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Modeling the Multidimensional Nature of Impulsivity and its Relation to Functional Outcomes

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MODELING THE MULTIDIMENSIONAL NATURE OF IMPULSIVITY AND ITS
RELATION TO FUNCTIONAL OUTCOMES

by
Bojana Knezevic, M.A.

A Dissertation
Submitted to the Faculty of Graduate Studies
through Clinical Neuropsychology
in Partial Fulfillment of the Requirements for
the Degree of Doctor of Philosophy at the
University of Windsor

Windsor, Ontario, Canada

2013

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Relation to Functional Outcomes

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ABSTRACT

The present studies examined the role that impulsivity plays in personality development and emotion dysregulation both concurrently and longitudinally. The three studies utilized two extant (secondary) datasets as well as new data collection with a Canadian undergraduate sample. First, data from the Block and Block dataset were used to assess the relations between impulsivity and personality development across the life span. Next, the lifelong relation between impulsivity and emotion dysregulation was examined using the Simmons Longitudinal Study dataset. Finally, 175 undergraduate students were administered multiple measures associated with impulsivity. The aim was to use measures across theoretical orientations to explore the multifactorial nature of impulsivity. Results revealed the existence of two distinct, yet related factors of impulsivity. Cognitive and Behavioural facets of impulsivity were differentially related to psychopathology and engagement in risky behaviour. The integrated results of these three studies identified a link between childhood impulsivity and subsequent personality development and emotion dysregulation. Clinical and research implications are discussed.

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LIST OF ABBREVIATIONS

- ADHD – Attention Deficit/Hyperactivity Disorder
- AUC – Area under the curve
- BAS – Behavioral Approach System
- BFI – The Big Five Inventory
- BIS^a – Behavioral Inhibition System
- BIS^b – Barratt’s Impulsiveness Scale
- CBQ – Children’s Behavior Questionnaire
- CCQ – California Child Q-Sort
- CFI – Comparative Fit Index
- CQ-Sort – California Q-Sort
- EFA – Exploratory Factor Analysis
- FIML – Full Information Maximum Likelihood
- NEO-PI-R – Revised NEO Personality Inventory
- ON-TOP – On Time, Organization, and Planning Questionnaire
- PCA – Principal Component Analysis
- RMSEA – Root Mean Square Error of Approximation
- SBCL – The Simmons Behavior Checklist
- SEM – Structural Equation Modeling
- SRMR – Standardized Root Mean Square Residual
- TLI – Tucker-Lewis Index
- UPPS-P – (Urgency, Premeditation, Perseverance, Sensation Seeking) Scale
- WISPI-IV – The Wisconsin Personality Disorders Inventory

CHAPTER 1

Literature Review

Objectives

The present chapter is a review of the theories and empirical research on the relations between impulsivity and mental health. Although the definition of impulsivity as a multidimensional construct is hotly debated, there is growing evidence indicating that impulsivity encompasses a range of behaviours, including lack of persistence and planning, risk-taking, acting on a whim, boredom susceptibility, and sensation-seeking, as well as some components of hyperactivity, behavioural disinhibition, and the inability to delay gratification (Depue & Collins, 1999; Evenden, 1999; Petry, 2001; Smith, Fischer, Cyders, Annus, & Spillane, 2007; Whiteside & Lynam, 2001). For the purposes of this chapter, several methods of conceptualizing and measuring impulsivity will be discussed, including personality questionnaires, reward-seeking, as well as tasks that assess ability to inhibit a prepotent response and delay gratification. As suggested by numerous studies, impulsivity is a fundamental psychological construct for understanding psychopathology and has been proposed as an underlying factor in Attention-deficit/Hyperactivity Disorder (ADHD), substance use disorders, eating disorders, Cluster B personality disorders, as well as other forms of psychopathology (American Psychiatric Association, 2000). Furthermore, impulsive behaviour has been found to follow a developmental trajectory and decreases with age among typically-developing individuals (Green, Fry, & Myerson, 1994; Mischel, 1974). As such, it is important to further investigate the association between impulsivity and mental health. The goal of this paper is to review research on impulsivity and its relation to psychopathology, including personality disorders and emotion dysregulation. Additionally, various impulsivity assessment tools across

theoretical orientations (e.g., personality, experimental, clinical, and neurobiological) will be discussed. Finally, limitations of the extant research will be identified to guide future investigations within the realm of impulsivity.

Organization of the Review

This chapter begins by reviewing the definition of impulsivity, the proposed multidimensional nature of impulsivity, and the frequently debated varieties of impulsivity. Theories from the personality, experimental, clinical, and neurobiological research fields are introduced. Impulsivity measurement methods are described as well as their relations to personality disorders and emotion dysregulation. Finally, studies regarding the association between impulsive decision-making and behaviour across the life span are discussed in addition to the importance of studying impulsivity as a predictor of problems later in life.

Following the review (Chapter 1), three studies are presented. The first study focuses on the developmental progression of impulsivity and personality development (Chapter 2). The second study examines the developmental progression of impulsivity in terms of reward-seeking and emotion dysregulation (Chapter 3). The third study investigates the multidimensional nature of impulsivity (Chapter 4). Each study builds on the previous work in order to address limitations and further the understanding of the obtained findings. Following these studies, a summative discussion (Chapter 5) integrates the results of the three studies, offers clinical implications of the presented work, and suggests future research.

Defining Impulsivity

Every day we are subjected to choices and engage in acts that may be characterized as impulsive. Some impulsive choices and behaviours present little or no difficulty in people's lives while others, such as binge eating, experimentation with illicit drugs, and gambling, may be

harmful to physical and mental health. Although a firm definition of impulsivity continues to be debated in the literature, several facets of impulsivity have been identified (Evenden, 1999; Smith et al., 2007; Whiteside & Lynam, 2001). Impulsivity may be used to describe socially appropriate actions, such as deciding to surprise a friend with an unannounced visit, as well as more problematic behaviours, such as attending a party instead of studying for an exam. It is thought to encompass a range of behaviours including lack of persistence and planning, risk-taking, acting on a whim, boredom susceptibility, sensation-seeking, reward-seeking, components of hyperactivity, behavioural disinhibition, and inability to delay gratification (Depue & Collins, 1999; Evenden, 1999; Petry, 2001; Smith et al., 2007; Whiteside & Lynam, 2001). According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), impulsivity is a fundamental psychological construct for understanding psychopathology (American Psychiatric Association, 2000).

Multidimensional Nature of Impulsivity

Although some measures of impulsivity are correlated, impulsivity is not a homogeneous construct. Gray's two-system behaviour regulation model has been extensively researched (Gray, 1970). One system is thought to be associated with approach behaviour and motivation, called Behavioural Approach System (BAS); whereas the other system is associated with behavioural inhibition and is referred to as Behavioural Inhibition System (BIS^a; Carver, Sutton, & Scheier, 2000). In particular, the neural substrates of BAS include the mesolimbic dopaminergic pathways and are proposed to underlie the personality trait of impulsivity. The idea of heterogeneity of impulsivity construct was further supported by Dickman's (1990) differentiation between functional and dysfunctional impulsivity, with the former being the tendency to act with diminished forethought when impulsive style is optimal and the latter

referring to tendency to act with less forethought than most individuals when impulsive responding leads to problems. White and colleagues (1994) conducted a multimethod, multisource assessment of impulsivity of more than 400 participants and presented a model with two distinct, yet related types of impulsivity; cognitive impulsivity, as measured by inability to delay gratification, was more strongly related to IQ, while behavioural impulsivity as measured by tasks of inhibitory control was more strongly related to externalizing behaviour. In more recent studies, Dawe, Gullo, and Loxton (2004) proposed a two-factor model of impulsivity including facets called reward drive (disinhibition) and rash impulsiveness (sensation-seeking). Reward-seeking was described as a heightened sensitivity to positive/pleasurable stimuli similar to Gray's highly sensitive BAS. At the neurobiological level, reward-seeking is stimulated by the less efficient inhibition of dopamine at the synaptic sites (Pickering & Gray, 1999). In contrast, rash impulsiveness was related to the inability to inhibit a prepotent response to a stimulus or an event. Individual differences in the frontal cortex have been proposed as the driving force for the disinhibited behaviour (Dawe et al., 2004). Exploratory factor studies with clinical populations, such as children with ADHD, identified two impulsivity factors. A strong inhibitory control factor included neuropsychological measures of inhibition of a prepotent response and was correlated with ADHD ratings. The second factor included skills such as planning/organizing and resistance to interference and was mildly correlated with Oppositional Defiant Disorder ratings (Avila, Cuenca, Felix, Parcet, & Miranda, 2004).

