-0.33	0.68	0.07-6.94
T1 Perceived peer cannabis use	-0.62	0.39	-1.59	0.54	0.25-1.15
Negative urgency	-2.49	2.43	-1.02	0.08	0.00-9.76
<i>Step 2</i>					
Negative urgency x perceived peer cannabis use	0.04	0.51	0.09	1.05	0.39-2.82
Count					
<i>Step 1</i>					
Gender	-0.09	0.22	-0.42	0.91	0.59-1.40
T1 Cannabis use frequency	0.03	0.06	0.43	1.03	0.91-1.16
T1 Perceived peer cannabis use	-0.04	0.07	-0.63	0.96	0.83-1.10
T1 Problematic use	0.25	0.10	2.67**	1.29	1.07-1.56
Negative urgency	-0.15	0.32	-0.48	0.86	0.46-1.61
<i>Step 2</i>					
Negative urgency x perceived peer cannabis use	0.21	0.07	2.98**	1.24	1.09-1.42
Likelihood ratio: $\chi^2(10) = 31.59, p < .001$					
Vuong test: $z = 3.68, p < .001$					
Test of overdispersion: $\chi^2(10) = 111.54, p < .001$					
<i>Positive urgency model</i>					
Logistic					
<i>Step 1</i>					
Gender	-0.51	1.33	-0.38	0.60	0.04-8.16
T1 Perceived peer cannabis use	-0.78	0.61	-1.29	0.46	0.14-1.51
Positive urgency	-2.75	2.09	-1.31	0.06	0.00-3.87
<i>Step 2</i>					
Positive urgency x perceived peer cannabis use	0.33	0.74	0.44	1.39	0.32-5.92
Count					
<i>Step 1</i>					
Gender	-0.08	0.22	-0.37	0.92	0.60-1.42
T1 Cannabis use frequency	0.04	0.06	0.61	1.04	0.92-1.17
T1 Perceived peer cannabis use	-0.06	0.07	-0.84	0.94	0.82-1.08
T1 problematic use	0.25	0.10	2.53*	1.28	1.06-1.55
Positive urgency	-0.05	0.35	-0.14	0.95	0.47-1.91
<i>Step 2</i>					
Positive urgency x perceived peer cannabis use	0.13	0.07	1.94	1.14	1.00-1.31
Likelihood ratio: $\chi^2(10) = 30.08, p < .001$					
Vuong test: $z = 3.54, p < .001$					
Test of overdispersion: $\chi^2(10) = 111.54, p < .001$					

Estimate = odds ratios for excess zeros are presented for logistic portions of the models and negative binomial incidence rate ratios are presented for count portions of the models; Gender was coded as female = 0, male = 1.

* $p < .05$. ** $p < .01$. *** $p < .001$.

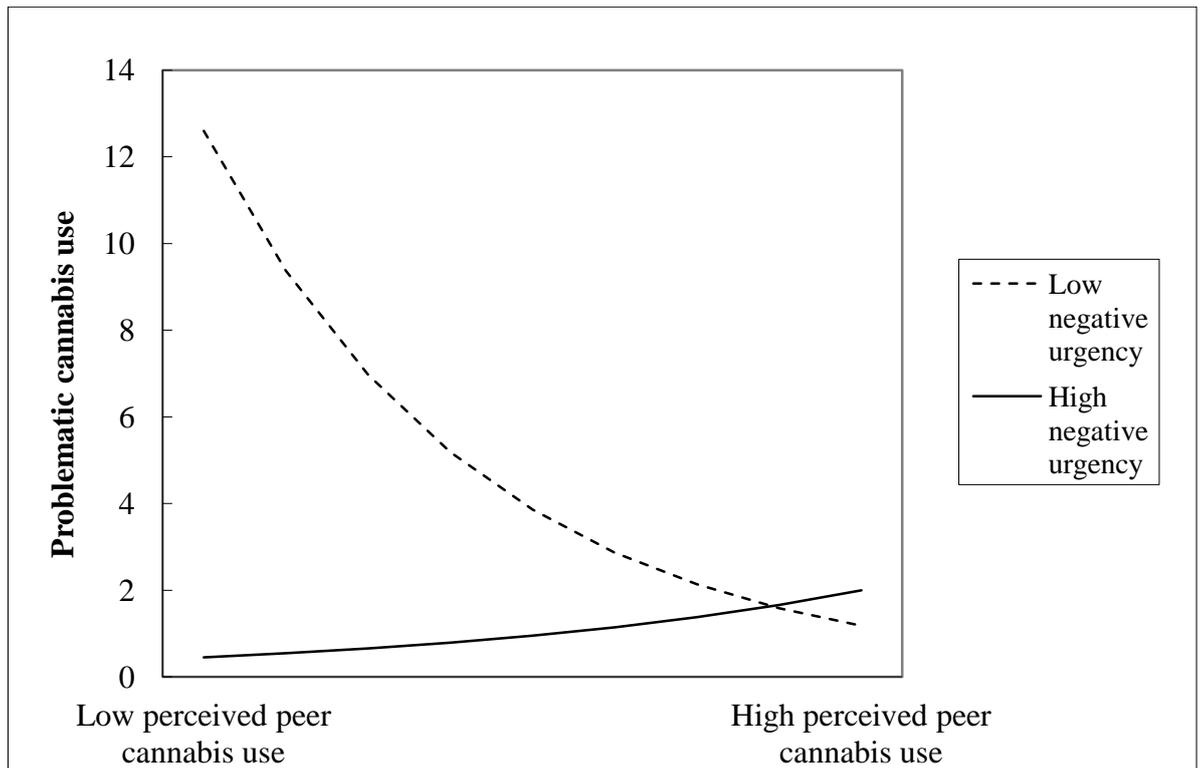


Figure 4.2. Moderation effect of negative urgency on the relationship between perceived peer cannabis use and prospective problematic cannabis use.

Peer selection

All scores for new substance-using friends were sufficiently normally distributed. Mean scores for new alcohol-using friends were 2.35 ($SD = 1.41$) at T1 and 1.88 ($SD = 1.32$) at T2, and for new cannabis-using friends were 1.37 ($SD = 1.32$) at T1 and 1.39 ($SD = 1.30$) at T2. These scores indicate that participants had made around 3 or 4 new alcohol-using friends and 1 or 2 new cannabis-using friends within the past three months at both time points.

Four multiple regression analyses were conducted to assess whether UPPS traits were cross-sectionally or prospectively associated with participants' reported number of new alcohol- or cannabis-using friends, controlling for the traits' shared variance and typical substance use. A combined urgency score was used for this analysis. Traits were entered simultaneously along with gender and T1 typical substance use scores.

With T1 new alcohol-using friends as the criterion, the regression model was significant, $R^2 = .13$, $F(6, 93) = 2.36$, $p = .04$. T1 alcohol use was the only significant predictor in the model ($\beta = .23$, $t = 2.04$, $p = .04$). For T2 new alcohol-using friends the regression model was not significant, $R^2 = .13$, $F(6, 49) = 1.26$, $p = .29$, and there were no significant predictors.

With T1 new cannabis-using friends as the criterion, the regression model was significant, $R^2 = .36$, $F(6, 92) = 8.45$, $p < .001$. T1 cannabis use ($\beta = .33$, $t = 3.01$, $p = .003$), male gender ($\beta = .24$, $t = 2.71$, $p = .01$), and lack of premeditation ($\beta = .33$, $t = 3.01$, $p = .003$) were significant predictors. For T2 new cannabis-using friends the regression model was again significant, $R^2 = .45$, $F(6, 49) = 6.57$, $p < .001$. T1 cannabis use ($\beta = .58$, $t = 5.03$, $p < .001$), male gender ($\beta = .29$, $t = 2.52$, $p = .02$), and lack of premeditation ($\beta = .32$, $t = 2.13$, $p = .04$) were again significant predictors.

Discussion

This study aimed to examine whether the previously shown moderating effect of urgency on the relationship between perceived peer alcohol use and own problematic use would replicate in an older sample, whether the effect would extend to cannabis use, and whether effects would persist over a three month period. A secondary purpose was to assess the possible role of impulsivity-related traits in the selection of substance-using friends during the first year at college.

Analysis of cross-sectional data revealed that lack of premeditation was the only trait to show a significant correlation with typical alcohol use, whilst sensation seeking was the only trait significantly associated with typical cannabis use (Table 4.1). For substance use measured after three months, lack of premeditation and negative urgency were significantly associated with typical alcohol use (Table 4.3). Although no traits

were significantly associated with prospective cannabis use, sensation seeking remained the largest correlate. These findings complement those of the previous chapter in that lack of premeditation was again shown to be the UPPS trait with the largest link to alcohol consumption. It is interesting that sensation seeking was the trait most associated with typical cannabis use in this sample but not in the younger adolescent sample studied in the previous chapter. Sensation seeking may become more closely linked with cannabis use in later adolescence. Donohew et al. (2000) found that the correlation between sensation seeking and cannabis use increased substantially from eighth grade to tenth grade (from $r = .05$ to $.30$). Such an increase could be due to a greater number of individuals having initiated cannabis use by later adolescence. Environmental factors such as the heightened availability of cannabis in older adolescence may also play a part (Gillespie, Neale, & Kendler, 2009).

Both urgency traits and lack of premeditation were significantly associated with concurrent problematic alcohol use. In a regression model controlling for shared variance among the UPPS traits and for typical alcohol use, urgency (a combination of positive and negative facets) was the only UPPS trait to significantly predict problematic alcohol use. These results follow a similar pattern to those reported in Chapter 3, and reinforce previous findings of an association between urgency and problematic alcohol use in college students (Curcio & George, 2011; Kaiser et al., 2012; Settles et al., 2012).

The urgency traits showed large bivariate associations with problematic alcohol use assessed after three months. This association remained significant in a regression model controlling for time 1 alcohol use and problematic use. This finding provides further evidence that urgency acts as a risk factor for problematic alcohol use, supporting previous evidence that urgency prospectively predicts alcohol outcomes over one year (Cyders et al., 2009; Smith et al., 2013). The three month timeframe

used here provides a less stringent test of predictive utility than earlier studies. Nonetheless, it should also be acknowledged that alcohol use behaviour would not be expected to change dramatically over this relatively short timeframe. That urgency predicted increases in problematic alcohol use over such a short timescale is good evidence that heightened levels of the trait can predispose individuals to negative consequences from alcohol use.

Urgency was the only UPPS trait to significantly predict concurrent problematic cannabis use in a regression model including all traits and typical cannabis use. Positive urgency showed a significant positive correlation with prospective problematic cannabis use. However, neither positive nor negative urgency significantly predicted this variable when accounting for time 1 use and problematic use. These data suggest that whilst urgency is linked to problematic use of both alcohol and cannabis when assessed at the same time, its predictive utility may be limited to problematic alcohol use. Alternatively, it is highly likely that due to the small follow-up sample there was insufficient statistical power in this study to detect a prospective effect. Zero-inflated models require larger sample sizes to detect significant effects than standard Poisson and negative binomial models (Williamson, Lin, Lyles, & Hightower, 2007). The prospective findings drawn from this study should therefore be viewed as tentative until they can be replicated with a larger sample.

Urgency significantly moderated (made stronger) the relationship between perceived peer alcohol use and concurrent problematic use, replicating the result reported in Chapter 3. This interaction effect was not found for prospective problematic use. It may be that high urgency individuals are more likely to drink problematically when they perceive or misperceive high normative alcohol use, but that this effect is time-limited. Again, however, inadequate power in prospective tests does not allow for firm conclusions to be made.

Data did not indicate a strengthening effect of urgency on the relationship between perceived peer cannabis use and problematic use, assessed concurrently or prospectively. A significant interaction between negative urgency and perceived peer cannabis use on prospective problematic use was shown. However, inspection of simple slopes indicated that participants low on both negative urgency and perceived peer cannabis use showed the highest problematic cannabis use scores. This counterintuitive finding was likely an artifact caused by low variation in prospective problematic cannabis use scores. Thus, the evidence presented in Chapter 3 and in this study does not support an interaction of urgency and perceived peer use with regard to problematic cannabis use. These null findings suggest that the hypothesised link between socio-affective information and problematic substance use in high urgency individuals may not apply to cannabis use. Risk profiles for problematic use of different substances are unlikely to be identical, with certain factors having greater effects on some substances than others. For instance, Gillespie, Lubke, Gardner, Neale, and Kendler (2012) report that amount of deviant peers predicts typical alcohol consumption but not cannabis. However, caution is again required due to sampling issues. Whilst the amount of lifetime cannabis users in this study was reasonable, there was not a high incidence of problematic use symptoms.

None of the UPPS traits were found to predict the amount of new alcohol-using friends made at either time point. It may be that individual differences in impulsivity are not influential in the selection of alcohol-using peers during the first year of college. Lack of premeditation was found to be significantly associated with the number of recent cannabis-using friends reported at both time points, controlling for other UPPS traits and typical cannabis use. This finding supports data reported in Chapter 3 which showed lack of premeditation to have the largest association of the UPPS traits with perceived peer use of cannabis. Individuals with a reduced capacity to

plan ahead may be less concerned about the illicit substance use behaviour of potential friends and thus more likely to acquaint with cannabis users. Lack of premeditation was not associated with cannabis use concurrently or prospectively in this sample, which suggests that the trait may act as an indirect risk marker in that it may encourage individuals to seek out potentially risky environments. Somewhat consistent with this interpretation, Miller, Flory, Lynam, and Leukefeld (2003) found lack of premeditation to be linked with multiple measures of externalising behaviours. Individuals who exhibit high externalising may be more likely to select into environments that encourage antisocial behaviour and substance use (see Iacono, Malone, & McGue, 2008).

The data presented here are inconsistent with previous studies that have identified sensation seeking as a predictor of selecting substance-promoting social environments (Kahler et al., 2003; Park et al., 2009). This may be a result of the sensation seeking scale of the UPPS-P being narrower in focus than scales used in previous studies, emphasising the thrill and adventure seeking aspect of the construct (Zuckerman, 1994). High levels of this aspect of sensation seeking may not be a factor in the selection of substance-using peers.

Limitations and future directions

A number of limitations affected this study. The follow-up rate was disappointingly low, meaning that power was weak in tests involving time 2 measures. The high dropout rate may have been due to data being collected online, with follow-up requests being made by emails that could have easily been dismissed. It is also noteworthy that participants who were followed up had lower positive urgency scores than those who were not, meaning that participants whose data would have been particularly valuable with regard to the hypotheses were not tested at time 2.

