Examining Adolescent and Adult Substance Use from a Dual Process Cognitive Perspective

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Certification

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

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Signature
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Summary

Dual process theories propose that humans have two cognitive systems, a rational system and an experiential (automatic, impulsive, affect-oriented) system. Previous research suggests adolescents may rely on experiential cognition more than do adults. Four studies investigated this possibility.

Study 1 examined the relationship between substance use related experiential cognition and substance use behavior through meta-analyzing 89 effect sizes, 17 of which pertained to adolescent samples. The overall relationship between experiential cognition and substance use was significant and moderate. While the relationship for adolescent samples was larger than that for adult samples, the difference was not significant, possibly due to the small number of adolescent samples.

Study 2 examined experiential drinking cognitions, expected costs and benefits of drinking, and binge drinking in 136 teen-parent pairs. Adolescents had stronger positive experiential drinking associations and stronger expected drinking benefits than did adults. In turn, both experiential drinking associations and higher expected benefit scores were associated with significantly higher levels of binge drinking. A moderation analysis revealed that alcohol-related experiential associations were a stronger predictor of binge drinking for adolescents than for adults.

Study 3 investigated relationships between impulsivity (premeditation, sensation seeking, perseverance, and urgency), rational beliefs about drinking, experiential drinking associations, and binge drinking in the same sample of adolescents and adults. Relative to adults, adolescents reported higher levels of sensation seeking and lower levels of premeditation, both of which were associated with higher levels of binge drinking. Moderation analyses revealed that the predictive relationship between alcohol memory associations and binge drinking was stronger for individuals who scored higher on urgency.
and lower on premeditation – adolescents exhibited this pattern of scores relative to adults.

The final study investigated how rational and experiential cognitions predict smoking in adults \( n = 200 \) and adolescents \( n = 222 \). Initial analysis revealed, counter to our predictions, that experiential cognitions were a stronger predictor of smoking for adults compared with adolescents. However, with the exclusion of daily smokers (who were mostly adults and were likely to be addicted to nicotine), this finding was reversed, with experiential cognition being a stronger predictor of smoking for adolescents than for adults. This may suggest that adolescents and individuals who are physically addicted to nicotine rely excessively on experiential cognition for making smoking decisions. The relationship between positive smoking expectancies and experiential smoking associations was also significantly stronger for adolescents, supporting the notion that adolescents may be less able than adults to override maladaptive experiential cognitions with adaptive rational cognitions.

Findings of the current research support the view that interventions targeting automatic responses from the experiential system could reduce substance abuse, particularly among adolescents.
Introduction

Adolescence and adulthood are differentially marked with regard to cognition, emotion, and behavior. Research on adolescents often suggests that suboptimal judgment, impulsiveness, and strong emotion characterize individuals in this age group (see Reyna & Farley, 2006). Several studies have been undertaken to identify how and why adolescents and adults differ from each other, and also the implications of these differences. A relatively new theoretical position addressing decision making and behavior involves a dual process account of human cognition. This dual process view offers important insights into the behavioral differences of adolescents and adults. In this thesis, a set of studies is presented that apply a dual process perspective to investigate adolescent-adult differences in substance use.

Decision Making from a Dual Process Perspective

Traditional theories of decision making often assume that decisions are the outcome of a rational-analytic process in which the individual systematically weighs potential costs of available options against potential benefits. Examples of such theories include Ajzen’s (1985) theory of planned behaviour (TPB), expectancy theory (e.g., Mitchell & Biglan, 1971; Vroom, 1964), and the health belief model (Rosenstock, 1974). While there is considerable evidence showing that outcome expectancies can predict behavior (e.g., Armitage & Conner, 1999; Bryan & Rocheleau, 2002; Fusilier, Ganster, & Middlemist, 1984; Leone, Perugini, & Ercolani, 1999), it is also very apparent that human decision making is not always consistent with this normative account of reasoning. Numerous studies have demonstrated that logical judgment is compromised by a range of biases, such as heuristic-based judgement (e.g., Davidson, 1995; Jacobs & Potenza, 1991; Markovits & Dumas, 1999).