More recent personality studies further subdivided the impulsivity construct. For example, Smith and colleagues (2007) assessed similarities and distinctions between related personality constructs and identified a hierarchical model of impulsivity with three distinct personality factors. Lack of planning and lack of persistence were identified as facets of a

common, higher-order construct, while urgency and sensation-seeking were identified as two separate constructs. Verheul (Verheul, van den Brink, Geerlings, 1999; Verheul, 2001) also proposed a three-pathway model of impulsivity. Within this model, behavioural disinhibition, stress reactivity, and reward sensitivity pathways are proposed as antecedents to antisocial behaviour, avoidant personality style, and sensation seeking, respectively.

Although the studies described above demonstrate variability with respect to the distinct factors of impulsivity, there is an overarching theme that suggests a multidimensional nature of impulsivity. In particular, empirical studies have identified at least three distinct facets of impulsivity utilizing personality measures (e.g., lack of planning, urgency, and sensation seeking) and have linked them to development of pathological behaviour. It is not clear at this time how these factors interact across the life span and whether different measures of impulsivity would yield additional factors.

Varieties of Impulsivity

Impulsive personality style. Impulsivity has been viewed as a major, enduring dimension of personality in childhood and adulthood (Cloninger, 1987) and various measures have been derived to assess this construct. For example, Eysenck, Easting, and Pearson (1984) described impulsivity in children as a tendency to be impatient and to act without thinking, and developed a self-report questionnaire to assess these traits. In addition, Block and Block (1980) discussed “ego control,” a construct based in the psychoanalytic tradition, as a tendency to translate impulses directly into actions. An ego-undercontrolled child would overreact to minor frustrations, become inattentive, rarely think before acting, and be emotionally dysregulated. Over time, exploratory factor analyses utilizing various personality questionnaires (discussed in the upcoming sections) continued to conceptualize impulsivity as a multidimensional construct.

Interestingly, the number of the obtained factors has been noted to vary. Evenden (1999) suggested that this alteration in the number of obtained factors does not necessarily indicate a change in human personality. Rather, the current personality questionnaires alone do not adequately capture the complexity of impulsivity construct (Evenden, 1999) or allow for capitalization on the local sample variability. Simple addition and deletion of questions over time does not seem to be a solution to improving assessment process. To obtain better understanding of the multidimensional nature of impulsivity, measurement tools across theoretical orientations were combined for the third study's paradigm (Chapter 4).

Behavioural disinhibition. Within the experimental research field, impulsivity is also viewed as a multidimensional construct and often studied via the stop signal paradigm that taps into one's ability to inhibit a prepotent response (Logan, 1994; Logan, Schachar, & Tannock, 1997). It involves the "go task" and the "stop task". A prepotent, well-practiced response is usually a two-choice visual discrimination task (e.g., press the button when you see "X" on the screen and don't press the button when you see "O" on the screen) and it comprises the "go task". The "stop task" is usually comprised of an auditory signal (e.g., do not press the button when you hear a brief tone even though "X" is on the screen). Various moderators influence one's performance on these tasks including stimulant medication which improves one's ability to inhibit a well-practiced response (Fillmore, Rush, & Marczinski, 2003) and drug abstinence which leads one to respond more impulsively (Harrison, Coppola, & McKee, 2009). Working within this paradigm, White and colleagues (1994) conducted a multimethod, multisource assessment of impulsivity of more than 400 male participants and presented a model with two distinct, yet related types of impulsivity. Behavioural impulsivity comprising tasks of inhibitory

control was related to externalizing behaviour. In turn, cognitive impulsivity, comprising delay of gratification tasks, was related to IQ.

Impulsive decision-making. Cognitive impulsivity taps into one's ability to make decisions about the presented choices with varying time delays (e.g., "you can eat this marshmallow now, or wait five minutes and get two marshmallows when I return"). The propensity to choose the immediate outcome, also called the inability to delay gratification, is an indication of impulsivity and has been tested in various ways. For example, when presented with a toy, most 18-month-old children cannot resist the temptation to immediately touch a toy (Kochanska, Coy, & Murray, 2001). In the case of opening a gift box now or later, three-year-old children typically can wait only a few minutes for the experimenter to return before opening a gift box (Vaughn, Kopp, & Krakow, 1984). Furthermore, sticker tasks have shown that three-year old children consistently choose the immediate reward while five-year-old children can wait for several minutes when the options are to either receive one sticker immediately or two stickers at the end of the game (Thompson, Barresi, & Moore, 1997). Although information about the developmental progression of ability to delay gratification is scant, one recent study has found that three- to four-year-old children are able to sustain a longer wait time for larger rewards relative to two-year-old children (Steelandt, Thierry, Broihanne, & Dufour, 2012).

Preschoolers' performance on delay of gratification tasks has also been linked to their subsequent social and academic success. In particular, it has been found that four-year-old children who delayed gratification longer to receive a larger reward (e.g., waited for some time to obtain two marshmallows versus eating one right away) were more likely to become socially and cognitively competent adolescents. They also were more likely to achieve better school

grades and cope better with frustration and stress relative to adolescents who experienced difficulty delaying gratification as preschoolers (Mischel, Shoda, & Peake, 1988).

Discounting the value of delayed rewards, also called delay discounting, is another approach to assessing impulsive decision-making and is defined as a preference for smaller-immediate outcomes over the larger-delayed ones. The important premise behind delay discounting is that the perceived value of an outcome diminishes as a result of its delayed receipt (Mazur, 1987). Delay discounting has been thought to underlie some forms of impulsive decision-making (Madden & Bickel, 2010). Results generated from animal and human research studies on impulsive decision-making and its link to social behaviour have stimulated interest in exploring delay discounting and its origins. In general, delay discounting tasks assess preference between larger-delayed and smaller-immediate consequences of one's choice. In animal studies, the consequences can be positive (Cardinal, Pennicot, Sugathapala, Robbins, & Everitt, 2001) as well as aversive (Mischel, Grusec, & Masters, 1969). Two types of impulsive choices within this paradigm of delay discounting exist: (1) preferring a smaller-sooner reward instead of a larger-later reward (e.g. food), and (2) preferring a larger-later aversive result instead of a smaller-sooner aversive result (e.g. a more intense shock administered after the delay). Studies of impulsive decision-making in humans also utilize this general paradigm and allow participants to choose between smaller-sooner and larger-later gains and losses (e.g. Buss & Plomin, 1975; Green, et al., 1994; Plunkett & Buehner, 2007).

Neuroscience and genetics of impulsive decision-making. Recent research has focused on the origins of individual differences in impulsive decision-making by exploring genetic bases and neural correlates of delay discounting, however, findings remain wide-ranging. In mice, an estimate of heritability of delay discounting was found to be 16% (Isles, Humby, Walters, &

Wilkinson, 2004). In adolescent humans, it has been estimated to be approximately 30% at ages 12 and 50% at age 14 (Anokhin, Golosheykin, Grant, & Heath, 2010). Furthermore, in human participants the relationship between dopaminergic genetic polymorphisms and discounting of delayed monetary outcomes has been examined. People who had at least one copy of the *DRD2 TaqI A* locus allele (A1+) appear more likely to discount monetary outcomes relative to participants without this allele (A1-; Eisenberg et al., 2007).

Much of the work investigating impulsive decision-making has focused on the limbic corticostriatal structures, in addition to the major forebrain neuromodulatory systems. Functional imaging and lesion studies have identified these structures as involved in making a choice between smaller-immediate and larger-delayed outcome (see Cardinal, 2006 for review). Bechara (2005) proposed a “competing brain systems” hypothesis that implicates two separate, but interacting neural systems that control decision-making. Neuroimaging studies with human participants have found that impulsive choices were associated with greater activity in the ventral striatum, the medial prefrontal cortex, and the posterior cingulate cortex (McClure, Laibson, Lowenstein, & Cohen, 2004). Delayed reward choices were associated with greater activity in the lateral prefrontal and posterior parietal cortical regions (McClure et al., 2004). Although these findings support the idea of competing brain regions, Kable and Glimcher (2007) provided functional magnetic resonance imaging (fMRI) evidence showing that subjective evaluation of an outcome is presented within a single evaluation network including the ventral striatum, medial prefrontal cortex, and posterior cingulate cortex.