The majority of the sample was female. Although it has been observed that relationships between UPPS traits and substance use outcomes do not differ substantially between genders (Cyders, 2013), the predominance of females in this sample may have restricted the range of cannabis use variables. Notably, there were significant gender differences on cannabis use measures, with males reporting higher use, problematic use, and perceived peer use. Additionally, males have been found to be more likely than females to change their drinking behaviour in response to pluralistic ignorance (Prentice & Miller, 1993), indicating that the observed interaction effect may be greater in a more gender-balanced sample.

A further limitation was that the measure of peer selection used was broad and did not assess factors such as variation in levels of new friends' substance use, or the strength of bond with new substance-using friends.

With these limitations in mind, it is clear that the present findings require replication using a larger sample with a more balanced gender ratio, assessed over a longer duration of time. Future studies examining peer selection may benefit from methods such as experience sampling, whereby participants could report their affiliation with new substance-using friends more regularly and in greater detail. Experience sampling is a useful method for capturing data relating to the contextual subtleties of behaviour (Hektner, Schmidt, & Csikszentmihalyi, 2007), and has been used previously to uncover relationships between personality traits, peer behaviour, and substance use in young adults (Hussong, 2003).

Conclusion

Results from this study support the key finding from the previous chapter. Trait urgency was again found to strengthen the relationship between perceived peer alcohol use and own problematic use, this time in a late adolescent undergraduate sample. This

effect did not extend to cannabis and was not evident on three month follow-up, although due to sample limitations these findings are tentative. In addition, an association was found between lack of premeditation and the selection of cannabis-using friends, supporting the possibility that aspects of impulsivity are related to selecting into environments that promote substance use.

Chapter 5

Effects of impulsivity, approach-motivated positive affect, and social context on alcohol consumption in late adolescence

Overview

The study outlined in this chapter sought to experimentally create emotional and social conditions that could lead to elevated drinking in impulsive individuals. Specifically, the study tested effects of approach-motivated positive affect and friend presence on relationships between two impulsivity-related traits (sensation seeking and positive urgency) and alcohol consumption in a beer taste test. A total of 100 undergraduate students (aged 18-21) took part in the study. Half of participants underwent a mood induction designed to elicit an approach-motivated positive affective state, whilst half underwent a neutral mood induction. Forty participants (20 in each mood condition), completed the experiment in pairs with a friend. No main effects of affect or social condition on beer consumption were found. There was a main effect of sensation seeking on beer consumed. No interaction effects between conditions and traits were observed. Analysis of trait effects on similarity of alcohol consumed among participants in the social condition showed that positive urgency was associated with similarity in the positive affect condition, an effect that approached significance. Results support evidence highlighting the role of sensation seeking in alcohol consumption, and indicate that positive urgency may influence social modelling of alcohol use.

Introduction

The literature review in Chapter 2 established that sensation seeking and positive urgency are associated with heightened alcohol consumption in adolescent samples. Associations were modest, however, suggesting that any effect that these traits might have on alcohol use may be dependent on other factors. This chapter will consider affective and social contexts that might make elevated alcohol consumption more probable in individuals with higher levels of these traits. Affect can be defined as the subjective quality of a feeling state (Leary, 2000), and is often used interchangeably with the terms mood, emotion, and feeling. Although distinctions between these terms can be made (see Russell & Barrett, 1999), doing so is not essential for the current study.

Impulsivity-related traits and positive affect

It is apparent that positive urgency and sensation seeking both contain a positive affective component. Indeed, positive urgency is defined as the tendency to act rashly when in a positive emotional state (Cyders et al., 2007). Sensation seeking is correlated with positive affect, negatively related to anhedonia, and is lower in depressed patients than controls (Carton, Morand, Bungenera, & Jouvent, 1995; McCann, Mueller, Hays, Scheuer, & Marsella, 1990; Zuckerman, Lubin, & Rink, 1983).

It is important to note, however, that the term ‘positive affect’ does not represent a single entity. Dominant theories of affective experience posit two dimensions of affect: the first reflecting hedonic tone, or valence, defined as the degree to which a feeling state is positive or negative; the second reflecting ‘activation’, arousal, or motivational direction, the degree to which an emotion encourages approach or avoidance (Feldman, 1995; Gable & Harmon-Jones, 2010; Posner, Russell, & Peterson, 2005).

Thus, an individual's 'core affect' at any one time is the degree to which they feel "good or bad...lethargic or energised" (Russell, 2009, p. 1264). In this two dimensional model positive affect can take multiple forms. High-approach positive affect encompasses feelings such as excitement and enthusiasm, whereas low-approach positive affect includes feelings of contentment such as calm and serenity. Klein (1984) makes the distinction between appetitively-motivated, or anticipatory, positive affect, posited to occur following presentation of reward cues, and consummatory positive affect which takes place after reward has been received.

There is evidence that these states may be dissociated neurobiologically, with dopaminergic activity thought to be responsible for anticipatory states (Alcaro, Huber, & Panksepp, 2007; Depue, Luciana, Arbisi, Collins, & Leon, 1994), and opioid and endocannabinoid activity for consummatory states (Berridge, Robinson, & Aldridge, 2009). These aspects of affect are also dissociable in relation to psychological outcomes. For example, it has been documented that high-approach positive moods lead to a narrowing of attentional focus, whilst low-approach positive moods lead to a broadening of this focus (Gable & Harmon-Jones, 2011). Importantly, high-approach and low-approach positive states have also been linked to addictive behaviours. Robinson and Berridge's (2001) incentive sensitisation theory proposes that substance dependence entails sharply elevated anticipatory states linked to increased incentive salience of substances and related cues (drug *wanting*), that occur despite reductions in the pleasure received from substance consumption (drug *liking*).

These differences in positive affect have not been widely considered in relation to adolescent experience. Gilbert (2012) suggests that the distinction between high-approach and low-approach positive emotion may be particularly useful for understanding adolescent psychopathology, and notes that approach-motivated positive emotion appears to be dysregulated in adolescents who engage in externalising

behaviour, including substance use. Indeed, the increase in risk-taking behaviour often observed in adolescence corresponds with an increase in reward seeking (Steinberg, 2008), which by definition reflects approach motivation (Ikemoto & Panksepp, 1999).

Although a general inclination towards positive affectivity does not appear to be strongly associated with alcohol consumption or problems (Wray et al., 2012), evidence from two studies suggests that positive affect can lead to increased alcohol consumption in individuals high in sensation seeking and positive urgency. Chakroun, Johnson, and Swendsen (2010) used experience sampling methods with an undergraduate sample to establish that individuals high in novelty seeking, a trait strongly related to sensation seeking, consumed more alcohol when in a positive mood than those low in novelty seeking. In an experimental study, Cyders et al. (2010) had participants undergo positive or neutral mood inductions before having the opportunity to consume beer. Positive urgency was found to be associated with quantity of beer consumed in the positive mood condition only, whilst sensation seeking and other UPPS traits were not.

Neither of these studies considered approach-motivation in their assessment of positive affect. Chakroun et al. (2010) assessed mood using a measure of hedonic tone ranging from extremely unhappy to extremely happy, and the positive mood inductions used by Cyders et al. (2010) focused on pleasure experienced after reward receipt, for example finding money or winning a free lunch.

One relevant study that has used a measure including approach-motivated positive affect items is that of Simons et al. (2010), who used experience sampling to assess affect, urgency, and alcohol use in a sample of college students. Positive affect in this study was measured as a composite of items covering hedonic tone (happy, joyful) and approach-motivation (excited, energetic, enthusiastic). These authors found that

positive urgency did not show a moderating effect on the relationship between positive mood and alcohol intoxication.

A gap in the literature emerges from this research. As yet, there has not been an attempt to assess the role of approach-motivated positive mood on the effects of trait sensation seeking and positive urgency on alcohol consumption under experimental controls. Simons et al. (2010) note that a limitation of their study was that mood was not assessed at the same time as measures of alcohol consumption. To remedy this issue, the current study will aim to experimentally manipulate mood directly before presenting an opportunity to use alcohol.

Social modelling

Alcohol use during adolescence and young adulthood is likely to take place with peers in a context of social facilitation (Fuller, 2011; Thombs, Wolcott, & Farkash, 1997), and a majority of adolescents report social motives for drinking (Kuntsche, Knibbe, Gmel, & Engels, 2005). Social motives to use alcohol longitudinally predict problematic alcohol use in mid-adolescence (Bradizza, Reifman, & Barnes, 1999). The empirical studies reported in chapters 3 and 4 concentrated on the potential influence of normative information on substance use consumption. Another key social influence on alcohol use particularly is the observed consumption levels of others. When drinking alcohol with friends, modelling effects can occur, whereby one individual temporarily imitates the drinking behaviour of others (Collins, Parks, & Marlatt, 1985). This phenomenon has been widely studied in college students using a paradigm in which a participant is paired with an experimental confederate who has been instructed to drink at a certain pace, and the participant's alcohol use is then monitored. Borsari and Carey (2001) reviewed 13 studies that used this paradigm, concluding that participants' drinking behaviour in these studies was strongly

influenced by the drinking behaviour of the confederate, and that a heavy drinking confederate can increase participant drinking, even in the presence of an additional low-drinking confederate.

These effects can be interpreted with reference to broader research on adolescent risk behaviour. It has been shown that simply having peers present leads to increased risk-taking among adolescents and young adults (Gardner and Steinberg, 2005). Chein et al. (2011) argue that this effect results from peer presence intensifying incentive processing in the adolescent brain, so that the rewarding properties of risk-taking are sensitised. Similarly, Casey and Jones (2010) suggest that the socially rewarding nature of peer presence might disrupt cognitive control processes in certain circumstances. It is possible that being in the company of a heavy-drinking peer acts to increase the perceived reward of alcohol use, leading to heightened consumption. Sensation seeking has been linked with elevated incentive processing and risk-taking during adolescence (Romer, Duckworth, Sznitman, & Park, 2010; Spear, 2011). Individuals high in sensation seeking may be more likely to value the potentially rewarding properties of alcohol when drinking in the company of peers and thus increase their alcohol intake. Similarly, those high in positive urgency may be inclined to consume a greater amount of alcohol when with friends than when alone due to increased positive mood caused by peer presence leading to a reduced ability to control rash action.

Individual differences in the tendency to model the drinking behaviour of others have not been widely investigated. Caudill and Kong (2001) found that a high need for social approval predicted heightened modelling effects. Another study, conducted by Peterson, Morey, and Higgins (2005), found moderating effects of trait extraversion and agreeableness on the alcohol consumption similarity of randomly-paired dyads participating in a taste test. These authors' interpretation of this finding was that

sociable, agreeable individuals are likely to attempt to accommodate themselves to their social environment. Positive urgency may also influence drinking similarity, yet for a different reason. In light of the interaction between urgency and perceived peer norms on problematic drinking observed in Chapters 3 and 4, it is possible that individuals high in positive urgency may use the observed drinking behaviour of their peers as a guide for their own drinking behaviour. If such an effect does exist, it is likely to be heightened in, or even limited to, positive affective states.

Aims and hypotheses

The key aim of this study is to experimentally manipulate conditions in which trait positive urgency and sensation seeking might influence elevated alcohol consumption in a late adolescent sample. Potential effects of approach-motivated positive affect and of peer presence on alcohol consumption will be tested, as will interactions between these contextual factors and the traits of interest. The study is the first to assess the role of approach-motivated positive mood on alcohol consumption in an experimental design. The potential influence of traits on social modelling of alcohol consumption will also be investigated by having some participants complete the experiment alone and others do so in pairs. Whereas previous modelling studies have used experimental confederates, this study will recruit actual friendship pairs. The study tests the following hypotheses:

H1: Positive urgency and sensation seeking will show stronger positive relationships with beer consumption in the positive mood condition than in the neutral mood condition.

H2: Positive urgency and sensation seeking will show stronger positive relationships with beer consumption in the social condition than in the alone condition.

H3: In line with findings from Chapters 3 and 4, positive urgency will be associated with partner similarity of beer consumption for participants in the social condition.

Method

Design

This study used a 2 (mood condition: positive or neutral) x 2 (social condition: alone or +friend) between-participants factorial design. The dependent variable was the amount of beer consumed in a sham taste test procedure.

Participants

One hundred participants (79 female) with an age range of 18-21 ($M = 19.12$, $SD = .90$) were recruited from Goldsmiths college campus. Sixty one participants were recruited through the Goldsmiths Psychology Department's research participation scheme and took part in exchange for course credit. An additional 39 participants were recruited using posters on college notice boards and paid £5 in return for participation. Participants were informed prior to taking part that the experiment would involve the consumption of alcoholic beer. Individuals were randomly assigned to mood and social conditions. Those assigned to the social condition were emailed prior to participation with a request to attend the experiment with a friend who would also be willing to

participate. Six of these participants attended without a friend and were thus tested in the alone condition.

Measures

Mood

The UWIST Adjective Check List (UMACL; Matthews, Jones, & Chamberlain, 1990) was used to assess current mood state. This measure assesses three aspects of mood: hedonic tone (sample items: cheerful, satisfied), energetic arousal (active, alert), and tense arousal (anxious, nervous). The UMACL has a four point Likert-type response format ranging from 1 – ‘Definitely not’ to 4 – ‘Definitely’. Higher scores represent greater levels of mood currently experienced. As the present study focused on positive mood, the tense arousal scale was not included in analysis. Cronbach’s alpha for the hedonic tone scale was .82 pre-induction and .87 post-induction. The alpha for the energetic arousal scale was .74 pre-induction and .73 post-induction.

Impulsivity-related traits

The UPPS-P Impulsive Behaviour Scale (Cyders et al., 2007, Whiteside & Lynam, 2001) was used to measure sensation seeking and positive urgency. Cronbach’s alpha values in the present sample were .90 for sensation seeking and .94 for positive urgency.

Alcohol use

The Alcohol Use Disorders Identification Test (AUDIT; Babor et al., 2001) is a ten item measure assessing alcohol use behaviour and negative consequences from drinking. A five point Likert-type response format is provided, with higher scores

reflecting greater use or more frequent negative consequences. The AUDIT has previously been shown to demonstrate good psychometric properties and reliability (Kokotailo et al., 2004; Reinert & Allen, 2002). Cronbach's alpha for the AUDIT in this sample was .82.