An alternative proposition to that offered by traditional decision making models, such as TPD, is that decisions are at times the outcome of non-rational cognitive processes. This
proposition is by no means a modern one – Freud’s psychoanalytic theory popularized the view a century ago (Epstein, 1994). More recently, however, a cluster of theories accommodating the notion that human behavior may stem from cognitive processes other than rationality has been put forward. Collectively, the theories are known as dual process theories of cognition. Dual process theories are somewhat compatible with psychoanalysis in that they emphasize the importance of preconscious processes in decision making; however, the theories diverge from Freudian teachings in several ways. Perhaps most importantly, dual process theories do not conceive of behavioral manifestations of preconscious cognitive processes as essentially maladaptive (Epstein, 1994).

Several dual process theories have been proposed (e.g., Epstein, 2003; Finucane, Peters, & Slovic, 2003; Hammond, 1996; Posner & Snyder, 1975; Sloman, 1996; Stanovich & West, 2000). All share the same basic idea that humans possess two cognitive systems, a rational system and an experiential system. The rational system parallels traditional models of decision making – it is deliberate and effortful, and arrives at decisions by weighing costs against benefits to achieve the optimal affective outcome. The experiential system is the default mode of cognition. Rather than engaging in effortful cognitive analysis, the experiential system makes judgments based on immediate emotions, intuitions, and heuristics. The system has enormous practical value in that it enables individuals to filter through copious amounts of information to arrive at a decision. Two prominent and representative dual process theories are Slovic, Finucane, Peters, and MacGregor’s (2002) affect heuristic and Epstein’s (2003) cognitive experiential self theory.

The Affect Heuristic. Slovic et al. (2002) proposed that decisions are often made through what they termed an affect heuristic. Rather than engaging in a process of systematic and effortful deliberation involving weighing the costs against the benefits of a given activity, individuals regularly base their judgments on general positive or negative feelings associated
with the activity. Several research findings support this argument. For example, Alhakami and Slovic (1994) found that the commonly observed negative relationship between perceived costs and perceived benefits can be attributed to non-rational judgment. When individuals have positive feelings toward a stimulus (e.g., alcohol), they are inclined to magnify its benefits and downplay its costs, and the reverse occurs when they dislike the stimulus. This effect is more pronounced under time pressure, which reduces the opportunity for rational cognitive processing (Finucane, Alhakami, Slovic, & Johnson, 2000).

Like other heuristics, the affect heuristic serves the pragmatic and generally useful purpose of filtering through information. In fact, Finucane and colleagues argued that affect is crucial to adaptive functioning and, indeed, that affect is an integral component of rational decisions. However, like other heuristics, the affect heuristic can lead individuals astray in certain situations. An example of this includes the aforementioned negative relationship between perceived costs and perceived benefits, which holds even when in reality the costs and benefits relating to a concept are positively correlated (Finucane et al., 2003).

_Cognitive Experiential Self Theory_. Epstein’s (2003) cognitive experiential self theory (CEST) is another influential dual process theory. The theory accentuates the contrast between rational and experiential cognition, describing rational cognition as slow, verbal, rule-based, affect free, and phylogenetically young. The experiential system, on the other hand, is described as automatic, holistic, non-verbal, affect-governed, and primitive (Pacini & Epstein, 1999). Epstein and colleagues emphasized that although the rational and experiential systems interact with each other to guide decision making, they are discrete and fundamentally different (e.g., Epstein, Pacini, Denesraj, & Heier, 1996). Furthermore, on many occasions, the rational and experiential systems will convey conflicting information. When this occurs, the impulsive experiential system generally wins out (Epstein, 1994).
However, Epstein (1994) proposed that individuals differ with regard to the extent to which they are guided by one system or by the other one, both generally and in specific situations.