Neurochemical systems and impulsive decision-making. Pharmacological studies identified several neurochemical mechanisms that influence impulsive choices and behaviour. These authors propose that it is the interaction of serotonergic (5-HT), dopaminergic (DA), and

norepinephrine (NE) systems that modulates impulsive behaviour (Evenden, 1999; Winstanley et al., 2010) unlike one unique neurobiological aspect of the human system (e.g. serotonergic underactivity; Linnoila et al., 1983; Soubrie, 1986). Additional evidence of 5-HT-DA interactions in controlling impulsive choice arises from research on the effects of the psychostimulants, a frequently used medication-type to treat ADHD by stimulating the DA system. Acute administration of amphetamine increases the frequency of choosing delayed, but larger reward (van Gaalen, van Koten, Schoffelmeer, & Vanderschuren, 2006; Winstanley, Theobald, Dalley, & Robbins, 2003). In contrast, administration of 5,7-DHT, which destroys serotonergic neurons, increases the frequency of the impulsive choice in animals (Winstanley et al., 2003). This latter action has also been demonstrated by administration of the DA-D2 receptor antagonist eticlopride, which has been found to diminish the effects of amphetamine on delay discounting tasks (Winstanley et al., 2003). NE has also been implicated in impulsive decision-making. In particular, administration of atomoxetine, a medication used to treat ADHD, has been found to decrease the frequency of impulsive choices on delay discounting paradigms as well as premature responding on the measures of behavioural inhibition (Robinson et al., 2007). Taken together, it therefore appears that DA, 5-HT, and NE systems act in tandem to regulate impulsive tendencies and perhaps compensate for one another.

In summary, impulsivity can be conceptualized and measured differently across research paradigms (e.g., personality style, poor inhibitory control, reward-seeking, and impulsive decision-making). Nevertheless, Gray's (1970) two-system behaviour regulation model seems to tie these classifications together providing evidence for an underlying neurobehavioural characteristic with significant heritability in humans that appears to involve several neural systems. In particular, within each one of the paradigms there seems to be a struggle between an

overactive BAS that leads to impulsive choices (e.g., immediate, smaller reward) and the BIS^a which provides careful assessment of the situation and inhibitory control (e.g., delayed, larger reward).

Impulsivity – Relation to Life Stressors and Psychopathology

Prior to delving into the research linking impulsivity and psychopathology, it is important to outline several environmental and individual factors that are often related to impulsivity. Various environmental factors (e.g. the amount, type, and sign of the reward, context of the choice, simultaneous demands on attention, drug administration, deprivation, etc.) have been identified as having an effect on behaviour. For example, impulsive decisions are more likely to be made when the rewards are small (Green, Myerson, & McFadden, 1997) and while multitasking (Hoffman et al., 2006), as well as when the participants are already engaged in an impulsive behaviour (e.g., while gambling; Dixon, Jacobs, & Sanders, 2006) and under the influence of drugs of abuse (Cardinal, Robbins, & Everitt, 2000; Dallery & Locey, 2005; Evenden & Ryan, 1996).

In terms of personality traits, individuals with an internal locus of control are less likely to make impulsive decisions relative to their counterparts with an external locus of control (Plunket & Buehner, 2007), extraverts tend to be more impulsive in comparison to more introverted individuals (Ostaszewski, 1996; 1997), and no consistent differences in the levels of impulsive decision-making have been noted between high and low sensation-seekers (Ostaszewski & Green, 1995). Finally, more impulsivity has been noted among younger individuals (Green et al., 1994), males (Moffitt et al., 2011), those with lower IQ scores (Olson, Hooper, Collins, & Luciana, 2007), lower income (de Wit, Flory, Acheson, McCloskey, & Manuck, 2007; Green, Myerson, Lichtman, Rosen, & Fry, 1996), and lower education level (de

Wit et al., 2007; Jaroni, Wright, Lerman, & Epstein, 2004), as well as among African Americans as compared to Caucasian participants (de Wit et al., 2007). Consequently, it can be expected that trajectory of impulsive behaviour across the life span will differ based on one's socioeconomic status, gender, ethnic background, as well as education level. For example, Moffitt and colleagues (2011) found that less impulsive children were more likely to have been raised in families of a relatively higher socioeconomic status. To avoid such bias, it is important to control for these factors by following a highly heterogeneous sample of children.

Psychiatric populations that present with higher levels of impulsivity are those with ADHD (Sonuga-Barke, Taylor, Sembi, & Smith, 1992; Barkley, Edwards, Laneri, Fletcher, & Metevia, 2001), cluster B personality disorders (Krueger, Caspi, Moffitt, White, & Stouthamer-Loeber, 1996), and addiction (Kirby & Petry, 2004). Interestingly, impulsivity can function as both a contributor and a consequence of drug use. In particular, in addition to one's propensity to make impulsive decisions being an important determinant of the likelihood of drug abuse, acute and chronic effects of drug use may affect neural systems and consequently increase impulsive behaviours. In turn, these behaviours may facilitate further drug use (de Wit, 2008).

In summary, a long standing association between impulsive decision-making and various life stressors and individual characteristics has been established. Furthermore, psychopathology across the life span has been linked to impulsivity as an underlying factor. Consequently, studies one (Chapter 2) and two (Chapter 3) explore these relationships across the life span in order to identify childhood risk-factors for subsequent development of pathological behaviour and personality disorders.

Personality and Personality Disorders

Personality is characterized by relatively stable behavioural characteristics across time (Eisenberg et al., 2007) that are influenced by an individual's experiences (Scherer & Peper, 2001) and biology (McCrae & Costa, 1996; 1999; McCrae et al., 2000). According to Wiggins (1968), Extraversion and Neuroticism have been identified as the "Big Two" factors describing personality traits. Subsequently, Costa and McCrae (1976; 1985) added a third dimension, Openness-to-Experience, followed by two more, Agreeableness and Conscientiousness in order to create the "Big Five" model of personality traits. Review studies have shown the usefulness of the "Big Five" model in various aspects of human experience including estimating job performance (Barrick & Mount, 1991), health (Smith & Williams, 1992), and educational attainment (De Raad & Schouwenburg, 1996). Countless references have been made to each of the "Big Five" constructs. Extraversion is defined by an interest in people of the external world demonstrated by outgoingness (De Raad & Perugini, 2002) often related to leadership roles (Lieberman & Rosenthal, 2001). Neuroticism, an elevated tendency to act anxiously across situations, has also been related to mood swings (Soldz & Vaillant, 1999) as well as poor school performance (Eysenck & Cookson, 1969) and lack of commitment in relationships (Kurdek, 1997). Openness-to-Experience has been described as proclivity to venture out into new adventures and related to engagement in risky behaviour (Booth-Kewley & Vickers, 1994). Agreeableness involves cooperation and kindness and is mostly concerned with interpersonal relationships (De Raad & Perugini, 2002). Several correlates of agreeableness include interpersonal skills in teams (Neuman & Wright, 1999) and limited vengefulness (McCullough, Bellah, Kilpatrick, & Johnson, 2001). Finally, Conscientiousness is the dimension that represents systematic thinking, organization, practicality, and systematic and efficient planning

(Goldberg, 1992), all factors necessary for well-developed drive to achieve (De Raad & Perugini, 2002). The “Big Five” model is meant to be used as a reference model to help evaluate human experience and identify maladaptive behaviour.

According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association, 2000), personality disorders are enduring dysfunctional patterns of internal experiences and behaviours. Further, these disorders typically encompass behaviours that are pervasive and inflexible. They are typically stable across the life span with an onset of diagnostic symptoms in adolescence or early adulthood. They are not in concordance with the individual’s culture, and must lead to significant distress and functional impairment. For example, individuals who are often dramatic, emotional, and erratic are usually diagnosed with a Cluster B personality disorder such as antisocial, borderline, histrionic, or narcissistic personality disorder. The diagnosis of personality disorder is rarely given to children and adolescents younger than 18 years of age. Nevertheless, underlying personality traits are most likely present since childhood, guiding behavioural presentation at each developmental stage. For instance, a pervasive pattern of impulsive behaviours including lack of planning, acting on the spur of the moment, and lack of consideration of the future consequences for self and others, is an essential feature of Cluster B personality disorders. Such behavioural patterns have been found to begin in childhood or early adolescence and continue into adulthood (American Psychiatric Association, 2000).