Mood induction stimuli

A guided imagery procedure was employed for the mood inductions in this study. This procedure entails participants being asked to imagine themselves in a series of scenarios (Ahsen, 1989, cited in Mayer, Allen, & Beauregard, 1995). Eight novel scenarios were composed, four each for the two mood conditions. The positive scenarios were designed to elicit an appetitive, motivated positive state, rather than a consummatory state. Scenarios are presented in Table 5.1. Mood-suggestive music was also played during the induction, as it has been shown that using two methods of inducing mood can be additively effective (Mayer et al., 1995). Participants in the positive mood condition were played Waltz of the Flowers from the Nutcracker Suite by Tchaikovsky, and those in the neutral condition were played the Largo movement from The New World Symphony by Dvorak. These pieces have previously been used in mood induction procedures to elicit positive-appetitive and neutral mood states, respectively (Smillie, Cooper, Wilt, & Revelle, 2012; Yeung, Dalgleish, Golden, & Schartau, 2006).

Table 5.1

Scenarios used for mood induction

Positive	Neutral
<p>You receive a phone call from a friend saying that they have just won two tickets to see a new band play this evening. You haven't heard of the band but your friend thinks you will really enjoy it. The concert is due to start in an hour, so you tell your friend you think you can make it and rush out of the door.</p>	<p>A friend sends you a message saying there is a song on the radio that they think you will like. You turn on the radio and listen. You think the song is okay, but nothing special. It sounds similar to another song.</p>
<p>You see a poster stating that a new shop selling luxury chocolates has opened today and that they are giving away free chocolates to their first 100 customers after 10.00am. The shop is reasonably nearby and it is now 10.15am. You think that if you hurry you might be in luck.</p>	<p>You see a poster for a restaurant that has recently opened in your area. You remember eating at another branch of this restaurant. You thought the food was quite good, but wouldn't be in a rush to try it again.</p>
<p>You have spontaneously bet someone £5 that you can beat them at pool. The game has gone back and forth, and now there is only one ball left on the table. The person to pot the ball will be the winner.</p>	<p>You are watching television when a game of snooker comes on. You are not especially interested in the game, but you decide to watch it anyway.</p>
<p>You are at a party when you notice an attractive stranger. The two of you make eye contact. You are feeling confident and decide that you will go and introduce yourself.</p>	<p>You are at a train station and bump into a work colleague you don't know particularly well. You have a brief chat and then go to catch different trains.</p>

Procedure

Testing took place inside two cubicles in a quiet, temperature-controlled laboratory on weekdays between 1pm and 6pm. Day and time of participation were recorded. Upon arrival, participants were shown to the first cubicle and the requirements of the study were outlined. Participants were then left to complete a consent form and the questionnaires in the order presented above. Once questionnaires

were completed, participants underwent either a positive-appetitive or neutral mood induction, which was presented as an imagination task. The following instruction was given, adapted from Smillie et al. (2012):

“Read the following four scenarios and imagine yourself experiencing the events as vividly as you can. Picture the event happening to you. Try to imagine all the details of the situation. Close your eyes and picture in your ‘mind’s eye’ the surroundings as clearly as possible. See the people or objects; hear the sounds; experience the event happening to you. Think the thoughts and feel the same feelings that you would actually think in this situation. Let yourself react as if you were actually there.”

Participants were presented with either the positive or neutral induction scenarios and were played the mood-relevant piece of music. Participants were given eight minutes to complete the task. To ensure engagement with the task, participants were informed that a memory test would be conducted later in the experiment to assess what was imagined. Participants were asked to complete the UMACL for a second time following the mood induction procedure as a manipulation check. They were told that the purpose of this was to assess their short-term mood stability.

Participants were then taken to a second cubicle. Three 200ml measures of beer were presented in clear plastic cups, along with a 200ml cup of tap water. The beer brands used were *Fosters* (abv 4%), *Becks* (abv 5%), and *Becks Blue*, a non-alcoholic beer. Beers were refrigerated for one hour prior to presentation. Participants in the social condition sat at a desk with an opaque barrier across the middle, so that participants could see each other but not each other’s cups. Participants were told that the experiment required them to rate the three beers for pleasantness, strength of taste, sweetness, and fizziness (adapted from Field & Eastwood, 2005), and were provided

with rating sheets that offered a five point Likert-type response format for each dimension. Participants were informed that they would have ten minutes to complete this task and that they could consume as much or as little of the beer as they liked. Participants in the social condition were allowed to speak to each other during the taste test but were asked not to look at their partner's cups. The researcher monitored participants from outside the cubicle for the duration of the taste test. Following the taste test, participants were debriefed and given the opportunity to ask questions about the study.

Results

Data screening

No variables showed missing values greater than 5%. Little's MCAR test suggested that missing data was completely at random, $\chi^2(62) = 45.29, p = .95$. The expectation maximisation algorithm was used to impute missing data. Inspection of histograms indicated that trait, mood, and AUDIT scores were sufficiently normally distributed.

Sample characteristics

Independent *t*-tests were used to compare participants' trait scores, AUDIT scores, and pre-induction mood scores between mood and social conditions. No significant differences were found. Descriptive statistics and bivariate correlations for the entire sample are presented in Table 5.2. It is noteworthy that positive urgency was significantly negatively associated with pre-induction hedonic tone but not energetic

arousal, whilst sensation seeking was significantly positive correlated with pre-induction energetic arousal but not hedonic tone.

Table 5.2

Bivariate correlations and descriptive statistics

	1	2	3	4	5
1. Hedonic tone ^a	-				
2. Energetic arousal ^a	.39***	-			
3. Sensation seeking	.10	.21*	-		
4. Positive urgency	-.31**	-.02	.09	-	
5. AUDIT	-.01	.05	.18	.26**	-
M	3.39	2.76	3.03	1.98	9.63
SD	(.45)	(.48)	(.68)	(.66)	(5.56)

N = 100; ^a = pre-induction scores.

* *p* < .05. ** *p* < .01. *** *p* < .001.

Mood induction

Repeated measures *t*-tests were used to compare pre- and post-induction hedonic tone and energetic arousal scores across the two mood conditions. In the neutral mood condition, hedonic tone scores did not significantly differ pre- (*M* = 3.44, *SD* = .42) and post-induction (*M* = 3.38, *SD* = .47), $t(49) = 1.10, p = .28$. Post-induction energetic arousal scores (*M* = 2.60, *SD* = .43) were significantly lower than pre-induction scores (*M* = 2.73, *SD* = .49), $t(49) = 2.39, p = .02$. In the positive mood condition, hedonic tone scores showed a near-significant difference between pre- (*M* = 3.35, *SD* = .47) and post-induction (*M* = 3.46, *SD* = .51), $t(49) = 1.99, p = .052$. Energetic arousal scores did not significantly differ pre- (*M* = 2.80, *SD* = .48) and post-induction (*M* = 2.75, *SD* = .48), $t(46) = .67, p = .50$. These results indicate that the positive mood induction procedure was partially successful in increasing hedonic tone but not energetic arousal.

To assess whether positive urgency and sensation seeking were related to changes in mood as a consequence of induction, bivariate correlations were calculated for trait scores and mood change scores (calculated as post- minus pre-induction UMACL subscale scores). In the neutral condition, positive urgency was not significantly correlated with hedonic tone change ($r = -.05, p = .76$) or energetic arousal change ($r = -.11, p = .46$). Sensation seeking was also not significantly correlated with hedonic tone change ($r = .07, p = .64$) or energetic arousal change ($r = -.08, p = .60$). In the positive condition, positive urgency was not significantly correlated with hedonic tone change ($r = .17, p = .26$) or energetic arousal change ($r = -.04, p = .81$). Sensation seeking was not significantly correlated with hedonic tone change ($r = -.03, p = .83$), but was significantly negatively correlated with energetic arousal change ($r = -.34, p = .02$), indicating that individuals high in sensation seeking showed a reduction in energetic arousal from the positive mood induction.

Beer consumption

Average beer remaining for participants in each condition is displayed in Figure 5.1. Beer remaining scores were substantially negatively skewed ($S = -1.22$). Scores were reflected and square root transformed. The resulting data showed a sufficient normal distribution ($S = .37$), with higher levels of this score representing more beer consumed. The score was significantly correlated with AUDIT scores ($r = .37, p < .001$), suggesting that alcohol consumption in the taste test procedure was a valid proxy of real-world alcohol use.

Experimental effects

To test effects of the experimental manipulations, a 2 (mood) x 2 (social) between-participants analysis of covariance (ANCOVA) was conducted. Positive urgency,

sensation seeking, and AUDIT scores were entered as covariates. Day and time of participation were entered as random factors. Results indicated no main effects of mood condition, $F(1, 72) = .49, p = .49$, partial $\eta^2 = .01$, or social condition, $F(1, 72) = 1.81, p = .18$, partial $\eta^2 = .03$.

Sensation seeking showed a significant main effect $F(1, 72) = 5.24, p = .03$, partial $\eta^2 = .07$. Post hoc correlation analysis indicated that higher sensation seeking was associated with more beer consumed ($r = .24, p = .01$). Sensation seeking was significantly associated with alcohol consumption in the positive mood condition ($r = .35, p = .01$), yet not in the neutral condition ($r = .18, p = .22$). A Z-test of these correlations confirmed that they did not significantly differ ($Z = .90, p = .37$). The main effect of positive urgency in the ANCOVA model approached significance, $F(1, 72) = 3.15, p = .08$, partial $\eta^2 = .04$. There was a significant main effect of AUDIT scores, $F(1, 72) = 6.98, p = .01$, partial $\eta^2 = .09$. Two-way interactions between conditions and traits were tested, as were three-way interactions between both conditions and each trait. No significant interactions were found (Table 5.3).

Table 5.3

ANCOVA interaction results

<i>Interaction</i>	<i>F</i>	<i>p</i>	<i>Partial η^2</i>
mood*positive urgency	.80	.38	.01
mood*sensation seeking	.89	.35	.01
social*positive urgency	.39	.53	.01
social*sensation seeking	1.15	.29	.02
mood*social*positive urgency	.59	.44	.01
mood*social*sensation seeking	.31	.58	.00

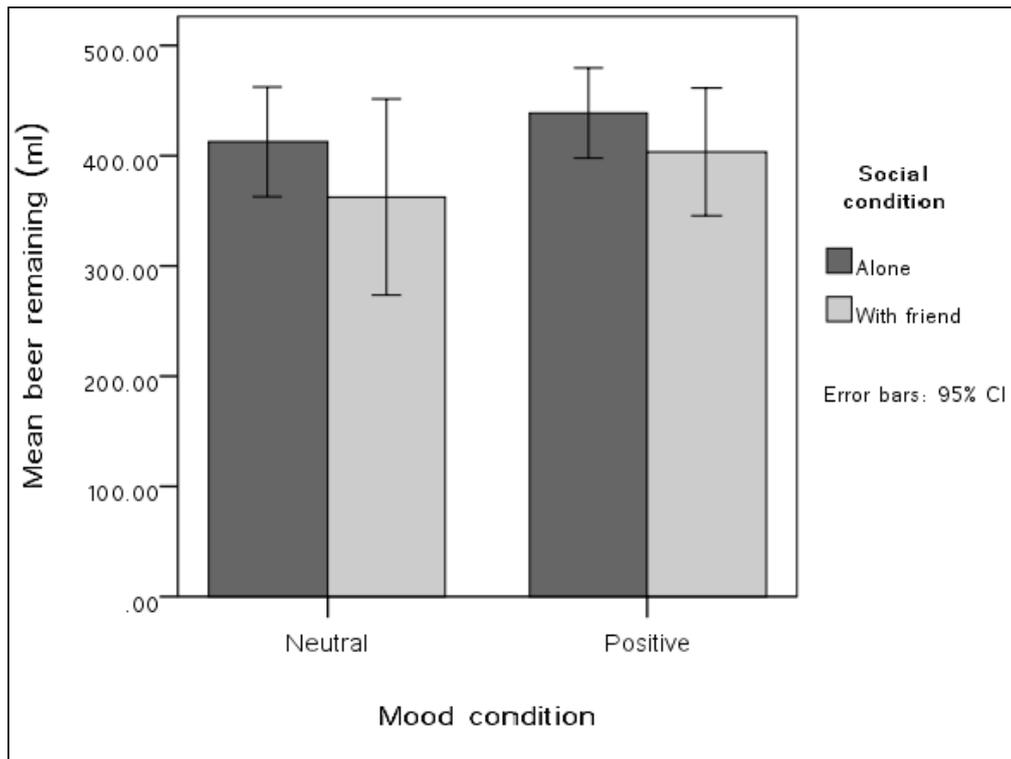


Figure 5.1. Beer consumption across experimental conditions.

Trait effects on drinking similarity

The beer consumption of partners in the +friend condition correlated substantially ($r = .88, p < .001$). To ascertain whether trait differences in positive urgency or sensation seeking affected similarity of alcohol consumption between partners, a difference score was calculated for participants in the +friend condition by subtracting one participant's beer remaining score (in ml) from their partner's. Difference scores ranged from 0 - 205 ($M = 61.50, SD = 51.59$). A hierarchical multiple regression analysis was conducted with the difference score as the criterion variable. Positive urgency and sensation seeking were entered at step 1, mood condition at step 2, and the product terms of trait*mood condition at step 3. As shown in Table 5.4, positive urgency, sensation seeking, and mood condition were not significant predictors of similarity of alcohol consumed. The positive urgency*mood interaction, representing the difference in slopes between mood conditions, approached significance ($p = .07$). Participants in the positive mood condition who were higher in positive urgency

showed a trend for consuming beer at a more similar level to their partner (Figure 5.2).

The sensation seeking*mood interaction was not significant ($p = .64$).