In support of dual process theories, Epstein (1994) pointed to everyday phenomena, such as religiosity, superstition, and phobias, all of which lack rational foundations. There are also research findings that highlight instances of conflict between the rational and experiential systems. For example, Kirkpatrick and Epstein (1992) compared the attractiveness of equivalent odds of winning a prize (1 out of 10 versus 10 out of 100), and found that individuals preferred the odds for which the absolute number of chances to win was larger (i.e., 10 out of 100). There is a marked absence of rationality to this, which Epstein (1994) attributed to the influence of the experiential system: According to CEST, the experiential system is incapable of thinking in abstract terms, and this precludes perspective-based decision making under its guidance.

Substance Abuse: A Malfunctioning of Experiential Cognition?

A ubiquitous real life example of human irrationality is substance abuse (Wiers et al., 2007). A central element of the dual process account of substance abuse is an imbalance between the rational and experiential systems. This involves a heightening of experiential cognition and a suppression of rational cognition. For example, a model proposed by Stacy and colleagues (e.g., Stacy, Ames, Sussman, & Dent, 1996; Stacy & Newcomb, 1998) indicates that repeated experience with drugs strengthens the drug-related memory network such that automatic drug associations become so accessible that they stifle inhibitory cognitions from the rational system. The absence of strong cognitive opposition to substance misuse leads to continuation of the behavior. Similarly, Yin and Knowlton’s (2006) account of substance use suggests that, once learned, substance use behavior becomes automatic. Thus, the recruitment of rational cognition ceases, preventing the user from discontinuing the behavior, even when the harmful effects have become palpable. According to Loewenstein
(1996), visceral urges to use a drug frequently override rational knowledge that continued use is not in the individual’s best interests.

Some dual process theorists have argued that experiential responses generally precede rational cognition (e.g., Deutsch & Strack, 2006; Finucane et al., 2003). Thus, without considerable cognitive efforts, outputs of the experiential system will inevitably transfer to the rational system. A weakness in the rational system or a strengthened experiential system (or both) could contribute to maladaptive substance use decisions.

**Adolescent and Adult Differences from a Dual Process Perspective**

Many research findings suggest that adolescents have a stronger reliance on experiential cognition and a weaker reliance on rational cognition than do adults. Research by Klaczynski (2001) suggests that analytic thinking is in the process of development during adolescence. This may result in adolescents relying excessively on experiential cognition, the default mode of cognition. Risk taking situations are a potent manifestation of this, often eliciting impulsive, experiential responses from adolescents and rational, cost-oriented responses from adults. Studies have shown that adolescents are less capable of recognizing risk. Cohn, MacFarlane, Yanez, & Imai (1995) assessed risk perception in teenagers and their parents. The authors found that, compared with adults, adolescents showed low recognition of the dangers of experimental drug and alcohol use. Another study, comparing adolescent and adult smokers, showed that adolescents had lower recognition of the addictiveness of smoking (Arnett, 2000). Finally, a study by Halpern-Felsher and Cauffman (2001) assessed decision making skills of adolescents and young adults in risk taking situations. They found that the processes involved in adult decision making were compatible with rationality-based judgment. Adults considered costs and benefits relating to potential decisions, whereas adolescents often failed to do so.
Adolescents have a propensity to seek immediate rewards, whilst showing low regard for the long-term consequences of their behavior (Reyna & Farley, 2006). Research has shown that adolescents are more inclined towards delay discounting of rewards (preferring smaller immediate rewards to larger delayed ones) than are adults (Green, Fry, & Myerson, 1994). They also have higher levels of impulsivity than do adults (see Pechmann, Levine, Loughlin, & Leslie, 2005). Because impulsivity involves acting without regard for future consequences (Carver, 2005; Whiteside & Lynam, 2003), the trait is likely to be compatible with reliance on experiential rather than rational cognition.

A study assessing emotional experiences in adolescents and adults found that adolescents experienced more intense negative emotions (Larson & Richards, 1994). Pechmann et al. (2005) pointed out that the primary causes of adolescent injury and mortality all relate to adolescents’ low control over impulses or emotions (e.g., substance abuse, reckless driving, violence, suicide). These observations indicate that the impulsive, emotion-oriented experiential system may play a sizeable role in determining adolescent behavior.