Furthermore, specific situational stressors (e.g., depression, anxiety, substance use) may precede behaviours characteristic of maladaptive personality traits. In such cases, personality disorder should not be diagnosed. For example, while indicators of an impulsive nature may be present in pre-adolescent children, exposure to substances of abuse including alcohol during

adolescence may result in additional impairment of neural circuitry underlying delay discounting, and hence in impaired functioning in adulthood. Sisk and Zehr (2005) suggested that adolescence is a period of refinement of neural circuits that have been shaped during the perinatal period of brain reorganization. For the purposes of this chapter, intrapersonal features of personality disorders will be discussed with an aim to explore the link between personality disorders and impulsivity within a developmental context.

Personality models and impulsivity. Impulsivity is an important aspect of several personality models. For example, Buss and Plomin's (1975) model contains a construct that represents inhibitory control and persistence, which are often related to impulsivity. The Five Factor Model of personality (Costa & McCrae, 1992) and Cloninger's three part model of temperament (Cloninger, Svrakic, & Przybeck, 1993) also suggest impulsivity. In particular, Whiteside and Lynam (2001) utilized the Five Factor Model of personality to identify distinct facets of personality that have been frequently combined under the overarching definition of impulsivity as a multidimensional construct. The factor analyses yielded a robust four-factor solution (urgency, lack of premeditation, lack of perseverance, and sensation seeking) that corresponded well to the four traits related to impulsivity found on the Revised NEO Personality Inventory (NEO-PI-R; Costa & McCrae, 1992). First, the tendency to act hastily, especially under conditions inundated with negative emotions, is called urgency and is associated with the impulsiveness facet of the NEO-PI-R. Second, lack of premeditation, is the most widely studied impulsivity measure, refers to the tendency to act on a whim without regard for the consequences, and is associated with the low deliberation facet of the NEO-PI-R. Third, lack of perseverance defined as inability to remain focused on the task at hand is associated with the self-discipline facet of the NEO-PI-R. The final facet identified by Whiteside and Lynam (2001)

is sensation seeking, commonly described as a tendency to enjoy and openness to new, exciting, and potentially dangerous experiences. It is associated with the excitement seeking facet of the NEO-PI-R. High scores on each one of these facets may be related to pathological behaviour patterns such as borderline personality disorder, antisocial personality disorder, ADHD, and substance use disorders, respectively. Smith and colleagues (2007) extended these findings by assessing the validity of distinctions among four proposed impulsivity-like traits. Overall, lack of premeditation and persistence were found to be two distinct facets of one broader trait, whereas urgency and sensation seeking were both very modestly related to each other and to the planning/persistence measure. Furthermore, the distinctions among them were useful as each accounted for different aspects of risky behaviour.

Taken together, various facets of impulsivity have been identified; however, research findings in regards to the relations among these facets remain ambiguous. If impulsivity is a multidimensional construct then it is not surprising that various measures of impulsivity do not necessarily relate. However, this premise should be studied using measures of impulsivity across multiple theoretical orientations including personality, experimental, clinical, and neurobiological research. Consequently, a multimethod, multisource assessment of impulsivity was conducted (Chapter 4) to explore the relationship between various measures of impulsivity, help clarify past, contradictory findings, and suggest future research and clinical directions.

Emotion Regulation and Impulsivity

Emotion regulation and coping. The appraisal theory of emotion states that evaluations of situations and events, also referred to as cognitive appraisals, elicit emotions (Smith, Haynes, Lazarus, & Pope, 1993). For example, studies have found that blaming others results in anger, blaming oneself results in guilt, thinking of oneself as endangered results in anxiety, and finding

satisfaction results in happiness (Suchy, 2011). Therefore, cognitions have been proposed as antecedents of emotion (Lazarus, 1982). Furthermore, only a limited number of evaluations actually result in emotion. Consequently, it is hypothesized that cognitive activity with adaptive significance is the one most likely to be related to the emotions people experience. This hypothesis rests on understanding the person-environment relationship including factors such as one's own goals, environmental constraints and demands, and the interaction of these factors. The evaluation process is often complicated and requires identification of subtle environmental cues to understand the meaning of what is happening for one's well-being.

In addition to cognitive appraisals, Lazarus and Smith (1988) acknowledged that the prior knowledge, also referred to as attributions, contributes to the emotion by providing non-evaluative facts that provide answers to questions such as who, what, where, when, how, and why. They suggested that attributions contribute to appraisal, which in turn results in emotion. Subsequently, Smith and colleagues (1993) examined the relationship between cognitions and emotions. They demonstrated that appraisals are more strongly related to emotional experience than are attributions and suggested that appraisal mediates the relationship between attribution and emotion (Smith et al., 1993). This theory stands in contrast to other theories that propose different origins of emotion including: (1) facial expressions (Tomkins, 1962); (2) physiological processes, such as neural patterns (Cannon, 1927); (3) motivational processes, such as thirst (Tomkins, 1962); and (4) events themselves (Watson, 1919).

Finally, the appraisal process has been suggested to guide coping by evaluating one's resources and options such as accountability, potential to engage in emotional- or problem-focused coping, and future expectancy (Lazarus & Folkman, 1984). Coping, also referred to as emotion regulation, is the ability to control personal feelings in the face of emotional disturbance

via evaluating, monitoring, and modifying emotional reactions (Tice & Bratslavsky, 2000). Appropriate emotion regulation employs informative aspects of emotions and expresses them adaptively in the face of emotional disturbance. Such emotion regulation leads to decreases in prolonged and unhealthy autonomic arousal via reductions in amygdalar and insular activation (Ohira et al., 2006) that have been found to be deleterious to health (Denollet, Nyklicek, Vingerhoets, & Vingerhoets, 2008; Myers et al., 2008). On the other hand, emotion dysregulation is viewed as inability to modulate the expression of emotion in response to external demands as well as the effects of emotions on personal thoughts and actions (Cole, Michel, & Teti, 1994). Baumeister, Heatherton, & Tice (1994) suggested that weakness in regulation (underregulation) or poor choice of regulating strategies (misregulation) leads to emotion dysregulation. Furthermore, emotion dysregulation has been positively associated with anxiety, depression, phobias, obsessive-compulsive tendencies (King & Emmons, 1991), and impulsivity (Kokkonen & Pulkkinen, 1999).

Emotion regulation within the concept of temperament. The definition of temperament has been debated upon since the 1978 International Conference on Infant Studies. Temperament is most often defined as variability between individuals in self-regulation and reactivity that has been shaped by one's genetic make-up and experience (Derryberry & Rothbart, 1997; Rothbart & Derryberry, 1981). This variability is most often noted in the realm of attention, motor activity, and emotion regulation (Rothbart & Derryberry, 1981). As children mature, regulating systems such as attentional effortful control and inhibition of fear develop. Using these systems, children become adults who are able to choose appropriate strategies to regulate their reactions to emotional events. However, children identified as difficult-to-manage do not attain such regulatory abilities and are at higher risk for development of psychopathology

at subsequent ages (Staudinger, Marsiske, & Baltes, 1995). These children are likely to be fearful, have a limited attention span, and are quick to cry even if the event is only moderately stimulating (Rothbart, 2007). Rothbart, Posner, and Hershey (1995) reviewed several ways in which temperament might be involved in development of emotional and behavioural difficulties. Most importantly, they suggested that individual differences in temperament may identify risk profiles for children with a disposition toward psychopathology. In addition, temperament may influence one's choices of more or less risky settings and relationships that may lead to a greater or lesser chance of development of psychopathology. Finally, different temperamental characteristics may interact to influence developmental outcomes.