Table 5.4

Hierarchical multiple regression predicting difference in beer remaining for participants in +friend condition

	R^2	F change	b	SE	β	t
<i>Step 1</i>	.00	.03				
Positive urgency			-3.22	13.96	-.04	-.23
Sensation seeking			-.94	12.09	-.01	-.08
<i>Step 2</i>	.03	1.14				
Mood			18.02	16.92	.18	1.07
<i>Step 3</i>	.12	1.75				
Positive urgency*mood			-51.13	27.77	-1.10	-1.84
Sensation seeking*mood			11.20	23.80	.36	.47

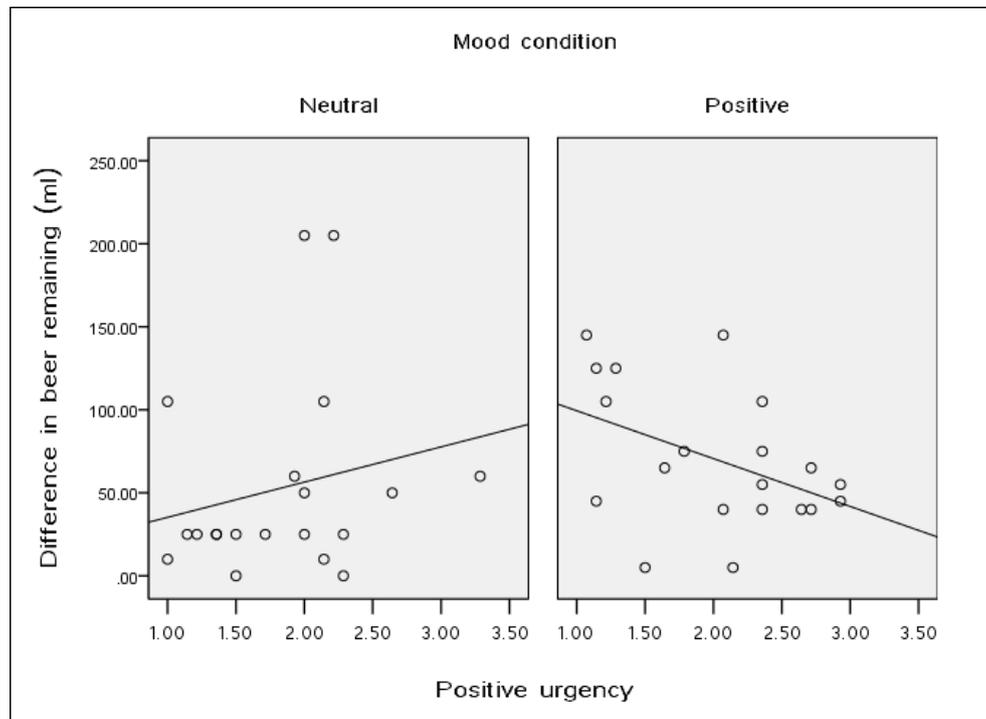


Figure 5.2. Associations between positive urgency and partner similarity in beer consumption (data are from participants in the +friend condition only [$n = 40$]).

Discussion

The purpose of this study was to investigate whether two contextual factors linked to adolescent risk-taking might strengthen any effects of trait sensation seeking or positive urgency on alcohol consumption. These traits have previously been shown to be positively associated with alcohol use in adolescent samples, yet only a small number of studies have considered situational variables that might exacerbate these associations. The present study used experimental controls to assess the possible influence of approach-motivated positive affect and the presence of a friend on relationships between traits and beer consumed in a taste test.

A main effect of sensation seeking on alcohol consumption was observed, with higher sensation seeking associated with more beer consumed. This finding is consistent with research that has linked UPPS sensation seeking with typical alcohol consumption and heavy drinking (Curcio & George, 2011; Stautz & Cooper, 2013). Individuals high in sensation seeking may be more inclined to drink large amounts of alcohol in order to experience the enhancing and exciting effects associated with its use (Comeau et al., 2001; Magid & Colder, 2007; Simons, Gaher, Correia, Hansen, & Christopher, 2005). There was not a significant main effect of positive urgency on alcohol consumption. This result is inconsistent with research showing a link between self-reported positive urgency and the quantity of alcohol usually consumed (Cyders et al., 2009), although is in line with experience sampling data from Simons et al., (2010), which showed no effect of positive urgency on number of drinks consumed.

Participants in the positive mood condition consumed less alcohol than those in the neutral condition, but this difference was not significant. There was no interaction between positive urgency and mood condition on alcohol consumption, in contrast to findings by Cyders et al. (2010). This finding implies that approach-motivated positive

affect does not lead to greater drinking in high positive urgency individuals. It may be that only low-approach positive moods trigger rash action in these individuals.

Notably, the concept of positive urgency was developed partly out of recognition that a great deal of risky behaviour occurs in celebratory situations (Cyders et al., 2007).

Celebration is a low-approach positive mood state that is generally experienced following the receipt of a reward.

No interaction was observed between sensation seeking and mood state on alcohol consumption. Although sensation seeking was significantly correlated with consumption in the positive mood condition only, the correlations between sensation seeking and consumption in the two mood conditions did not significantly differ. It is noteworthy that sensation seeking was negatively correlated with changes in energetic arousal scores in the positive mood condition. The positive mood induction procedure affected high sensation seekers in the opposite way to that intended, i.e. it led to a reduction in their level of approach-motivated positive affect. It appears that the stimuli used in this study were not of a great enough intensity to induce an elevated positive-appetitive mood in high sensation seeking participants. It is believed that high sensation seekers are less responsive to stimulation than low sensation seekers (Zheng et al., 2011; Zuckerman, 1997). Attempts to activate a positive-appetitive state in these individuals may therefore require highly arousing stimuli, or the use of genuine rewards rather than guided imagery.

This methodological issue presents an opportunity for further study. As sensation seeking was positively associated with alcohol consumption following the positive mood induction despite high sensation seekers showing reduced energetic arousal, it is possible that low levels of energetic arousal produce a motivating state for alcohol consumption in high sensation seekers. This possibility is, of course, in direct contrast with the hypothesis tested in this study, yet is certainly feasible. Sensation seekers

engage in heavy alcohol use partly due to enhancement motives (Adams et al. 2012; Magid et al., 2007). When experiencing reduced levels of energetic arousal, perhaps due to low environmental stimulation, these individuals may be inclined to use alcohol in order to feel more excited or to bring themselves nearer to an optimal level of arousal (Roberti, 2004; Zuckerman, 1994).

Partners in the social condition, who completed the experiment in pairs with a friend, showed a high similarity in alcohol consumed. As a group, however, these participants did not consume significantly more than those in the alone condition. This finding is supportive of a social modelling effect, whereby alcohol use is influenced by the observed drinking behaviour of others, and suggests that the mere presence of a friend when drinking does not lead to elevated alcohol consumption compared to when drinking alone. Although peer presence can lead to increased risk-taking in adolescents and young adults (Gardner & Steinberg, 2005), it has been suggested that such an effect may subside by around age 17 (Steinberg et al., 2008).

The prediction that traits would be associated with heightened alcohol consumption in the social condition was not supported. Whilst sensation seeking is associated with social motives for alcohol use, it shows a larger relationship with enhancement motives (Magid et al., 2007, Urbán et al., 2008). High sensation seekers' alcohol use may be less dependent on their social context than on their own internal need for stimulation.

Analysis of possible trait effects on partner similarity of alcohol consumption found positive urgency to be associated with drinking similarity for participants in the positive mood condition. Individuals high in positive urgency and in a positive mood drank beer at levels more in line with their partner than those in a neutral mood. This result approached significance, and may warrant further investigation. A possible link between positive urgency and modelling of alcohol consumption can be consolidated

with the interaction effects described in Chapters 3 and 4. Direct modelling of peer behaviour could be viewed as a time-limited effect of normative influence. If trait urgency moderates the influence of perceived peer alcohol norms on own problematic drinking, high levels of the trait might also encourage elevated modelling effects.

Limitations and future directions

Results from this study must be interpreted with regard to a number of methodological shortcomings. The positive-appetitive guided imagery induction used in this study was not effective in increasing approach-motivated positive affect. This may have been due to the positive scenarios not being exciting enough to stimulate energetic arousal, yet could also have been due to the laboratory environment. Participants underwent the induction whilst sitting down and listening to classical music in an enclosed cubicle. These may have been inappropriate surroundings to produce the intended state. A further point of concern is the use of a cover story in the mood induction procedure. Larger effects might have been attained by more direct methods, for instance an autobiographical memory induction in which participants are asked to recall times when the desired state had been experienced. This method would have guaranteed personally relevant imagery, although could also raise issues with validity due to individual differences in interpretation of instructions.

The taste test procedure used here may not have been an externally valid measure of alcohol consumption. Excessive alcohol consumption is likely to take place over much longer periods of time and in an environment much different to a quiet laboratory cubicle. Consumption on the taste test was positively associated with a measure of real-world alcohol use, offering support for validity, yet future research may benefit from using more naturalistic settings, for instance the ‘laboratory bar’ setting that has been employed in previous studies (e.g. Bot, Engels, & Knibbe, 2005).

Related to this issue, beer consumption in a laboratory setting is perhaps a weak measure of risk behaviour in first year college students due to the highly normative nature of alcohol use amongst this demographic (O'Malley & Johnston, 2002). In future, researchers may need to consider ethical ways of studying peer modelling effects on other substances. Cannabis use may be a logical extension as this substance is currently undergoing changes in its legal status in some parts of the world. For instance, recreational use of cannabis was recently legalised in Colorado and Washington in the United States (Marijuana Policy Project, 2013). Substance use researchers could capitalise on these changes by substituting cannabis into existing alcohol-related research paradigms where appropriate.

There were also limitations with the sample in this study. Females were over-represented and there was a reliance on psychology undergraduates. Engs and Hanson (1990) report that females tend to favour wines and spirits when drinking alcohol, whilst males commonly prefer beer. Thus, levels of consumption in the taste test could have been influenced by some female participants drinking less due to a dislike of beer.

Conclusion

This study aimed to create emotional and social conditions in which heightened levels of specific impulsivity-related traits would lead to elevated alcohol consumption in a beer taste test. Positive urgency and sensation seeking showed no interaction with experimentally manipulated approach-motivated positive affect or with social context on alcohol consumption. A significant main effect of sensation seeking on alcohol consumption was found, supporting previous findings that link high levels of this trait with elevated alcohol consumption. Whilst the main hypotheses for the study were not supported, results may help to inform methodological improvements in future studies.

Chapter 6

Urgency, peers, and the affect heuristic: Implications for understanding risky decision making

Overview

This chapter reports a cross-sectional study examining possible mechanisms by which trait urgency might influence substance use. A total of 286 participants, divided into three age groups (adolescents, late adolescents, and adults), completed measures of urgency and affective associations about drug use. They were then asked to consider a hypothetical situation in which a protagonist considers using a 'legal high', and to report their perceived peer approval and perceived positive and negative consequences of such substance use, as well as the likelihood that they would personally use the substance. Multiple-group path analysis was employed to test a model by which urgency influenced the substance use decision via affective associations and perceived peer approval. Affective associations significantly predicted the substance use decision in the adolescent and adult groups. Affective associations were significantly related to urgency in adolescents. Analysis of indirect effects showed a small but significant path from urgency to decision via affective associations in adolescents, and significant paths from urgency to decision via peer approval in the older two groups. Results indicate that high urgency individuals may rely on emotional representations when considering whether to engage in substance use. This may help to explain the link between urgency and problematic substance use outcomes.

Introduction

Throughout this thesis the urgency facets of impulsivity have stood out in terms of their links to problematic substance use. Factors that might account for these associations are yet to be explored. In this final empirical chapter, an attempt will be made to identify mechanisms by which high levels of urgency might produce elevated risk for problematic substance use, as well as other risky or maladaptive behaviours.

It may be useful at this point to reflect briefly upon the broader aims of studying personality traits in relation to certain outcomes. Personality traits represent stable individual differences in patterns of affect, cognition, motivation, and behaviour (Wilt, Oelberg, & Revelle, 2011). Establishing links between these patterns and outcomes is certainly interesting, but such findings can only be descriptive. To move toward an explanatory account, traits should be linked to psychological and biological processes, underpinned by functional and structural brain differences, ultimately caused by genetic variation and environmental influence. Any programme of research assessing trait-outcome relationships should consider these different levels of explanation to provide a deeper understanding of why and how trait x might relate to outcome y . A multi-level approach can also stimulate thought about how to change maladaptive patterns of psychological functioning.

With these points in mind, what more can be surmised about the urgency-substance use relationship? In terms of psychological processes, urgency appears to reflect individual differences in the capacity to regulate emotions and impulses. This idea might be best explained with reference to dual process theories of cognition, which propose the existence of two brain systems: a reflexive, automatic, implicit system, termed by some authors as System 1; and a reflective, deliberative system, termed System 2 (Kahneman, 2011). The reflexive system is believed to be responsible

for automatic processes that occur spontaneously without conscious deliberation, whilst the reflective system is involved in more effortful, logical thought. Individual differences in impulsivity, broadly defined, could be viewed as reflecting the interaction of the two systems (Hofmann, Friese, & Strack, 2009). Impulsive behaviour occurs when a reflexive motivational drive influences action, and an individual is unable or unwilling to employ reflective processes to inhibit this action. Linking this idea to the multi-component view of impulsivity, it is clearly the urgency facet that best characterises a tendency for the reflexive system to get the better of the reflective system.

The few studies that have examined urgency alongside neurobiological measures support this view. Boy et al. (2011) used magnetic resonance spectroscopy to measure γ -amino butyric acid (GABA) in a number of brain areas thought to be integral to impulse control. They found that individual differences in GABA concentration in dorsolateral prefrontal cortex were negatively associated with urgency in two male samples. Urgency scores have also been shown to negatively correlate with activity in anterior medial orbitofrontal cortex and anterior cingulate in response to arousing pictures (Joseph, Liu, Jiang, Lynam, & Kelly, 2009). These brain areas are believed to be involved in emotional decision making and emotion regulation (Joseph et al., 2009).

Implicit cognition and the affect heuristic

A dual process approach has also been applied to the study of addictive behaviour (Wiers et al., 2007). As noted by Wiers and Stacy (2006), addiction is paradoxical in that substance dependent individuals continue to use substances despite knowledge of the negative consequences that can ensue. Such behaviour seems to reflect the dominance of automatic, or implicit, processes over deliberative capacity. Uncovering what these implicit processes are and how they might override the reflective system

may help to explain the persistence of problematic substance use. Various tests have been employed to do this, including modified versions of the Implicit Association Test and the Stroop test, as well as substance-related word association tasks (Stacy & Wiers, 2010). Results have shown that implicit associations about alcohol and other substances correspond reliably with actual use and predict future use (Rooke, Hine, & Thorsteinsson, 2008; Stacy & Wiers, 2010). This effect appears to be due to positive associations predicting heightened use, rather than negative associations leading to lowered use (Houben & Wiers, 2008).

An explanation of how implicit associations might override cognitive control comes from the decision making literature. Slovic and colleagues (Slovic, Finucane, Peters, & MacGregor, 2007) document a cognitive bias termed the ‘affect heuristic’, defined as the tendency to make decisions based on the emotional valence assigned to those decisions. An individual’s positive or negative representations, or ‘affective associations’, about a given behaviour are likely to influence their judgements of the risks and benefits of that behaviour, with positive associations leading to lower risk perception and making a decision to engage in the behaviour more likely. A similar theory has been presented by Loewenstein et al. (2001), whose ‘risk as feelings’ hypothesis states that when an emotional response to risk is in conflict with cognitive assessment of that risk, the emotional response is more likely to drive behaviour. These theories are extremely relevant to adolescent risk-taking. There is growing consensus in the literature that emotional and experiential factors may be more reliable predictors of risk behaviour in adolescents than ‘rational’ decision making processes (Albert & Steinberg, 2011; Romer, 2010; Slovic, 2003).