Physiological evidence also suggests that adolescents are at a disadvantage when it comes to using rational cognition. The frontal lobes appear to be a key region of differentiation between adolescents and adults. This area of the brain has been implicated in problem solving, rationality, and analytic cognition (e.g., Coolidge & Griego, 1995; Damasio, 1985; Goldberg & Podell, 2000; Mutsuo, 2004), and has also been linked with impulse control (Hill, 2004). The frontal lobes do not complete their development until around the mid 20s (Geid, 2004). It has been argued at length that adolescents are less capable of making rational decisions due to this developmental limitation (e.g., Cauffman & Woolard, 2005; Steinberg & Scott, 2003; Wang, 2006). Evidence for this argument goes beyond the finding that adolescents are generally poorer decision makers than are adults. For instance, studies have shown that when processing information, adolescents are less prone to
rely on the frontal lobes. In an fMRI study involving emotion recognition, Yurgelun-Todd (1998) found stronger activity in the amygdalae and weaker activity in the frontal lobes of adolescents compared with adults. Similarly, Blakemore, den Ouden, Choudhury, & Frith (2007) observed fMRI brain activity in adolescents and adults during decision making. While the brain activity of adults occurred mostly in the frontal lobes, adolescent brain activity occurred primarily in the anterior sulcus, a brain region associated with basic behavioral functioning.

Steinberg (2007) distinguished between two brain networks, one associated with impulse control and emotion regulation, and another linked with emotion and reward processing. These two brain networks are compatible with the two systems proposed by dual process theories of cognition. Steinberg argued that not only is the former network undeveloped in adolescence, the latter network is at its most active during this period.

It is important to note that research on adolescents and adults has also found similarities between the two age groups. For instance, Beyth-Marom et al. (1993) asked adolescents and adults to generate lists of possible consequences of engaging in and abstaining from risky activities, and on the whole, the responses of adults and adolescents resembled one another. Quadrel, Fischhoff and Davis (1993) assessed in adolescents and adults the magnitude of positive biases in the context of perceiving oneself as less vulnerable to risk than others. Results showed no significant difference between adolescents and adults. While these findings indicate that adolescents may in fact be just as capable as adults at assessing risk when prompted to do so, they do not necessarily suggest that adolescents base any of their decisions on these risk assessments, or that the findings would extend to real-life situations in which stress and emotion may be involved. Luna (2004) argued that while, on the surface, the capacities of adolescents and adults appear very similar, the introduction of stress can readily expose the gulf between adolescent and adult functioning. In alignment
with this argument, Reyna and Farley (2006) suggested that adolescents are unlikely to reason as well as adults in situations involving factors such as high emotion, immediate reward at the expense of long-term advantage, unfamiliarity, or need for behavioral inhibition.

*Theories of Adolescent Substance Use*

The initiation of substance use usually occurs during adolescence. The two most common substances used by adolescents are alcohol and tobacco (Bonomo & Proimos, 2005). Alcohol abuse can lead to many serious immediate and long-term health problems. The most serious immediate health risks include liver failure, coma, and death. Long-term health risks include vitamin deficiency, depression, reduced sexual drive, liver damage, heart problems, nerve and brain damage, and memory loss (United Nations Educational Scientific and Cultural Organisation, 2004). In adolescents, alcohol abuse may even inhibit brain development (Australian Drug Foundation, 2003). Alcohol misuse also has considerable safety implications, contributing substantially to accidents and assaults (Ministerial Council on Drug Strategy, 1998), and leads to many social problems, such as child abuse, family dysfunction, and divorce (Institute of Alcohol Studies, 2007).