Neuroimaging Studies of Emotion Regulation. As a result of growing evidence of the relationship between emotion dysregulation, impulsivity, and physical and mental health (Madden & Bickel, 2010; Williams, Suchy, & Rau, 2009), recent research studies have used functional neuroimaging and lesion studies to examine how people regulate emotion when presented with emotion-evoking images (Duffy, Campbell, Salloway, & Malloy, 2001; Narashima, Kosier, & Robinson, 2003; Ochsner & Gross, 2008). In general, the prefrontal cortex has been found to exert some degree of control over the emotional trigger including (1) the anterior cingulate cortex and its subregions, (2) left, right, or bilateral dorsolateral prefrontal cortex (depending on the regulating strategy), and (3) ventral prefrontal cortex (Ochsner & Gross, 2008). Specifically, if the individual's goal is to increase an emotional experience, increases in amygdalar activation are typically observed (Ochsner, Bunge, Gross, & Gabrieli, 2002), which in turn has been correlated with the increased prefrontal activation (Ochsner & Gross, 2008). The opposite is true if the participant's goal is down-regulating or decreasing an emotional experience (Goldin, McRae, Ramel, & Gross, 2008). Furthermore, patients with

lesions in the ventral frontal areas are found to be more irritable, aggressive, and present with emotional outbursts, suggesting that the ventral frontal areas are important for control of overt behaviour (Duffy et al., 2001). In contrast, patients with lesions in dorsolateral and frontotemporal areas are more likely to present with depressive symptoms (Narashima et al., 2003). Narashima and colleagues (2003) suggested that this may be due to their difficulties with reinterpretation. In particular, patients with left dorsolateral lesions may have difficulties re-creating stories. Consequently, they may be unable to abandon their initial negative interpretations of troublesome situations, which in turn may maintain their depressed state (Narashima et al., 2003).

As previously mentioned, the prefrontal cortex has also been implicated in impulsive decision-making and behaviour (McClure, Laibson, Loewenstein, & Cohen, 2004). Regardless of the noted neuroanatomical overlaps, only a limited number of studies have explored emotion dysregulation in relation to impulsivity in terms of reward-seeking. Therefore, the second study (Chapter 3) explored how emotion dysregulation interacts with and can be potentiated by a neurobiological propensity for reward-seeking across the life span.

Impulsivity as a predictor of problems later in life. Self-regulatory skills such as ability to delay gratification, premeditation of action, and inhibition of impulsive choices provide an essential foundation for the development of normal social and academic competence (Barkley, 1997; Kochanska, Murray, & Coy, 1997). Learning and achievement problems (Hinshaw, 1992), ADHD (American Psychiatric Association, 2000), peer rejection (Hinshaw & Melnick, 1995), and features of conduct disorder (August, Realmuto, MacDonald, & Nugent, 1996) are more likely to arise in later childhood and adolescence among children who present with impulsive behaviours at a young age (Hinshaw, 1992). Various disorders have been

classified as failure of impulse control such as ADHD, substance abuse, kleptomania, pathological gambling, and eating disorders (e.g., American Psychiatric Association, 2000). Moreover, childhood ADHD is associated with lower conscientiousness scores in adolescents and young adults and persisting ADHD symptoms in adolescence are associated with increased neuroticism scores, as well as decreased agreeableness (Miller, Miller, Newcorn, & Halperin, 2008). Although there is an apparent link between childhood psychopathology and psychopathology later in life (Miller et al., 2008; Murphy & Barkley, 1996), the relationship between the underlying factors and the behavioural presentation across the life span is less clear. Furthermore, neuroticism and extraversion seem to decline with age, whereas agreeableness and conscientiousness increase (Costa & McCrae, 2006). Consequently, the first study within this manuscript (Chapter 2) assessed the relations between carefully selected measures of personality traits associated with behaviors of poor impulse control inability to delay gratification across the life span.

Also, impulsivity during childhood (Musher-Eizenman et al., 2004), adolescence (d'Acremont & Van der Linden, 2007), and adulthood (Kokkonen & Pulkkinen, 1999) has been linked to difficulties regulating emotion. For example, childhood impulsivity has been related to poor anger control and aggressive behaviour (Musher-Eizenman et al., 2004). Impulsive adolescents have been characterized as more depressed and more likely to think about suicide than their non-impulsive peers (Hutchinson, Patock-Peckham, Cheong, & Nagoshi, 1998) and adolescent depression has been linked to poor emotion regulation strategies (Garnefski, Legerstee, Kraaij, van den Kommer, & Teerds, 2002). Finally, impulsivity in adult men was positively correlated with anxiety, aggression, and difficulty coping with occasional negative consequences of expressing emotion (Kokkonen & Pulkkinen, 1999). Impulsivity in adult men

was also negatively associated with indicators of emotion regulation including socialization and cognitive control (Kokkonen & Pulkkinen, 1999).

In summary, impulsivity decreases with age among typically developing children (Mischel, 1974). Nevertheless, more impulsive children are at a greater risk of various forms of addiction, poor academic achievement, personality disorders, and depression later in life. In addition, various facets of impulsivity have been determined. However, research remains contradictory regarding how these facets relate when multidimensional, multisource studies are conducted. Due to important social consequences of dysfunctional behaviour and the limitations of the cross-sectional research conducted thus far, the aim of the following three studies was to offer a developmental perspective on impulsivity and further assess its proposed multidimensional nature.

The first study (Chapter 2) utilized data from the Block and Block Longitudinal Study funded by the National Institute of Mental Health (NIH) Grant MH 16080. It was a 3-year long examination of personality development, development of gender differences, parental child-rearing attitudes, development of the self-concept over time, and other topics. The obtained findings provide information about the developmental progression of impulsivity from preschool to early adulthood and its relation to personality development. For the second study (Chapter 3) data were derived from the Simmons Longitudinal Study: Adaptation and Development across the Lifespan funded by National Institute of Mental Health (NIMH) grant number 5-R01 MH-27458. This study utilized a multidisciplinary, multi-method approach to: (1) trace the development and course of academic difficulties, behaviour problems, and psychopathology, and (2) identify health promoting factors from early childhood to adulthood. The obtained findings further clarify the developmental progression of reward-seeking from preschool to early

adulthood and its relation to emotion dysregulation. Finally, the third study (Chapter 4) utilized a multidimensional, multisource approach to assessment of impulsivity. It borrowed measures from several theoretical orientations including personality, experimental, clinical, and neurobiology research fields. These measures were administered to undergraduate students at the University of Windsor. The obtained findings further our understanding of the multidimensional nature of impulsivity and the relations among the obtained factors, inform clinical practice, and suggest future research directions.

CHAPTER 2

Impulsivity across the Life Span: Inability to Delay Gratification and its Relation to Personality Development

Impulsivity

An ability to delay the receipt of a reward for the greater good or reduced negative consequences is an important and socially desirable skill. It demonstrates an efficient decision-making process and, as a result, promotes cohesive functioning of the members within the society. However, it has long been observed that individuals are often motivated by the more immediate rewards than the rewards that occur after a delay. Consequently, people frequently engage in impulsive decision-making. Some impulsive choices present little or no difficulty in people's lives, while others, such as binge eating and gambling, may be harmful to physical and mental health. Although impulsivity remains an imprecisely-defined construct in the clinical literature, it is a fundamental psychological construct for understanding a range of psychopathology, including Attention-deficit/Hyperactivity Disorder (ADHD), substance abuse, eating disorders, and antisocial and borderline personality disorders, among others (American Psychiatric Association, 2000). Furthermore, heritability of impulsive traits in terms of low self-control has been noted. In particular, poor self-control of one generation (i.e., inability to delay gratification) disadvantages the next generation secondary to biological basis of such behaviour as well as modeling (Moffitt et al., 2011). Therefore, changing one's propensity to engage in these unhealthy behaviours may have a broad impact on society. In particular, early identification of one's tendency towards impulsive decision-making may reduce the burden of injury, disease, and associated economic costs by developing and implementing effective prevention programs.