Given a tendency towards emotion taking precedence over control, individuals high in urgency may be especially likely to employ the affect heuristic. More specifically, those high in urgency may tend to rely on their affective or implicit

cognitions about substance use when considering whether to engage in use. Two studies have shown that this is indeed the case with regard to alcohol. The first, a study of Australian high school students (Phillips, Hine, & Marks, 2009), found that individuals high in negative urgency showed a direct association between affective associations about alcohol use and self-reported binge drinking. In low urgency individuals, this relationship was fully mediated by beliefs about the pros and cons of alcohol use, a measure more in line with deliberative analysis. A second study (Burton, Pedersen, & McCarthy, 2012) identified a moderating (strengthening) effect of both urgency traits on the relationship between positive implicit associations about alcohol use and past month alcohol use in sample of undergraduates.

A question that has not yet been explored is whether urgency is associated with an inclination to generate positive associations about substance use. Settles, Cyders, and Smith (2010) suggest that the urgency traits might influence how individuals learn from their experiences with substance use, and provide evidence suggesting that heightened levels of urgency might lead to the formation of drinking motives and expectancies of alcohol use that promote greater use. It is possible that this process also applies to affective associations, with high urgency individuals more likely to learn positive associations about substance use. The current study aims to test this by assessing urgency alongside affective associations about substance use, and examining whether affective associations might act as a mediator between urgency and substance-related decision making.

Peers as an affective stimulus

Many of the key findings in the thesis have been explained with reference to a theory that adolescents high in urgency might be prone to allowing the real or perceived substance use behaviour of their peers to guide their own substance use

decisions, due to such information being influential in states of elevated affect. This idea rests on an assumption that normative information forms part of implicit cognition and has a high degree of affective salience. What is the evidence for this assumption? There is certainly mounting evidence that concerns about social acceptance and rejection activate neural responses in areas implicated in affective and reward processing (Guyer, McClure-Tone, Shiffrin, Pine, & Nelson, 2009; Masten et al., 2009). It seems fair to suggest that thoughts about whether to follow peer norms would be included in such concerns.

Nelson et al. (2005) suggest that social information processing in the adolescent brain is carried out by three sequential nodes: a detection node which characterises stimuli as social, an affective node which assigns contextual emotional properties to the stimuli, and a cognitive-regulation node which integrates the information into planning goal-directed behavioural responses whilst inhibiting prepotent responses. Applying this model to substance use behaviour, adolescents who experience their friends or respected peers using substances or talking positively about substance use may assign positive emotional valence to such behaviour, in turn making individual use more likely.

Gerrard and colleagues have also proposed that certain social information may act as an implicit stimulus. Their prototype willingness model posits two paths to adolescent risk behaviour: a reasoned path involving deliberative processing, and a 'social reaction' path that is heuristic and dependent on past experiences (Gerrard, Gibbons, Houlihan, Stock, & Pomery, 2008). It is suggested that the latter path is responsible for unintended risk-taking such as substance use. These authors propose that adolescents develop mental images or representations of prototypical risk-takers, which are influenced by peer norms. If these images are positive, they may take on a motivational effect, increasing an individual's willingness to engage in certain risks.

Consistent with this model, Romer and Hennessy (2007) found that peer norms regarding tobacco, alcohol, and cannabis were related to affective evaluations of these substances, which in turn were related to actual use. Importantly, peer norms and affective evaluations also mediated the relationship between sensation seeking and substance use in this study, supporting the possibility that these may be mechanisms by which impulsivity-related traits influence substance use. To expand upon this research, the current study employs a measure of affective associations about substance use alongside measures of perceived peer approval and of urgency.

Substance use assessment

A recurring limitation for studies in this thesis and for research into adolescent substance use more generally is a low level of individuals who report substance use. This could of course be due to genuinely low levels of use, but may also result from commonly-reported limitations of self-report substance use measures. Brener, Billy, and Grady (2003) have grouped these limitations into two factors: cognitive factors, such as difficulty recalling precise levels of use over a long time period; and situational factors, such as concern with reporting illegal behaviour and broader issues of social desirability. In an attempt to avoid these limitations, the present study will use a hypothetical scenario to assess intention to engage in substance use, rather than actual use. The substance in the scenario will be a 'legal high'. This term defines psychoactive substances not currently controlled by drug law (European Monitoring Centre for Drugs and Drug Addiction [EMCDDA], 2011). Although sold as a legal alternative to controlled substances, legal highs are by no means risk free. Use has been associated with multiple negative symptoms, including agitation, paranoia, and tachycardia (Spiller, Ryan, Weston, & Jansen, 2011), and despite their name legal highs may include banned chemicals (Brandt, Sumnall, Measham, & Cole, 2010).

It is acknowledged that hypothetical risk measures are limited in terms of their external validity. However, as noted by Cauffman and Steinberg (2000), adolescents who endorse antisocial behaviour in response to hypothetical scenarios are more likely to use illegal substances than those who do not. In addition, responses on a hypothetical risk-taking scale have previously been shown to correlate significantly with measures of smoking and problematic alcohol use in undergraduate students (Magar, Phillips, & Hosie, 2008).

Aims and hypotheses

This study aims to test a model whereby urgency is linked to substance use decision making through its relationship with affective associations about substance use, and to compare this model across three age groups: adolescents, late adolescents, and adults. Direct and indirect effects will be analysed. The study will also test the association between affective associations and perceived peer approval for substance use. Finally, the study aims to further explore a possible link between urgency and the affect heuristic, non-specific to age group. The following hypotheses will be tested:

H1: In adolescents, but not other age groups, affective associations about substance use will be a stronger predictor of hypothetical substance use likelihood than perceived positive or negative consequences of use.

H2: In adolescents, affective associations will mediate the association between urgency and substance use likelihood.

H3: Affective associations and perceived peer approval of substance use will be associated across all age groups, with the largest association in adolescents.

H4: High urgency individuals will be more likely to use the affect heuristic in response to the hypothetical substance use situation presented.

Method

Participants and procedure

The sample for this study comprised 286 participants (226 female) with an age range of 15 to 50 ($M = 22.19$, $SD = 7.04$). Two methods were used for recruitment. Seventy one adolescent participants aged 15-17 ($M = 16.65$, $SD = .54$) were students from schools in the South East London area, visiting Goldsmiths for a university ‘taster day’. These participants were given the opportunity to take part in the study following a presentation on psychological research methods. The remaining participants were recruited using online notice boards and completed the measures using the Qualtrics website (<http://www.qualtrics.com>). These participants were offered entry into a £20 prize draw. Online participants were divided into two groups: those aged 18-20 were classified as late adolescents ($n = 95$, $M = 19.00$, $SD = .81$), and those aged 21 and over were classified as adults ($n = 117$, $M = 28.17$, $SD = 7.58$). Three online participants did not report their age.

Measures

Urgency

Positive and negative urgency were assessed using the relevant subscales of the UPPS-P Impulsive Behaviour Scale (Cyders et al., 2007; Whiteside & Lynam, 2001).

Reliability coefficients in this sample were .89 for negative urgency and .95 for positive urgency.

Affective associations

Free associations about drug use and their affective salience were measured using the word association approach detailed by Peters and Slovic (1996). Participants were asked to write down the first five thought or images that immediately came to mind when shown the phrase “using drugs”, and then to rate each thought/image on a scale ranging from (1) very negative to (5) very positive. The five response scores were summed for a continuous score ranging from 5 to 25 with high scores reflecting more positive associations. The alpha reliability was .80.

Risk scenario

The following fictitious quote was designed to describe a situation in which substance use could occur:

“I was at a birthday party with three of my friends last Friday night. We were laughing a lot and having a really good time. Then one of my friends said that they had got a bag of this drug called ‘High Beams’ off of the internet. Apparently it was completely legal to buy. Two of my friends had taken it before and said it made them feel really happy, energetic, confident, and sociable. They said that music and colours became really intense after they took it. I had never done any drugs before, so I wasn’t sure whether to try it or not.”

The quote was intended to be applicable to any age group. The gender-neutral name Sam was used for the protagonist. Description of drug effects was adapted from information provided on the website *HerbalHighs* (www.herbalhighs.co.uk).

Perceived peer approval

After reading the quote, participants were asked to estimate how many of their five closest friends would take the drug if in this situation.

Beliefs about consequences

Participants were next asked to report the likelihood of 12 possible consequences occurring if the drug in the scenario was consumed. Items were adapted from the Beliefs about Consequences scale, provided by the EMCDDA Evaluation Instruments Bank. Items are not drug-specific. Six items reflect positive consequences that may occur, for instance ‘have more friends’ and ‘feel more relaxed’, and six reflect negative consequences, for instance ‘get into trouble with police’ and ‘become an addict’. A five point Likert-style response format ranging from Very Unlikely to Very Likely was used. Reliability coefficients for the scales were .86 for positive consequences and .88 for negative consequences.

Substance use likelihood

Participants were asked to report the likelihood that they themselves would take the drug if in this situation, with a five point Likert-style response format ranging from (1) very unlikely to (5) very likely.

Analysis

Multiple-group path analysis was conducted using Mplus version 6 (Muthén & Muthén, 1998-2011) with maximum likelihood estimation. An observed variable model was specified as sample sizes across groups were not large enough to substantiate a latent variable model. The χ^2 statistic was used to assess model fit. A well-fitting model is indicated by a non-significant χ^2 value, although this test is sensitive to large samples (Iacobucci, 2010). Three additional fit indices were used: the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardised root mean residual (SRMR). Hu and Bentler (1999) suggest the following rules of thumb for acceptable fit: CFI > .95, RMSEA < .06, and SRMR < .08. Indirect effects and 95% confidence intervals were calculated using bias-corrected bootstrapping of 5000 samples, in line with recommendations by MacKinnon, Lockwood, and Williams (2004). A significant effect is indicated by a confidence interval that does not include zero.

In the initial proposed path model, substance use likelihood was hypothesised to be predicted by urgency, affective associations, perceived peer approval, and perceived positive and negative consequences of use. Perceived positive and negative consequences were hypothesised to be predicted by affective associations and perceived peer approval, in line with theories stating that socio-affective information can influence deliberative processes. Affective associations and perceived peer approval were allowed to co-vary in order to test these variables' association. Finally, affective associations and perceived peer approval were hypothesised to be predicted by urgency.

Results

All variables showed less than 5% missing values, and Little's MCAR test was non-significant, $\chi^2(44) = 38.67, p = .70$. Missing data were imputed using expectation maximisation. Two multivariate outliers were identified using Mahalanobis' distance. These were removed from analysis. Three participants did not report their age so could not be included in between-groups tests.

Mean scores across age groups and for the entire sample are presented in Table 6.1. The substance use likelihood measure was sufficiently normally distributed, with only modest skewness (.50) and kurtosis (-1.05). These values were similar across age groups. One-way ANOVAs were used to assess differences on mean scores between age groups. Results showed significant group differences on positive consequences, $F(2, 278) = 8.40, p < .001$, and negative consequences, $F(2, 278) = 4.24, p = .02$. Inspection of means showed that both of these scores were largest in the adolescent group before progressively declining across the two older groups. Post hoc comparisons with Bonferroni correction showed that for positive consequences adolescents differed significantly from adults ($p < .001$) but not late adolescents. For negative consequences adolescents again differed significantly from adults ($p = .02$) but not late adolescents. Late adolescents and adults did not significantly differ on either scale. No other significant group differences were found.

Item scores for affective associations, positive consequences and negative consequences were entered into an exploratory factor analysis with maximum likelihood extraction and direct oblimin rotation. Three factors with eigenvalues greater than 1 were extracted, reflecting the three measures exactly. All items loaded at least .55 onto their respective factor with no cross-loadings above .16 (Table 6.2).

Table 6.1

Descriptive statistics

Variable	Age group			Total
	Adolescents (<i>n</i> = 71) M (SD)	Late adolescents (<i>n</i> = 95) M (SD)	Adults (<i>n</i> = 117) M (SD)	
Negative urgency	2.38 (.62)	2.45 (.63)	2.51 (.66)	2.46 (.64)
Positive urgency	1.90 (.68)	1.95 (.59)	1.82 (.67)	1.89 (.65)
Affective associations	12.01 (4.56)	12.42 (5.57)	12.16 (5.39)	12.21 (5.24)
Peer approval	3.30 (1.38)	3.05 (1.57)	2.96 (1.46)	3.07 (1.48)
Positive consequences	19.99 (4.16)	18.60 (5.23)	17.03 (4.84)	18.28 (5.00)
Negative consequences	20.33 (5.86)	19.47 (6.73)	17.72 (6.12)	18.96 (6.34)
Substance use likelihood	2.62 (1.40)	2.45 (1.40)	2.25 (1.28)	2.41 (1.35)

Table 6.2

Pattern matrix of exploratory factor analysis

<i>Item</i>	Negative consequences	Positive consequences	Affective associations
Affect 1			.63
Affect 2			.61
Affect 3			.74
Affect 4			.63
Affect 5			.66
Have more friends		.60	
Trouble with police	.81		
Perform badly at school/work	.81		
Feel more relaxed		.56	
Trouble with parents	.63		
Have more fun		.76	
Be more popular		.66	
Be expelled/fired	.86		
Forget troubles		.68	
Have problems with friends	.69		
Confident and outgoing		.76	
Become an addict	.68		

Values below .30 are suppressed.

Correlations between variables for the entire sample are presented in Table 6.3. Negative and positive urgency correlated substantially and did not differ largely in their associations with other variables (all within .07). As the hypotheses for the current study did not specify separable effects for the urgency traits, it was decided to combine negative and positive urgency into one variable, as has been demonstrated previously (Smith et al., 2013).

Table 6.3
Bivariate correlations for entire sample

	1	2	3	4	5	6	7	8
1. Gender	-							
2. Age	-.10	-						
3. Negative urgency	-.16**	.11	-					
4. Positive urgency	.01	-.07	.65***	-				
5. Affective associations	.07	-.01	.17**	.20**	-			
6. Peer approval	.08	-.13*	.30***	.26***	.24***	-		
7. Positive consequences	.03	-.20**	.14*	.14*	.15*	.38***	-	
8. Negative consequences	-.07	-.10	-.08	-.01	-.38***	-.27***	.00	-
9. Substance use likelihood	.10	-.11	.21***	.22***	.37***	.55***	.42***	-.30***

N = 284-286; Gender coded as female = 0, male = 1.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Path analysis

The initial model fit the data well, $\chi^2(9) = 9.84, p = .36, CFI = .997, RMSEA = .03, SRMR = .03$. However, it was observed that the direct path from urgency to decision was non-significant across groups. This path was removed from the model.