A recent study found that almost 20% of adolescents consume alcohol on a regular basis, and that the average age of drinking initiation is on the decline (Australian Institute of Health and Welfare, 2004). Alcohol use in adolescents is generally more problematic than in adults because it tends to involve binge drinking (Chikritzhs et al., 2003), and often occurs with other risky activities including drug use, delinquency, and unsafe sex (Cooper, Wood, Orcutt, & Albino, 2003; Dryfoos, 1996). Unsurprisingly, alcohol use results in death and injury substantially more often for adolescents than for adults (Australian Institute of Health and Welfare, 2004).
Cigarette smoking accounts for the largest proportion of preventable illness and disease in Australia (Australian Institute of Health and Welfare, 2003). Although smoking has become less socially acceptable in recent years, and messages relating to the dangers of smoking are prevalent, adolescents continue to take up the behavior. In 2005, around 9.5% of adolescents aged 12 to 17 reported smoking cigarettes. The figure increased with age, such that around 18% of 17-year-old adolescents reported smoking (New South Wales Cancer Council, 2007).

The high rates of alcohol abuse and smoking among adolescents have led to intensive study of the behaviors in this age group over the past few decades. Many theories addressing the factors that lead to adolescent substance use have been proposed. These include the application of generic decision making theories, such as expectancy theory and TPB, to substance use decisions (e.g., Goldman, Del Boca, & Darkes, 1999; Kuther, 2002; Marcoux & Shope, 1997; McMillan, Higgins, & Conner, 2005). Other explorations of adolescent substance use emphasize social learning factors such as the influence of peers and role models (e.g., Akers & Lee, 1996; Lanza-Kaduce, Akers, Krohn, & Radosevich, 1984; Preston & Goodfellow, 2006). Scheier and Botvin (1997) found evidence for an integrative model of adolescent drinking, including both social learning and expectancy related factors.

Theories developed specifically to address adolescent substance use focus on a range of variables, such as self esteem (Kaplan, 1975), family relationships (Brook, Brook, Gordon, Whiteman, & Cohen, 1990), and stress stemming from school-related problems (Kumpfer & Turner, 1990-1991). Other theories approach adolescent substance use more broadly. For instance, peer cluster theory (Oetting & Beauvais, 1986) suggests that social, institutional, psychological, and attitudinal variables all contribute to the substance use decisions of adolescents.
Slovic et al. (2002) provided a dual process explanation of the mechanisms behind smoking initiation in adolescence. According to this account, adolescents initiate smoking because information about its consequences conveyed in rational terms is powerless against the immediate affective experience of smoking, which may be primarily positive (e.g., smoking may be a source of novelty, excitement, and feelings of acceptance).

Wiers et al. (2007) proposed a dual process model of adolescent substance use, with a focus on alcohol use. The model indicates that there are two systems involved in drinking decisions. One is a reward-oriented system that seeks out immediate positive affect and is sensitized by alcohol with repeated use. The other system operates in a regulatory fashion, inhibiting impulsive reward seeking in order to optimize long-term outcomes. The reward system can operate unchallenged in the early stages of alcohol use during adolescence. By the time the consequences of repeated alcohol use become sufficiently negative for the adolescent to recognize the harm, the inhibitive system is powerless to overthrow the reward system. This imbalance occurs because the inhibitive system is not fully developed, and the reward system has been strengthened by repeated exposure to alcohol.

In a review of theories of adolescent substance use, Petraitis, Flay, and Miller (1995) classified theories according to three levels of influence, including proximal (e.g., expectancies, emotional responses to substance cues), distal (e.g., role models, affective states), and ultimate (e.g., personality, environment, biology) influences. With their emphasis on decision making and automatic versus controlled cognitive responses to substance use cues, the direct focus of dual process theories in relation to substance use is proximal. However, both distal and ultimate influences can determine (a) the content of rational and experiential responses to drug cues, and (b) whether the individual is more likely to be influenced by rational or by experiential drug cognitions. For instance, rational (Christiansen, Goldman, & Inn, 1982) and experiential (Krank & Goldstein, 2006) drug-
related cognitions are often formed prior to the initiation of drug use; and these cognitions are likely to be formed through distal influences, such as social factors. Additionally, having an impulsive personality may be an ultimate influence that increases the likelihood of following experiential rather than rational substance use cognitions (see Phillips, Hine, & Marks, 2006).