Assessment of Impulsive Decision-Making

To function successfully, individuals must exercise goal-oriented self-control demonstrated by deliberate postponing of immediate gratification and persistence in goal-directed behaviour guided by the value of the later outcomes (Mischel, Shoda, & Peake, 1988). Consequently, studies of impulsive decision-making in humans often ask participants to choose between smaller-sooner and larger-later gains and losses (e.g. Buss & Plomin, 1975; Green, Fry, & Myerson, 1994; Plunket & Buehner, 2007). The propensity to choose the delayed outcome, also called delay of gratification, is tested in various ways. For example, when presented with a toy, many 18-month-old children cannot resist the temptation to immediately touch a highly desirable toy (Kochanska, Coy, & Murray, 2001). In the case of opening a gift box now or later, three-year-old children typically can wait only a few minutes for the experimenter to return before opening a gift box (Vaughn, Kopp, & Krakow, 1984). Furthermore, sticker tasks have shown that three-year old children consistently choose the immediate reward while five-year-old children can wait for several minutes when the options are to either receive one sticker immediately or two stickers at the end of the game (Thompson, Barresi, & Moore, 1997). Although information about the developmental progression of ability to delay gratification is scant, one recent study has found that three- to four-year-old children are able to sustain a longer wait time for larger rewards relative to two-year-old children (Steelandt, Thierry, Broihanne, & Dufour, 2012).

Preschoolers' performance on delay of gratification tasks has also been linked to their subsequent social and academic success. The famous marshmallow experiment (Mischel, Shoda, & Peake, 1988) demonstrated that four-year-old children who delayed gratification longer to receive a larger reward (e.g., waited for some time to obtain two marshmallows versus eating one

right away) were more likely to become socially and cognitively competent adolescents. They also were more likely to achieve better school grades and cope better with frustration and stress relative to adolescents who were experiencing difficulty delaying gratification as preschoolers (Mischel et al., 1988).

Another method of assessing impulsive decision-making tendencies has arisen from the field of economics and also involves choosing between the smaller, immediate over larger, but delayed monetary alternatives. One's tendency to choose smaller, immediate monetary reward, also termed delay discounting (Ainslie, 1975), is based on the premise that the value of an outcome diminishes as a result of its delayed receipt (Mazur, 1987), and has been thought to underlie some forms of impulsive decision-making (Madden & Bickel, 2010). Although there is a large body of well-established research concerning the many facets of impulsivity, for the purpose of this paper I primarily focus on one's inability to delay gratification and its relation to human behaviour and personality development. Obtained findings may guide programs designed to prevent or treat impulsive decision-making by providing a clear idea of what is normative, how it changes across the life span, and by identifying risk factors as early as preschool.

The Neuroscience of Impulsive Decision-Making

Neuroimaging studies found evidence for the involvement of a single evaluation network, composed of the ventral striatum, medial prefrontal cortex, and posterior cingulate cortex, in the subjective evaluation of an outcome (Kable & Glimcher, 2007). Neuroimaging studies have also implicated deficits in structure and function of frontal and limbic regions in Cluster B personality disorders, such as Antisocial and Borderline Personality Disorders (Coccaro & Siever, 2005). In particular, Coccaro & Siever (2005) found reductions in the volume of these brain regions that are in turn associated with self-regulation. The noted neuroanatomical overlap in brain regions

involved in impulsive decision-making and Cluster B personality disorders suggests a potential developmental relation. These findings offer a compelling reason for further investigation of impulsivity, in terms of impulsive decision-making, and its relation to development of certain personality styles as the brain matures from childhood to adulthood.

Personality and Impulsive Decision-Making

One's experiences (Scherer & Peper, 2001) and genetic inheritance (McCrae & Costa, 1996; 1999; McCrae et al., 2000) play an important role in shaping one's character. The obtained collection of relatively stable behavioural characteristics across time characterizes individual's personality (Eisenberg et al., 2007). Costa and McCrae (1976; 1985) proposed the "Big Five" model of personality as a reference model to help evaluate human experience and identify maladaptive behaviour. It contains five dimensions of personality; Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness. Neuroticism has been referred to as a component of anxiety and individuals with high scores on this scale are often described as having fluctuating moods, behaving unpredictably, and giving up easily when frustrated (Soldz & Vaillant, 1999). Extraversion is commonly defined as a comfort level with social engagement, particularly with large groups of people, and the positive resulting effects on the psychological states (De Raad & Perugini, 2002), Openness-to-Experience has been described as a willingness to experience the unfamiliar (Booth-Kewley & Vickers, 1994), and people who score high on Agreeableness are usually cooperative and willing to compromise (De Raad & Perugini, 2002). Finally, Conscientiousness is the dimension that represents systematic thinking, organization, practicality, and efficient planning (Goldberg, 1992).

Personality is also understood as a highly heterogeneous set of traits that may be associated with two or more neurobiological networks and behavioural systems. In terms of

impulsivity, several personality models have been proposed that further support a multidimensional nature of the impulsivity construct. For example, Whiteside and Lynam (2001) utilized the Five Factor Model of personality to identify distinct facets of impulsivity as measured by self-report personality questionnaires. The factor analyses yielded a robust four-factor solution (urgency, lack of premeditation, lack of perseverance, and sensation seeking) that corresponded well with the four traits related to impulsivity (impulsiveness, low deliberation, self-discipline, and excitement seeking, respectively) measured by the Revised NEO Personality Inventory (NEO-PI-R; Costa & McCrae, 1992). Subsequent studies extended these findings and found that lack of premeditation and persistence comprised a single factor that was modestly correlated with urgency, and sensation seeking (Smith et al., 2007).

Extreme variations of typical personality traits have been suggested to characterize behavioural features of personality disorders (Harkness, 1992; Widiger & Costa, 1994; Widiger, Trull, Clarkin, Sanderson, & Costa, 1994). Individuals diagnosed with personality disorders exhibit pervasive, inflexible, and enduring patterns of internal experiences and behaviours that often lead to dysfunctional academic, occupational, and social outcomes, as well as produce significant distress within the person (American Psychiatric Association, 2000). Although the diagnosis of personality disorders is rarely given to children and adolescents younger than 18 years of age, underlying personality traits are most likely present since childhood and consequently guide behavioural presentation at subsequent developmental stages. For instance, a pervasive pattern of impulsive behaviours including lack of planning, acting on the spur of the moment, and lack of consideration of the future consequences for self and others, is an essential feature of Cluster B personality disorders. This characteristic has been found to begin in

childhood or early adolescence and continue into adulthood (American Psychiatric Association, 2000).

Despite these findings, the relation between impulsive decision-making and measures of personality traits characteristic of impulsive behaviour has received little research attention and the findings remain mixed (de Wit, Flory, Acheson, McCloskey, & Manuck, 2007). Two explanations were proposed for these inconsistencies. First, previous research was noted to be flawed due to relatively homogeneous, small samples (de Wit et al., 2007). Second, if the argument that impulsivity is a multidimensional construct holds, then it is not surprising that various measures of impulsivity are not necessarily relatable (Acheson et al., 2006). Of note, when more heterogeneous and larger samples were assessed, a positive association was obtained between impulsive decision-making tendencies and the impulsive personality traits as measured by the Non-planning Impulsiveness and Cognitive Impulsiveness dimensions of the Barratt Impulsiveness Scale (Barratt, 1985; de Wit et al., 2007).

Impulsive Decision-Making and Problem Behaviour Across the Life Span

Only a few cross-sectional studies have been conducted to examine impulsive decision-making at several time points. Green and colleagues (1994) found that relative to young children who were most likely to discount hypothetical monetary rewards, young adults chose delayed rewards more often than older adults who were the least likely to choose smaller, immediate rewards (Green et al., 1994). Overall, these findings suggest a decline in impulsive decision-making during young adulthood and point to the need of large-scale, well-controlled longitudinal studies to determine the social and neurobiological factors that may be responsible for this change. Consequently, the current study aims to assess the link between childhood propensity to make impulsive decisions and subsequent pathological behaviour in adulthood.

Research has shown that young children with impulsive behaviours are at greater risk for later learning and achievement problems (Hinshaw, 1992), ADHD (American Psychiatric Association, 2000), peer rejection (Hinshaw & Melnick, 1995), and features of conduct disorder (August, Realmuto, MacDonald, & Nugent, 1996). Moreover, childhood ADHD has been associated with lower scores on the NEO-PI Conscientiousness subscale in adolescents and young adults and persisting ADHD symptoms in adolescence are associated with increased Neuroticism scores and decreased Agreeableness (Miller, Miller, Newcorn, & Halperin, 2008). In a typically developing population, the opposite pattern has been noted. Specifically, neuroticism and extraversion decline with age, whereas agreeableness and conscientiousness increase (Costa & McCrae, 2006). Although there is an apparent link between childhood psychopathology and psychopathology later in life (Miller et al., 2008; Murphy & Barkley, 1996), the relation between the underlying factors and the behavioural presentation across the life span is less clear.