The revised model showed excellent fit to the data, $\chi^2(12) = 11.46, p = .49, CFI = 1.00, RMSEA = .00, SRMR = .03$. Standardised regression coefficients for all three groups are presented in Figure 6.1. The R^2 for substance use likelihood for each group was as follows: adolescents = .47, late adolescents = .47, adults = .35 (all $p < .001$).

This model was tested against a model in which all paths were constrained to be equal across age groups. The two models differed significantly, $\chi^2_{diff}(22) = 35.38, p = .04$,

indicating that path coefficients differed between age groups to the degree that coefficients would be better interpreted separately.

In adolescents, affective associations significantly predicted substance use likelihood whilst perceived positive and negative consequences did not. This finding supports *H1*. However, the difference between the standardised beta coefficients of these variables was marginal. In partial support of *H3*, affective associations were significantly associated with perceived peer approval in adolescents and late adolescents, although not in adults. This association was largest in adolescents, as predicted.

Results of indirect effects analysis are presented in Table 6.4. In the adolescent group there was a marginally significant indirect effect of urgency to likelihood via affective associations. In the late adolescent and adult groups, significant indirect paths were found from urgency to likelihood via peers, and from urgency to likelihood via peers and positive consequences. In the late adolescent group there was also a marginally significant path from urgency to likelihood via peers and (low) negative consequences.

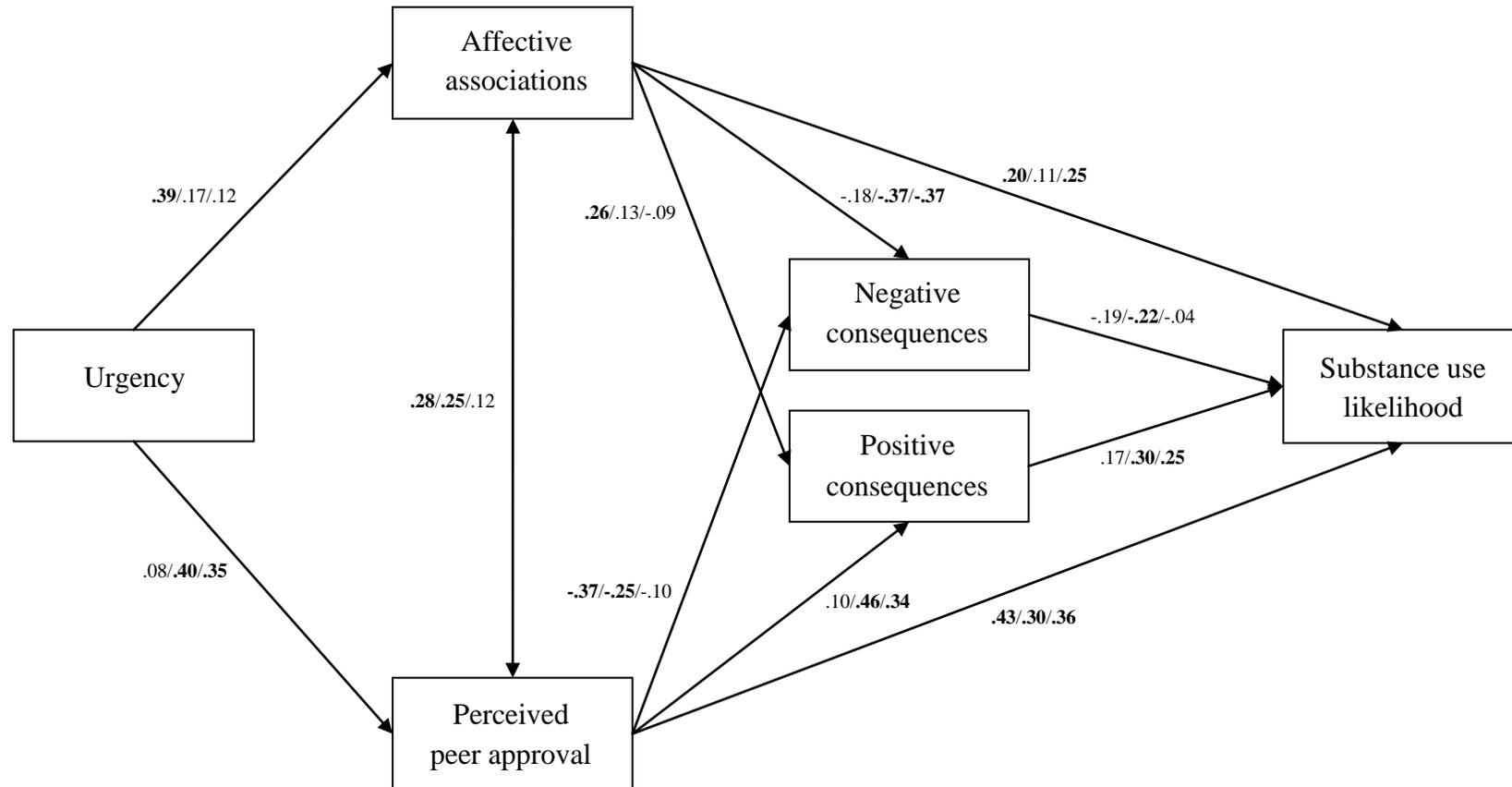


Figure 6.1. Multiple-group path model. Standardised regression coefficients are presented for adolescents/late adolescents/adults. Double-headed arrow represents correlation coefficient. Bold values are significant at $p < .05$.

Table 6.4

Indirect effects

Path	Age group								
	Adolescents			Late adolescents			Adults		
	<i>b</i>	CI	β	<i>b</i>	CI	β	<i>b</i>	CI	β
Urg-Aff-Subs	.19	.01 - .46	.08	.05	-.01 - .23	.02	.06	-.02 - .20	.03
Urg-Aff-Neg-Subs	.03	.00 - .13	.01	.03	.00 - .12	.01	.00	-.01 - .04	.00
Urg-Aff-Pos- Subs	.04	.00 - .15	.02	.02	.00 - .09	.01	-.01	-.04 - .00	.00
Urg-Peer- Subs	.08	-.13 - .34	.03	.31	.08 - .64	.12	.26	.10 - .50	.13
Urg-Peer-Neg- Subs	.01	-.01 - .11	.01	.05	.01 - .16	.02	.00	-.01 - .04	.00
Urg-Peer-Pos- Subs	.00	.00 - .06	.00	.14	.05 - .30	.05	.06	.02 - .15	.03

CI = 95% confidence interval, Urg = urgency, Aff = affective association, Peer = perceived peer approval, Neg = perceived negative consequences, Pos = perceived positive consequences, Subs = substance use likelihood.

Test of interaction between urgency and affective associations

To further examine the hypothesised link between high urgency and the affect heuristic, a moderated multiple regression analysis was conducted on data from the entire sample. The aim of this analysis was to test whether individuals with higher levels of urgency showed a stronger relationship between affective associations and substance use likelihood than those low in urgency, controlling for perceived positive and negative consequences. Age groups were not compared in this analysis due to power considerations. Substance use likelihood was used as the criterion variable. Predictor variables were entered hierarchically, with urgency, affective associations, positive consequences, and negative consequences entered at step 1, and the interaction term between urgency and affective associations entered at step 2. Results are presented in Table 6.5. At step 1, all predictor variables significantly predicted substance use likelihood. The interaction term in step 2 was marginally significant ($p = .049$). Simple slopes analysis indicated that at low levels of urgency ($-1 SD$) the slope of the relationship between affective associations and substance use likelihood was $b = .03$, $SE b = .02$, $B = .11$, $p = .14$, and at high levels of urgency ($+1 SD$) the slope was $b = .08$, $SE b = .02$, $B = .29$, $p < .001$. These relationships are displayed in Figure 6.2.

Table 6.5

Moderated multiple regression analysis with likelihood of substance use as criterion

	R^2	F change	b	SE	β
<i>Step 1</i>	.33	33.83			
Urgency			.29	.12	.13*
Affective association			.05	.01	.20***
Positive consequences			.10	.01	.37***
Negative consequences			-.05	.01	-.22***
<i>Step 2</i>	.34	3.89			
Urgency x affective associations			.04	.02	.10*

* $p < .05$. *** $p < .001$.

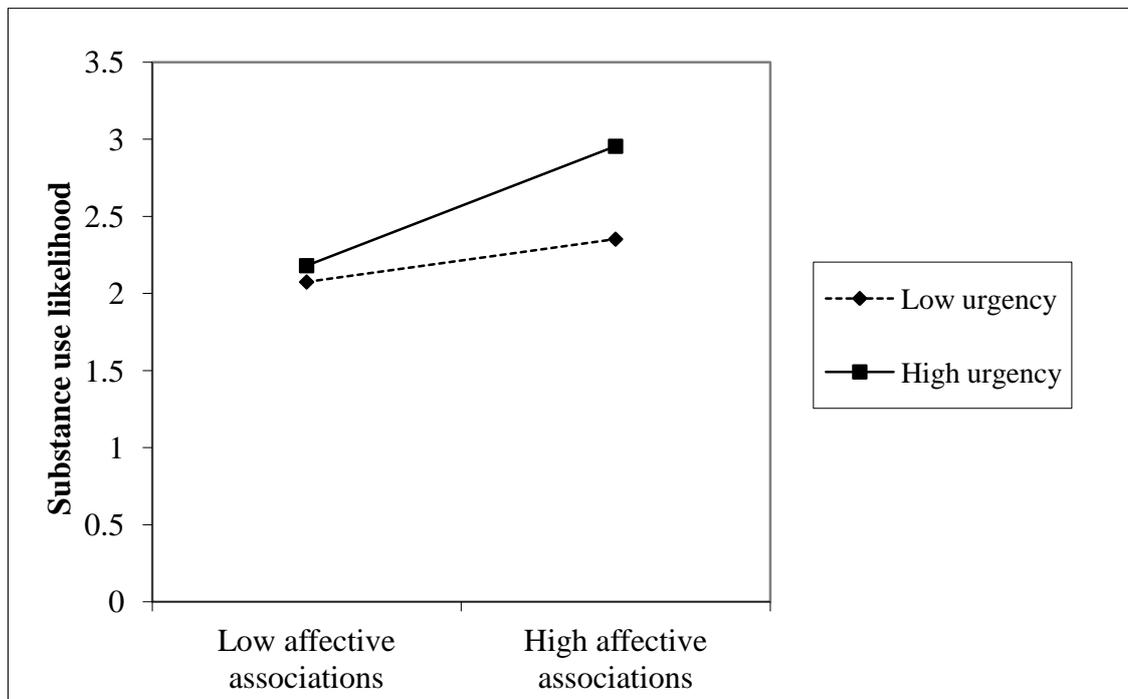


Figure 6.2. Moderation effect of urgency on the relationship between affective associations and hypothetical substance use likelihood

Discussion

This study attempted to explore potential mechanisms by which trait urgency might lead to decisions to engage in substance use. Results suggest that affective associations about substance use, perceived peer approval, and perceived consequences of substance use might help to explain urgency's link with risky behaviour. Negative and positive urgency showed significant bivariate relationships with likelihood of substance use in a hypothetical scenario, yet the association was explained by the addition of these other factors in a path model.

Urgency was strongly related to affective associations in the adolescent group only. This is the first reported evidence that urgency is related to a tendency to generate more positive associations about substance use, a finding that supports the idea that high urgency might form part of an acquired preparedness to engage in substance use by predisposing individuals to learn positive substance-related associations and expectancies (Combs, Spillane, Caudill, Stark, & Smith, 2012; Settles et al., 2010). Analysis of indirect effects showed a marginally significant indirect path from urgency to substance use likelihood via affective associations in adolescents only. This is tentative evidence that affective associations might act as a mediator between urgency and substance use in adolescents.

Among adolescents, affective associations, perceived positive consequences, and perceived negative consequences showed similar relationships with the likelihood of using a legal high, although only affective associations showed a significant association. This finding partially supports the hypothesis that affective associations would be a stronger predictor of substance use likelihood than perceived consequences in adolescents, but also reveals that 'deliberative' cognitions about substance use might be almost as important. It may be that in response to the hypothetical scenario

provided, adolescents were able to use all available information to guide their decision. Affective associations may become a better predictor in ‘hot’ situations where longer deliberation is not possible (Johnson, Dariotis, & Wang, 2012). It is noteworthy that the adolescent group showed the highest scores for perceived negative consequences of substance use, yet also the highest score for likelihood of using the drug in the hypothetical scenario. This result supports the view that adolescent risk-taking is not a consequence of faulty risk perception (e.g. Steinberg, 2007).

Affective associations were positively associated with perceived peer approval of substance use in the youngest two groups, supporting the hypothesis that substance-related peer norms are related to implicit cognitions and have affective salience in younger individuals. The direction of influence here is unclear, and may indeed be reciprocal. Individuals who generate positive images about substance use may believe that their friends will endorse such behaviour, and vice versa. Interestingly, Coronges, Stacy, and Valente (2011) have shown that implicit cognitions about substance use may even be transmitted between friendship groups during adolescence. The present data are concordant with this idea of ‘cognitive contagion’, and indicate that the association between positive affective associations about substance use and perceived peer approval subsides by adulthood.

In late adolescents and adults, an indirect path from urgency to likelihood via perceived peer approval was shown, indicating that individuals high in urgency aged 18 or over may be more likely to assume that their peers would endorse substance use, in turn making their own use more likely. This finding offers support for the theory that high urgency individuals’ problematic behaviour could be partially explained by socio-affective factors. It is unclear, however, why this indirect effect was not found in the adolescent group, and replication will be required before firm conclusions can be made.

In a test of urgency's possible moderating effect on the tendency to use the affect heuristic, it was found that high urgency individuals showed a significant association between affective associations and hypothetical substance use likelihood, whilst individuals with low levels of urgency did not show this effect. This finding supports the hypothesis that individuals high in urgency are more likely to use the affect heuristic when making risky decisions, in line with results reported by Phillips et al. (2009) in relation to adolescent alcohol use.

Implications for intervention

Although the present data are preliminary, they may contribute to ongoing debate about effective strategies for the prevention of adolescent substance use. Reducing substance use may require a focus on exposing adolescents to negative substance-related imagery to attenuate any influence of positive affective associations. It is noteworthy that introducing graphic imagery of the negative consequences of smoking onto cigarette packaging has shown to be effective in discouraging use (Fong, Hammond, & Hitchman, 2009). Developing similar imagery for other potentially harmful substances and finding ethical ways to present such imagery may be a useful avenue for further enquiry.