**The Current Research**

The behavioral and biological evidence presented earlier in this chapter supports the view that, when making substance use decisions, adolescents may over-rely on impulsive, reward seeking cognition, and often neglect to apply rationality, even when this compromises future positive outcomes. However, comparisons of adolescents and adults relating to how well experiential and rational cognitions predict decision making have not been conducted in relation to substance use or any other behavior. Experiential cognition may play an important part in problematic drug use, especially in adolescents. Many drug use situations encapsulate all of the factors that Luna (2004) and Reyna and Farley (2006) theorized to lead to poor reasoning in adolescents (high emotion, immediate reward, novelty, need for behavioral inhibition). Thus, it is probable that adolescents frequently use the default (experiential) mode of cognition when making substance use decisions.

Other dual process factors may have implications for adolescent and adult substance use decisions. For instance, adolescents and adults may differ with regard to the strength and valence of their rational and experiential substance use cognitions. To our knowledge, no research has compared adolescents and adults in relation to these factors. Additionally, adolescents’ higher levels of impulsivity could render them generally more reliant on the experiential system.

Knowledge of the ways in which adolescents differ from adults in terms of how rational and experiential cognition may influence substance use decisions could be valuable for the development of substance use intervention strategies. Reyna and Farley (2006)
suggested that interventions that attempt to engage rationality may be ineffective for adolescents because negative outcomes do little to influence adolescent behavior. Corresponding with this, the outcomes of interventions targeting drinking and smoking expectancies in adolescents and young adults have not been promising (e.g., Park, 2006; Thush et al., 2007; Van de Luitgaarden, Wiers, Knibbe, & Boon, 2006; Wiers, Van de Luitgaarden, van den Wildenberg, & Smulders, 2005).

In the current thesis, four studies examined the differences between adolescent and adult substance use decisions from the dual process perspective. The first study investigated the relationship between experiential cognition and substance use through a meta-analysis. The meta-analysis had two primary objectives. The first was to determine the overall strength of the relationship between experiential cognition and substance use. The second objective was to compare the effect sizes associated with adolescent versus adult samples. This would provide an initial indication of whether adolescents may be more inclined than adults to make substance use decisions based on outputs from the experiential system.

The second study was a questionnaire based study that assessed the alcohol-related experiential cognitions of adolescents and adults. The study also assessed rational drinking cognitions, with the objective being to investigate the relative contributions of experiential and rational cognition to predicting binge drinking in adolescents and adults.

The third study also focused on adolescent and adult alcohol use. However, the aim of this study was to examine the role of impulsivity in the riskier drinking decisions of adolescents. An additional objective was to determine whether high impulsivity may render individuals vulnerable to excessive reliance on experiential cognition and lower reliance on rational cognition.

The final study focused on cigarette smoking, comparing adolescents with adults in terms of how strongly rational and experiential smoking cognitions predicted smoking
behavior. An additional objective of the study was to compare the two age groups with regard to the degree of possible transference of positive experiential smoking cognitions to the rational system. This would provide an indication of whether the adolescent rational system has a decreased ability to override maladaptive smoking cognitions from the experiential system with inhibitive rational outputs.

Overall, the research aimed to achieve the following objectives:

1. To assess the relationship between experiential substance use cognitions and substance use behavior, and determine whether the magnitude of this association varies between adolescents and adults.

2. To determine whether there are differences between adolescents and adults with regard to the relationship between rational substance use cognitions and substance use behavior.

3. To establish whether patterns of relationships investigated as part of objectives 1 and 2 generalize from alcohol use to cigarette use.

4. To assess the possible roles of experiential and rational cognition in adolescents’ problematic drinking behavior.

5. To assess the possible role of impulsivity (a trait related to experiential cognition) in adolescents’ problematic drinking behavior.

6. To determine whether impulsivity may be linked with stronger reliance on experiential cognition and weaker reliance on rational cognition.

7. To determine whether age (adolescents versus adults) predicts possible transference of maladaptive experiential cognitions to the rational system.
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