In summary, a developmental progression of impulsive decision-making has been demonstrated in a limited number of studies. In particular, children are more likely to choose immediate, smaller reward, whereas older adults are more likely to choose a delayed, larger reward (Green et al., 1994). These findings complement developmental research indicating that impulsivity decreases with age (Mischel, 1974). Nevertheless, more impulsive children are at a greater risk of various forms of addiction, poor academic achievement, and personality disorders later in life. Due to important social consequences of such behaviour and the cross-sectional nature of the majority of the studies conducted thus far, a longitudinal study of profiles characterized by behavioural impulsivity in terms of impulsive decision-making is warranted.

The Current Study

Relatively few studies have examined impulsive decision-making in relation to traditional personality trait measures from childhood to early adulthood (Miller et al., 2008). The current study extends previous impulsivity and personality research by including an assessment of impulsive decision-making across the lifespan as a core neurocognitive trait in personality development. Specifically, the current study investigated the relations between childhood indicators of impulsivity in terms of impulsive decision-making and subsequent personality development during adolescence and early adulthood. This study addressed the following research questions: (1) How do personality and impulsivity interact during childhood, early adolescence, and late adolescence?; (2) What are the indicators of impulsivity across the life span in terms of impulsive decision-making?; and (3) Can we identify childhood predictors, such as inability to delay gratification, of personality profiles?

Impulsivity has been examined in the literature primarily as an antecedent behaviour (e.g. contributing to substance use, gambling; Petry, 2001) and less often as an outcome variable (e.g. substance use leads to increased likelihood of making impulsive choices; de Wit, 2008). In the current study, impulsive decision-making and personality variables were examined as both antecedent and outcome variables to further understanding of the relation between impulsive decision-making during early childhood and subsequent personality development. Therefore, by using an existing dataset, measures and indicators of impulsivity and personality were obtained at three time periods: childhood (four years old), early adolescence, (14 years of age), and late adolescence (18 years of age).

Research Hypotheses

The current study proposed a model to explain the relation between impulsivity and personality across the life span employing measures of delay of gratification, reports of drug use, antisocial tendencies, and neuroticism. A longitudinal approach with secondary data was utilized to examine the relation between impulsivity and personality within a context of the proposed model. More parsimonious models based on theory and initial premises were also proposed.

Hypothesis 1. Significant positive paths were expected between: (1) childhood, early adolescence, and late adolescence impulsivity, (2) childhood, early adolescence, and late adolescence personality, (3) childhood impulsivity and subsequent personality styles, and (4) childhood personality and subsequent impulsivity. Significant positive reciprocal paths were tested between impulsivity and personality at each age group (see Figure 1).

It was expected that a higher degree of impulsivity during childhood would produce a stronger relation with impulsivity at subsequent ages. In addition, greater impulsivity was expected to be associated with a less adaptive personality style during childhood as well as at subsequent ages. More specifically, greater inability to delay gratification during childhood and adolescence may be a behavioural marker of underlying neurocognitive propensity to impaired decision-making at later ages. Furthermore, it was proposed to have a greater influence on development of dysfunctional personality styles.

Hypothesis 2. The paths connecting the more distal points in time were the least likely to show significant relationships. Furthermore, four different variables were predicting the personality during late adolescence (early adolescent personality, childhood impulsivity, early adolescent impulsivity, and late adolescent impulsivity) in contrast to only three variables predicting personality during adolescence (childhood personality, childhood impulsivity, and

early adolescent impulsivity) and only one variable predicting personality during childhood (childhood impulsivity). Similarly, four different variables were predicting impulsivity during late adolescence (early adolescent impulsivity, childhood personality, early adolescent personality, and late adolescent personality) in contrast to only three variables predicting impulsivity during adolescence (childhood impulsivity, childhood personality, and early adolescent personality) and only one variable predicting impulsivity during childhood (childhood personality). Increased number of variables explaining the variance in late adolescence personality and impulsivity causes a reduced likelihood of a strong relation between these constructs and childhood impulsivity and personality, respectively. Consequently, the second model excluded the paths most distant in time.

Methods

Participants

Data were derived from the Block and Block Longitudinal Study funded by the National Institute of Mental Health (NIH) Grant MH 16080; a long-term examination of personality development, gender differences, parental child-rearing attitudes, development of the self-concept over time, and other topics (Block & Block, 2006). This longitudinal project followed participants from birth to early adulthood for 30 years starting in 1968. Since that time, more than 150 studies have used data from the project. Drs. Block and Block were the original owners of the copyright and associated intellectual property rights for the whole of the study. Currently, materials are preserved at the Henry A. Murray Research Archive of the Institute for Quantitative Social Science with a principal place of business at 1737 Cambridge Street, Cambridge, MA 02138 and NIH owns the copyright materials. Collected data are available through the Data-PASS project under the Henry A. Murray Research Archive's standard terms of

use. Furthermore, the use of the study is subject to no restrictions other than the requirements to include (1) the following statement: “The data employed in this study derive from a 30-year longitudinal study begun with 3-year-old girls and boys, planned and conducted by Jack and Jeanne H. Block, involving a sequence of nine independent assessments based on personality and cognitive Life, Observational, Test, and Self-report (LOTS) measures.”, and (2) the inclusion of a bibliographical citation of this study (please refer to the Reference section).

The study began by testing children from two nursery schools in Berkeley, California. The sample was heterogeneous with regard to the socioeconomic and education status of the parents with slight overrepresentation of the middle- and upper-middle class levels, as well as ethnic background. Participants were tested at ages 3, 4, 5, 7, 11, 14, 18, 23, and 32 years. Participants were encouraged to attend multiple testing sessions across time by repeating friendly contacts between assessment periods, providing a nominal payment once participants entered adolescence, and keeping the records up-to-date with respect to participants’ locations. For a full description of the original study, see Block and Block (1980). Data of interest for this analysis were available for 142 participants in three age groups: 4, 14, and 18 years of age. As a result of missing data, the number of participants ranged from 102 to 128 participants across the measures. The summary of sample size for each measure can be seen in Table 2.

Measures

An extensive battery of widely ranging and in-depth procedures was administered during ages 3, 4, 5, 7, 11, 14, 18, 23, and 32. At ages three, four, five, and seven years, 90-minute sessions were conducted over several days for the total duration of 10 to 11 hours. Children received a 15-minute break after each 30 minute segment within a session. At ages 11, 14, 18, and 23 years, six sessions were conducted and each one lasted two hours or longer. Assessment

at the age of 32 years consisted mostly of gathering life information and personality testing. Various kinds of data were utilized, including (1) life history, school, or demographic information, (2) ratings of the participants by parents, teachers, or knowledgeable observers, (3) structured experimental procedures or standardized tests, and (4) questionnaires or other self-report techniques. In the early years of the study, data from the parents and observers as well as experimental procedures were primarily collected. As the participants approached adolescence, self-reports became more prominent and testing was further extended. During adulthood, mostly information pertinent to one's life was collected (e.g., education, employment, income, health, etc.). Much of the data collected is beyond the scope of the present study.

Personality measures. The *California Q-Sort* (Adult and Child; CQ-Sort; Block, 1971) is an assessment technique from which an overall profile of an individual's personality characteristics can be generated. The subject is described by an observer who sorts 100 descriptive statements into nine categories ranging from the least (1) to most (9) relevant. Analysis is conducted by assessing the distribution of statements and comparing them to a standardized set of items and distributions (Block, 2008). The CQ-Sort items can be subdivided into five groups that have been found to closely resemble the five factors of personality on the NEO-PI obtained by peer raters as well as self-reports (McCrae, Costa, and Busch, 1986). According to a factor analytic approach (McCrae et al., 1986), CQ-Sort Neuroticism factor was significantly correlated with NEO-PI Neuroticism factor ($r = .73, p < .001$), CQ-Sort Extraversion with NEO-PI Extraversion ($r = .70, p < .001$), CQ-Sort Openness with NEO-PI Openness ($r = .62, p < .001$), CQ-Sort Agreeableness and NEO-PI Agreeableness ($r = .36, p < .001$), and CQ-Sort Conscientiousness and NEO-PI Conscientiousness ($r = .31, p < .001$). For the purpose of this study, and based on research by McCrae and colleagues (1986), the

Neuroticism scale was defined by the CQ-Sort items presented in Table 4. The California Child Q-Sort (CCQ-Sort; assessment at age 4 years) and the California Adult Q-Sort (CAQ-Sort; assessments at ages 14 and 18 years) were used to obtain the Neuroticism factor score. Both versions involve ratings of 100 age-adjusted personality characteristics by multiple, independent assessors who were able to observe the participant in diverse, often intimate situations for a significant amount of time.