Limitations

The inferences that can be drawn from this study are limited by a number of factors. First, the outcome measure was hypothetical, and it is unclear whether responses to this measure reflect a real-world tendency to use substances. It is notable that responses to the hypothetical measure showed a reasonably normal distribution, in contrast to data from many of the actual substance use measures used throughout the thesis. It is unclear, however, whether this difference reflects increased honesty in

response to a hypothetical scenario, or merely exaggeration. It is suggested that future studies assess the external validity of hypothetical substance-related scenarios in greater detail, as these may be an effective way of assessing potential risk for actual substance use.

Second, the scenario used to stimulate consideration of hypothetical substance use may not have been as applicable to adult participants as it was to those in the younger groups. Adolescents and younger university students are perhaps more likely to attend parties and to be offered substances by their friends. In future, greater effort could be made to match relevant scenarios with the age groups being tested.

Third, the affective association measure used here was not a true implicit measure as it required introspection and self-reporting. The measure may have been prone to the same issues that limit explicit measures, such as differences in motivation to report mental content, and difficulties with translating mental images into words (Nosek, Hawkins, & Frazier, 2011). Further study of urgency and substance use would benefit from including true implicit measures such as the word association tasks developed by Stacy (1997).

Finally, the data presented here are cross-sectional, and the directional associations of the path model presented are speculative. Researchers investigating affective associations in relation to other behaviours have postulated a different chain of influence, with associations as a mediator between cognitive decision making factors and behaviour (Kiviniemi, Voss-Humke, & Seifert, 2007). Unpicking the nature of these relationships more thoroughly will require the use of more sophisticated methods.

Future directions

A key next step is to test whether the affect heuristic becomes more prevalent under extreme mood conditions in high urgency individuals. An extension to the present study could employ positive and negative mood induction procedures before assessing risk-taking tendency. Alternatively, participants could be tested at multiple time points and assessed for current mood alongside measures of risky decision making and actual substance use. Such evaluation could quite easily be carried out using experience sampling methods.

An additional area for further study is to focus on the positive aspects of the affect heuristic. It is important to note that although the use of this cognitive bias might lead to risk-taking and undesirable consequences under certain conditions, under others it would most certainly be beneficial. As Slovic et al. (2004) put it, the affect heuristic works “beautifully when our experience enables us to anticipate accurately how we will like the consequences of our decisions” (p. 321). In this sense, affect is an essential component of rational action. Individuals who as a result of brain injury show impairments in their ability to use affective cues, or ‘somatic markers’, to inform their judgements tend to make decisions that are disadvantageous and potentially dangerous (Damasio, 1994). Future work could delineate further the conditions in which affect-based biases in decision making can lead to positive or negative outcomes.

Conclusion

This study has found support for the idea that urgency’s relationship with adolescent substance use may be partially explained by the affect heuristic. Urgency was significantly related to affective associations about substance use in adolescents but not other age groups, and affective associations mediated the relationship between urgency and likelihood of substance use in a hypothetical scenario. Additionally,

urgency moderated the relationship between affective associations and likelihood, such that the effect was only significant in participants reporting high levels of the trait. This is the first study to have investigated a link between urgency and the affect heuristic in relation to substance use other than alcohol, and the first to compare links between urgency and affective associations across age groups.

Chapter 7

General discussion

Overview

This chapter will review the key findings of the thesis and consider their implications for current theory and for the development of prevention and intervention campaigns. Broad limitations of the research will be acknowledged with a focus on issues relating to sampling and measures. Finally, ideas for further research shall be presented.

Key findings

The research programme documented in this thesis set out to elucidate understanding regarding how trait impulsivity relates to substance use during adolescence, and to identify possible interactive effects between impulsivity and peer influence on substance use outcomes. A strong evidence base exists linking these factors to adolescent substance use, yet there has been little attention given to studying their potential interplay. The studies presented herein employed systematic review, cross-sectional, prospective, and experimental designs to address this issue. The main findings of the thesis are presented below with reference to the four overall thesis aims outlined in Chapter 1.

Aim 1: To establish whether separable impulsivity-related personality traits show different relationships with aspects of adolescent alcohol and cannabis use

This first broad aim of the thesis sought to reframe the existing literature regarding impulsivity and adolescent substance use in terms of a multi-trait conceptualisation of impulsivity. The separation of trait impulsivity into a number of facets has helped to further understanding of the role of impulsive behaviour in a diverse set of behaviours and aspects of psychopathology (Miller et al., 2003), but has not been widely employed to understand adolescent substance use and risk-taking. It was proposed that a clarification of the relationships between impulsivity-related traits and aspects of adolescent alcohol and cannabis use could help to determine which individuals might be at greater risk for problematic use of these commonly-used substances. The UPPS framework (Whiteside & Lynam, 2001) was selected as the method of operationalisation for trait impulsivity due to its growing consensus in the literature,

and evidence from older samples indicating that separable UPPS traits may be associated with different aspects of substance use through distinct pathways (e.g. Curcio & George, 2011).

The quantitative review presented in Chapter 2 illustrated that discrete facets of impulsivity do show different levels of association with adolescent alcohol use. Sensation seeking and positive urgency were the traits with the largest associations with typical alcohol consumption, indicating that heightened alcohol consumption during adolescence is related to individual differences in motivation for novel and exciting experiences, and a reduced ability to regulate impulsive behaviour when in a positive emotional state. Positive and negative urgency showed the largest associations with problematic alcohol use, indicating that difficulty with regulating impulsive behaviour when in heightened emotional states is related to experiencing negative consequences from alcohol use and to symptoms of abuse and dependence. This finding was limited to college age samples due to a lack of data regarding the urgency traits and alcohol use in younger samples.

The empirical study reported in Chapter 3 addressed this gap in the literature by examining the urgency traits along with other UPPS traits and substance use measures in a sample of adolescent sixth form students. Findings supported the conclusions drawn from the quantitative review. The urgency traits were found to show the largest associations with problematic alcohol use, even after controlling for non-urgency impulsivity-related traits and typical alcohol consumption.

The literature on impulsivity-related traits and adolescent cannabis use was shown to be small compared to alcohol use. Previous studies have tended to focus on sensation seeking, with findings showing reasonably consistently that the trait is associated with the initiation and maintenance of cannabis use. The shortage of studies

assessing other impulsivity-related traits meant that no firm conclusions could be made regarding differential associations between traits and cannabis use outcomes.

The study reported in Chapter 3 was the first to administer the UPPS scale alongside measures of cannabis use in an adolescent sample. Lack of premeditation showed the largest association with typical cannabis use in this sample. Regarding problematic use, findings mirrored those for alcohol in that the urgency traits showed the largest bivariate associations and were the only significant predictors when accounting for the UPPS traits' shared variance in a regression model. This result was replicated with a late adolescent sample in the study reported in Chapter 4.

There is mounting evidence that urgency is a risk factor for problematic substance use and other maladaptive behaviours (Cyders et al., 2009; Dir, Karyadi & Cyders, 2013; Zapolski et al., 2009). The prospective data presented in Chapter 4 offered tentative further support that heightened urgency is predictive of later problematic alcohol use. Urgency, analysed as a combination of positive and negative facets, was found to significantly predict problematic alcohol use assessed after three months, controlling for baseline typical consumption and problematic use. However, due to the small follow-up sample in this study, definite conclusions cannot be drawn from these data and further research is required.

Overall, these results support the utility of separating impulsivity into multiple facets when examining its role in adolescent substance use behaviour, and indicate that urgency is the aspect of impulsivity most associated with problematic substance use in adolescent samples. Thus, the first aim of the thesis was achieved, and a novel contribution to the literature was made.

Aim 2: To examine relationships between impulsivity-related traits and social processes linked to substance use and to look into possible interactive effects on individual substance use behaviour

Past research has shown perceived peer use of substances to be strongly related to individual use. Although measures of perceived norms have their limitations (Bauman & Ennett, 1996) they remain a useful proxy of peer influence on individual substance use. Relationships between perceived substance use norms and impulsivity have not been widely investigated. The study reported in Chapter 3 was the first to assess perceived peer use of alcohol and cannabis alongside the impulsivity-related traits defined by the UPPS framework. Results showed that lack of premeditation was the trait with the largest associations with perceived peer alcohol and cannabis use. Similar results were obtained in the study reported in Chapter 4 in a late adolescent college undergraduate sample.

Turning to the issue of interactions, Chapter 3 reported moderating effects of negative and positive urgency on the relationship between perceived peer alcohol use and own problematic use. Individuals with higher levels of the urgency traits showed stronger relationships. Chapter 4 reported a replication of this effect in the older sample. An effort was made to test whether this effect persisted longitudinally by following up participants in this study after three months. Support for a longitudinal effect was not found, although results were limited by high attrition at follow-up.

Another important social process in understanding peer effects on substance use behaviour is peer selection. Research in younger adolescent samples has consistently shown that selection plays an important role in the similarity between individual and peer substance use levels (Bauman & Ennett, 1996). Surprisingly, selection effects have not previously been widely studied in first year college students, despite this

being an important transitional period when new friends are made and opportunities to use alcohol and substances are increased. The study reported in Chapter 4 investigated whether impulsivity-related traits were related to the selection of new alcohol and cannabis-using friends at two time points during the first year at college. Accounting for traits' shared variance, lack of premeditation was a significant predictor of new cannabis-using friends measured concurrently and prospectively. No trait significantly predicted new alcohol-using friends.

The study reported in Chapter 6 examined a possible link between trait urgency and the perceived peer approval of substance use in a hypothetical scenario. The sample for this study was divided into three age groups: adolescents, late adolescents, and young adults. Urgency was significantly positively associated with perceived peer approval in the two older groups only. Furthermore, indirect effects were observed in these two groups, with urgency associated with own likelihood of endorsing substance use via an association with perceived peer approval.

To summarise, the evidence presented indicates that lack of premeditation is the aspect of impulsivity most associated with the tendency to affiliate with substance-using peers. It is possible that this trait may have an indirect effect on substance use outcomes by promoting engagement with risky environments. Trait urgency is not only associated with problematic substance use outcomes but might also exacerbate the influence of peer-related risk factors. This is a novel and potentially important finding, contributing in a small way to understanding how dispositional and environmental risk factors act together to produce greater likelihood of negative outcomes. Finally, trait urgency is also associated with the perception that peers will advocate substance use, although this effect may be limited to older adolescents and adults.

Aim 3: To explore contextual factors that might exacerbate the influence of ‘risky’ impulsivity-related traits.

Building on the interaction effects found in earlier chapters, Chapter 5 sought to identify emotional and social conditions which might exacerbate the influence of sensation seeking and positive urgency on alcohol consumption. A study was presented which tested possible effects of approach-motivated positive mood (compared to neutral mood) and friend presence (compared to no friend presence) on associations between these traits and consumption in a beer taste test. Whilst a main effect of sensation seeking on alcohol consumption was observed, results indicated that the contextual factors under investigation did not exacerbate this effect. There was also no evidence of an interaction between conditions and positive urgency. The aim of this study was therefore not fully accomplished. Nevertheless, data did offer some speculative indication that reduced approach motivation might influence alcohol consumption in high sensation seekers. This observation warrants further investigation.

A trend was observed in that individuals high in positive urgency and in the positive mood condition drank beer at levels more similar to their experimental partner than did individuals low in positive urgency. Although by no means conclusive, this result suggests that high positive urgency individuals may be susceptible to modelling the drinking behaviour of peers when in a positive mood state. Thus, a situation in which these individuals experience positive affect in the company of a heavy-drinking peer might be particularly risky.

Aim 4: To investigate psychological processes that might account for relationships between impulsivity-related traits, peer influence, and substance use, and to link findings to current understanding of adolescent neurodevelopment

In Chapter 6, an attempt was made to link trait urgency with implicit cognition processes that have begun to receive significant attention in the substance use literature (Wiers & Stacy, 2006). It was hypothesised that affective associations (positive or negative thoughts and images) about substance use would mediate a relationship between urgency and likelihood of substance use in a hypothetical scenario, but that this effect would be limited to adolescents. Further, it was predicted that urgency would be associated with a tendency to use the affect heuristic when faced with a hypothetical decision to engage in substance use. Support for both of these predictions was attained, although effects were marginal and will require replication. A further issue explored in Chapter 6 was whether affective associations about substance use were related to perceived peer approval of substance use. These variables were found to be positively correlated in adolescents and late adolescents yet not in adults.

Implications

For theory

In Chapter 1 the literature on risk factors for substance use was outlined with reference to the importance of using multi-component models of risk that acknowledge interplay between factors. There has been a good deal of speculation on possible interactions between individual differences and social processes and their effects on substance use but a relatively small amount of research examining the precise nature of these interactions. The interactions found between urgency and perceived peer alcohol use contribute to this evidence base, and add to recent findings regarding urgency's moderating effect on other risk factors for problematic substance use (Burton et al., 2012; Karyadi & King, 2011; Martens et al., 2010). Understanding how urgency

relates to other risk factors is a useful step in integrating the trait into broader theories of vulnerability.

Looking more closely at liability to substance use disorders, findings complement current theories that emphasise the role of emotional dysregulation in the transition from recreational substance use to dependence (Cheetham, Allen, Yücel, & Lubman, 2010; Murphy et al, 2012; Wilens, Martelon, Anderson, Shelley-Abrahamson, & Biederman, 2013). Eisenberg, Fabes, Guthrie, and Reiser (2000) distinguish between emotion regulation, defined as the modulation of internal feeling states, and emotion-based behaviour regulation, defined as the modulation of behaviour resulting from these states. Trait urgency appears to reflect individual capacity for the latter. It has been shown here that young, non-clinical alcohol and cannabis users who experience problems with use show a reduced capacity for emotion-based behavioural regulation compared to those who do not. Increased focus on this aspect of regulatory ability and how it might predispose for substance dependence seems warranted.

Regarding the conceptualisation of impulsivity, the studies presented offer further support for the separation of this trait cluster into discrete facets. Although previous studies have found the UPPS factor structure to be present in adolescent samples (d'Acremont & Van der Linden, 2005), there has been limited effort to link these separate factors to behavioural outcomes in this age group. The differing patterns of association between traits and substance use outcomes, and the reasonable consistency of these associations across studies, indicate that studying impulsivity as a number of distinct but related traits may be helpful for understanding these outcomes more clearly. It is recommended that researchers looking at impulsivity and adolescent substance use are clear which aspects of impulsivity they intend to focus on.

On the whole, the data presented are consistent with the 'systems' models of adolescent neurodevelopment that have been used to inform this research programme

(Ernst et al., 2006; Steinberg, 2010). These approaches highlight the differential maturational patterns of conceptual brain systems comprising areas responsible for reward, emotion processing, and regulatory control, and link possible imbalances between these systems to the increase in risk-taking behaviour commonly observed in adolescence. A main premise of these approaches is that adolescent decision making can be disrupted by salient socio-affective stimuli, internal or external to the individual, leading to an increased likelihood of risk-taking or potentially problematic behaviour. Adolescents who are more prone to this disruption may be more likely to engage in such behaviour. The present findings indicate that adolescents who tend to act impulsively when in heightened mood states are more likely than other adolescents to experience negative consequences from alcohol and cannabis use, to show a link between elements of social substance-related information and their own substance use behaviour, and to use affective representations to inform substance use decision making. Thus, the integration of recent advances from both the individual differences and developmental literatures contributes to a more intricate understanding of adolescent risk-taking. Incorporating individual and social factors into models of adolescent behaviour should be a continued focus of theory development.

For intervention

The urgency traits showed only modest relationships with typical substance consumption in the empirical studies outlined in Chapters 3 and 4, much weaker than their relationships with measures of problematic use. These findings are consistent with the view that certain psychological characteristics are associated with risk of problematic substance use despite not being linked to increased typical use (Colder & Chassin, 1999; Smith et al., 1995). Adolescents high in urgency may be prone to experiencing negative consequences from alcohol and cannabis use even at relatively

low levels of use. This information may be useful for the planning of campaigns to prevent or reduce the onset and maintenance of substance use.

Conrod and colleagues have had success in implementing personality-based interventions for adolescent substance use, focusing on traits including impulsivity and sensation seeking (Conrod, Castellanos-Ryan, & Mackie, 2011; Conrod, Castellanos-Ryan, & Strang, 2010). Trait urgency has not yet been widely considered as a target for prevention efforts. However, there have been attempts to address broader problems with emotion regulation. Emotional dysregulation has been found to predict multiple forms of adolescent psychopathology (McLaughlin, Hatzenbuehler, Mennin, & Noelen-Hoeksema, 2011), and there is ongoing work to develop interventions that focus on self-regulation of distress (e.g. Kovacs et al., 2006). However, as noted by Gilbert (2012) adolescent psychopathology is linked to maladaptive responses to positive as well as negative emotion. The urgency construct appears to be a useful reflection of such response patterns. Further research is needed on how best to regulate maladaptive expression of urgency in adolescence. Once this is achieved, pilot studies can be conducted to assess whether reducing behaviours reflected by high urgency has any influence on preventing or attenuating symptoms of problematic substance use.

Findings may also have relevance for social influence approaches to prevention and intervention. Many school-based attempts to reduce alcohol and other substance use have used a social norms-based method, whereby possible misperceptions of normative substance use in schools and universities are explained in order to counter problems caused by the overestimation of peer substance use (Berkowitz, 2003). Evidence for the efficacy of such approaches is mixed. School and community-based interventions are often successful in the short-term but effects diminish substantially over time, whilst college-based programmes appear to be largely ineffective (Donaldson et al., 1996; Wechsler et al., 2003). The findings presented here suggest

that a consideration of individual differences in trait urgency could help to strengthen these efforts, specifically with regard to alcohol. High urgency individuals might benefit substantially from attempts to adjust their perception of normative alcohol use behaviour.

Limitations

Specific limitations of each study have been discussed in respective chapters. Here, some overarching weaknesses of the thesis will be presented, focusing on the samples used and the measures employed.

Samples

The first limitation to note is that all of the empirical studies reported used samples with a pronounced female bias. Substantial gender differences were not expected based on the previous literature, as studies have not tended to find prominent gender differences in the relationship of personality traits to substance use outcomes (Elkins, King, McGue, & Iacono, 2006), including specific tests of UPPS traits (Miller et al., 2003). The tests of gender differences reported here similarly found no notable effects. However, it is acknowledged that the overrepresentation of female participants causes difficulties in terms of generalisation, and it is recommended that greater efforts are made in future studies to use samples with more balanced gender ratios.

Second, there were issues of range restriction with regard to sample age. Although the thesis investigated issues relevant to all stages of adolescence, the youngest adolescents studied were aged 15. Adolescence is a dynamic period of development in which individuals undergo substantial maturational and experiential changes. Findings from samples with a narrow age range are therefore unlikely to be relevant to all

adolescents. For example, susceptibility to peer influence varies substantially at different time-points across the second decade of life (Sumter et al., 2009). It is possible that stronger effects of peer-related variables assessed here may be found in younger samples. An additional age-related concern is whether it is accurate to consider individuals up to the age of 21 as ‘late adolescents’, as was reported in Chapters 4, 5, and 6. Some authors and organisations specify cut-offs for adolescence at ages 18 or 19 (e.g. World Health Organisation). With these considerations in mind, it is important that any interpretation of the findings presented acknowledges the precise age range of samples in each study, taking care not to extrapolate findings to younger or older age groups.

Third, two of the reported studies sampled from the university undergraduate population. As Henrich, Heine, and Norenzayan (2010) discuss, these participants may not be particularly representative of the wider population. For example, college students are more likely to binge drink and to be diagnosed with an alcohol abuse disorder than similar-aged peers who do not attend college (Slutske, 2005), although such differences are not seen with regard to other substances (O’Malley & Johnston, 2002).

A final limitation of the samples used was a low number of participants reporting problematic substance use, particularly for cannabis. Future research into problematic substance use in adolescence may benefit from strategies to oversample individuals with abuse or dependence symptoms, possibly by recruiting from treatment facilities.

Measures and stimuli

All studies used self-report questionnaires to assess all or many of the variables of interest. Previous research has concluded that adolescent self-reports of alcohol and substance use behaviour are reliable and valid, although perhaps more so for

consumption than for problematic use (Smith, McCarthy, & Goldman, 1995; Williams, Toomey, McGovern, Wagenaar, & Perry, 1995; Winters, Stinchfield, Henly, & Schwarz, 1990-1991). Nonetheless, self-reports have a number of weaknesses, both general and specific to substance use assessment. These include social desirability issues, underreporting of substance use, and potential for researcher bias (Richter & Johnson, 2001). Biological measures such as saliva or hair analysis could have been used to validate self-reports, although these measures of course have their own disadvantages including cost and time of administration.

Measures assessing perceived peer substance use may not have provided an accurate representation of genuine peer substance use levels. Issues such as false consensus and pluralistic ignorance can limit the accuracy of perceived norm measures (Henry et al., 2011; Prentice & Miller, 1993). However, the strengths of these measures should also be emphasised. The thesis focused strongly on the role of individual differences in responsiveness to peer influences on substance use behaviour, emphasising the idea that individuals can vary in how they respond to external (i.e. peer-related) stimuli. Indeed, many of the key theoretical perspectives used throughout highlight the importance of internal representations of socio-affective stimuli. In this regard, measures of perceived substance use norms are perhaps as important as measures of genuine peer use. In saying this, additional work could certainly benefit from measuring actual peer substance use levels alongside the measures used here. Doing so could help to uncover whether adolescents high in impulsivity-related traits are prone to misperceive normative information regarding substance use.

A further limitation was the use of novel stimuli in two studies. In Chapter 5, unique scenarios for guided imagery mood inductions were presented, and in Chapter 6 the quote that participants were asked to respond to was created specifically for this study. The decision to create these novel stimuli was made based on a lack of

appropriate stimuli currently available in the literature. However, it is acknowledged that these stimuli did not undergo rigorous tests of validity, and the findings gathered from these studies may be limited as a result.

Future directions

This section will offer suggestions for further enquiry based on the findings and limitations of the thesis. As possible advances of the specific studies presented have been considered throughout, the ideas here will focus on broader research themes.

Further research is required into the nature of impulsivity. The UPPS model used prominently in the thesis shows much promise, but is limited due to its lack of underlying theory. The model is descriptive rather than explanatory, and as such does not produce testable predictions without the incorporation of wider research evidence. These are criticisms that have also been levelled at the Big Five approach to personality (Eysenck, 1992), and it is noteworthy that the UPPS model was formulated with reference to the Big Five (Whiteside & Lynam, 2001). Many questions remain. For instance, what neural processes might the UPPS traits reflect? Why do these traits tend to be positively correlated? Why do the two urgency traits in particular consistently show such high correlations, and would these be better assessed as a single factor of mood-based impulsivity? Another key flaw in the UPPS model is that reward sensitivity, long considered a key aspect of impulsive behaviour (Gray, 1987), does not feature at all. In contrast, the two-factor model of impulsivity proposed by Dawe and colleagues (Dawe, Gullo, & Loxton, 2004) is limited not so much by theoretical shortcomings but by inconsistent measurement. The rash impulsiveness component of this model has been measured by a wide number of scales which, as

Whiteside and Lynam's (2001) analysis shows, might actually reflect separable aspects of impulsivity.

The two-factor model and the UPPS framework have significant strengths, but research into each has tended to be carried out with little or no reference to the other. It is therefore recommended that efforts are made to consolidate these models into an overarching theory of impulsivity. At least three avenues of research are required to do this. First, psychometric studies using the UPPS Impulsive Behaviour Scale alongside measures of reward drive and rash impulsiveness are needed to confirm factor structure. Second, neurobiological studies are required to identify the processes that these traits reflect. Findings from the developmental neurobiology literature, which distinguish between neural underpinnings of impulsive responding and sensation seeking behaviour (Casey et al., 2008), may be useful for developing hypotheses in this area. Third, laboratory tasks that reliably gauge behaviours that these traits are thought to represent will need to be developed. A glaring weakness in the field of impulsivity research is the almost nonexistent overlap between self-report and behavioural measures (Cyders & Coskunpinar, 2011).

Looking specifically at trait urgency, it is clear that more work is needed to establish whether this trait construct is a risk factor for problematic substance use outcomes. The data presented in Chapter 4 offered some evidence of urgency's predictive utility, consistent with previous findings. However, the sample in this study was too small for findings to be conclusive. Larger longitudinal studies such as that recently reported by Smith et al. (2013) are needed, preferably with urgency assessed prior to substance use initiation.

As well as examining urgency's role in risk for negative outcomes, further enquiry could also consider the positive consequences of high urgency. In reference to impulsivity more generally, Gullo and Dawe (2008) observe that emphasising a trait's

link to negative outcomes can lead to the perception that the trait is essentially maladaptive. Evolutionary theory suggests that a characteristic would not remain in a population if it did not confer some adaptive advantage, and it has been speculated that variation in personality traits may be related to adaptive problem-solving strategies (Buss, 2009). Indeed, Dickman (1990) has highlighted that impulsivity need not always be problematic, separating the trait into functional and dysfunctional forms. Functional impulsivity is defined as the tendency to make rapid decisions when conditions are optimal, whereas dysfunctional impulsivity is the tendency to make rapid decisions due to a limited capacity for more in-depth deliberative processing. With this distinction in mind, it may be useful to also study the functional aspects of heightened urgency. In what circumstances might a tendency to act impulsively in response to emotional signals be beneficial for the individual?

The studies presented here did not consider how impulsivity-related traits might be influenced by pre-existing substance use. There is evidence that increases in impulsive behaviour can be a consequence, as well as a determinant, of substance use (de Wit, 2009). Previous studies with humans and non-human animals have shown that acute and chronic alcohol and cannabis use can have effects on behavioural measures of impulsivity, as well as suspected neurobiological correlates such as white matter integrity (Dick et al., 2010; Gruber, Silveri, Dahlgren, & Yurgelun-Todd, 2011; Jacobus, Squeglia, Infante, Bava, & Tapert, 2013; Whitlow et al., 2004). There is currently limited evidence on the effects of substances on self-reported impulsivity during adolescence. This will be an interesting area for future longitudinal studies to address, and an important one in terms of confirming causal sequences from traits to substance use outcomes.

Another avenue for further research is to clarify similarities and differences in how the risk factors studied here relate to alcohol, cannabis, and other substance use

outcomes. The common liability model of substance use disorder outlined by Vanyukov and colleagues (2003) proposes the existence of a generalised predisposition towards the use and abuse of substances, yet there is also evidence that alcohol dependence and substance use dependence have disorder-specific genetic liabilities (Kendler et al., 2003). It is known, for instance, that variation in the ALDH2 gene is related to risk for alcoholism through its effect on alcohol metabolism (Harada, Agarwal, Goedde, Tagaki, & Ishikawa, 1982), and there is evidence of substance-specific risk factors for adolescent alcohol and cannabis initiation and consumption (Gillespie, Lubke, Gardner, Neale, & Kendler, 2012). Here, whilst it was found that urgency was related to the problematic use of alcohol and cannabis as well as the hypothetical use of legal highs, supporting the common liability perspective, it is noteworthy that the interaction effects of urgency and perceived norms were only found for alcohol, and not cannabis. More research is needed to clarify whether this difference is genuine or merely the result of sample limitations.

Finally, an issue that was touched upon during the thesis but not explored to a great extent is the relationship between sensitivity to social reward and substance use, and how this may be related to aspects of impulsivity. Brain areas and neurochemicals involved in the processing of social rewards strongly parallel those involved in processing substance rewards (Trezza, Baarendse, & Vanderschuren, 2010), and it has been speculated that areas of the brain that have evolved to process social rewards are most prone to being ‘hijacked’ by addictive substances (Insel, 2003). Social popularity during adolescence has been linked to alcohol and illicit substance use (Martin-Storey et al., 2011; Mayeaux, Sandstrom, & Cillessen, 2008). Conversely, data from non-human animals suggest that low social rank is associated with a higher likelihood of self-administering cocaine, perhaps via a modulating effect on dopamine receptors (Morgan et al., 2002), and with impulsive behaviour (Fairbanks, 2001). Future studies

could investigate the interplay between social status, impulsivity, and substance use in human participants.

Conclusion

This thesis has delineated effects of separable impulsivity-related personality traits on adolescent substance use, consistently showing that emotion-based impulsivity, or urgency, is the facet of impulsivity most associated with problematic alcohol and cannabis use. It has identified relationships between specific impulsivity-related traits and aspects of peer influence on substance use, showing that lack of premeditation is associated with perceived levels of peer substance use and with selection of cannabis-using friends. It has also considered interactive effects of impulsivity and peer influence on substance use, showing that urgency strengthens the relationship between perceived peer alcohol use and own problematic use in two samples. Finally, it has considered mechanisms for these relationships, proposing that a tendency to engage in affect-based decision making may partially explain urgency's association with adolescent substance use, and perhaps risk-taking and problematic behaviour more generally. It is hoped that these modest contributions to the literature can inform theoretical development of complex models of risk for problematic substance use, and inspire further investigation of risk factor interplay.

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Studies preceded by an asterisk were included in meta-analysis.

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