Impulsivity measures. Assessment of preschool (4 years) and early adolescence (14 years) impulsive behaviour consisted of objective testing. Late adolescence impulsivity was assessed via life questionnaires. Four year old children were tested using the *Candy Train Task* (Block & Block, 2006). Upon completion of the assessment battery, the participants were asked to manipulate M&M's through a large candy machine. Once they received the earned number of M&M's, they were asked if they would rather eat them right away or wait two days at which time they would get three times as many M&M's. It was assumed that the children who received more candies presented with lower levels of impulsivity. Psychometric data for this task were not provided with the dataset and have never been published.

Delay of Gratification Payment Schedule (Block & Block, 2006) was set up for 14 year old adolescents. They could choose between being paid \$4 after each of the six comprehensive testing sessions (for a total of \$24) or they could wait to be paid the full amount plus interest (for a total of \$28) at the end of the last session. For verbatim instructions, please refer to Funder and Block (1989). The measure of delay of gratification was the total amount of money earned, with higher scores reflecting lower impulsivity. Lower scores indicated either a choice of immediate payment or premature ending of the study. Thus, the higher the monetary amount earned, the

more likely the participant was to delay gratification. The psychometric data for this task were not provided, but was successfully used in several studies (Funder & Block, 1989).

During late adolescence (age 18 years), indicators of impulsivity included in the statistical analysis of the measurement model consisted of: (1) used amphetamines, (2) used barbiturates, (3) used cocaine, (4) used codeine, (5) used hallucinogens, (6) used heroine, (7) used inhalants, (8) used tranquilizers, (9) used other drugs (excluding alcohol and tobacco), (10) got in trouble with the law in the last 3 years, (11) stole something valuable in the last 3 years, (12) got/made pregnant in the last 3 years, (13) in trouble at the school in the last 3 years, (14) got/gave venereal disease in the last 3 years, (15) ran away from home in the last 3 years, (16) had poor grades at school in the last 3 years, (17) did not get along with parents in the last 3 years, (18) described him/herself as impulsive on the adjustment rating scale.

Procedure

A summary of instruments and their sequence of administration are given in Table 1. During ages three and four years, the children had been brought to the university for a parent-child dyad laboratory observation session and completion of the questionnaires by the mother. The entire assessment lasted approximately 90 minutes and parents were not present during the administration of the battery to the child. Impulsivity measures were derived from this battery. In terms of personality, each child was described by a different nursery school or kindergarten teacher who had worked with the child for a minimum of eight months and who was briefly trained in the use of the CCQ-Sort. Each teacher arranged 100 CCQ-Sort items describing the child's behaviour and psychological characteristics in a forced, quasi-normal distribution according to the salience of each item with respect to that particular child. Teachers were asked to do California Q-sorts independently on four children. The correlations between teachers for

all 100 items ranged from 0.53 to 0.74. A similar battery was administered to the adolescent participants several years later (ages 14 and 18 years).

Data Analysis

Introduction to and justification for the model. The main aim of the current study was to investigate the relations between impulsive decision-making and personality development from early childhood to late adolescence. The research questions of interest were: (1) How do personality and impulsivity interact during childhood, early adolescence, and late adolescence?; (2) What are indicators of impulsivity during adolescence and how are they associated with impulsive decision-making?; and (3) Can we identify childhood predictors, such as the propensity to make impulsive decisions, of certain dysfunctional personality profiles? Overall, it was hypothesized that childhood impulsivity and personality styles predict subsequent impulsive behaviour and personality development.

Statistical Analyses. The statistical analysis proceeded in three steps: (1) developing a measurement model of impulsivity construct at age 18 years using exploratory factor analysis (EFA); factors were extracted via maximum likelihood method, (2) conducting structural equation modeling (SEM) to test all hypotheses, and (3) reviewing the Chi-square (χ^2) and other model-fit indices to assess the fit of the model.

While scores on candy (number of candies earned) and money (amount of money earned) tasks were assumed to be indicative of impulsive decision-making during childhood and early adolescence, respectively, EFA was utilized to identify the best fitting measurement model of impulsivity construct at age 18 years. Information such as illicit drug use, problems at home and school, as well as presence of legal issues was obtained from the interview and the questionnaires. EFA allowed determination of a multiple factor model at age 18 years that

included behaviours that serve as the best indicators of impulsivity at this time. Personality was measured by the total score for the CQ-sort Neuroticism factor validated against the Neuroticism scale on the NEO-PI for all three time points (see Table 4; McCrae et al., 1986). Next, SEM was utilized to test all hypotheses and determine the relation between impulsivity and neuroticism within and across the three age groups. Path coefficients were estimated using maximum likelihood estimation method due to its ability to avoid capitalizing on unique item variance. With increasing sample size, the maximum likelihood estimation method allows for increased probability that the estimator is close to the population parameter making it a highly consistent estimator. It is also an efficient estimator as it has a low error variance among results from random samples (Kline, 2011). Additionally, the observed variables were all continuous and therefore able to satisfy the assumption of multivariate normality necessary for this approach (Kline, 2011). Finally, the goodness of model fit was indicated by Chi Square (χ^2 ; Kline, 2011), Root Mean Square Error of Approximation (RMSEA; Chen, Curran, Bollen, Kirby, & Paxton, 2008), Comparative Fit Index (CFI; Hu & Bentler, 1999), and Standardized Root Mean Residual (SRMR; Hu & Bentler, 1999). An illustration of the obtained, best-fitting model is presented in Figure 2.

Results

Missing Data, Outliers, and the Assumption of Normality

In terms of missing data, the extent of missing data ranged from 20.0% (Neuroticism scale at age 4 years) to 36.9% (drug use factor at age 18 years). The cases with more than 50% missing data on a variable of interest were deleted. The remaining cases (N varying from 102 to 128 amongst variables) were mostly complete. It was determined that the data were missing completely at random (Little's MCAR test: $\chi^2_{(57)} = 74.424, p = 0.060$). The Full-Information

Maximum Likelihood (FIML) method uses all of the information of the observed data to calculate a casewise likelihood function (Enders & Bandalos, 2001) and has been extensively applied to SEM (Muthen, Kaplan, & Hollis, 1987). The FIML estimates have been shown to be unbiased and more efficient relative to pairwise deletion, listwise deletion, and similar response pattern imputation (Enders & Bandalos, 2001). Therefore, FIML approach was used to estimate missing data. Using the Explore feature in the SPSS software package, the data were also screened for outliers. Following an analysis of the lowest and highest values, it was determined that all values for all variables were within the expected limits ($|z| > \pm 3.29$). Finally, the data were checked to determine whether the assumption of univariate normality had been violated. According to the accepted cutoff values for skewness and kurtosis (within two standard deviations), it was found that all of the variables conformed to a normal distribution. Table 2 presents descriptive values for all the variables.

EFA with an oblique rotation identified two factors indicating impulsive tendencies at age 18 years. Only measures of impulsivity with absolute value of loadings of 0.4 or greater were kept. As a result, Factor 1 “Drug Use” comprised scores on questions inquiring about the use of (1) amphetamines (.76), (2) barbiturates (.78), (3) cocaine (.71), (4) codeine (.61), (5) hallucinogens (.82), (6) heroin (.41), (7) inhalants (.45), and (8) tranquilizers (.74). Factor 2 “Antisocial tendencies” comprised scores on questions inquiring about (1) stealing something in the last 3 years (.53), (2) exhibiting trouble at school in the last 3 years (.50), (3) running away from home in the last 3 years (.63), (4) having poor school grades in the last 3 years (.57), and (5) not getting along with parents in the last 3 years (.45). A composite score for each factor was created by taking the average of the participants’ scores on the chosen measures.

Overall Fit of the Model

First, Pearson correlations were calculated to assess the relations between the chosen variables (see Table 3). Next, all hypothesized paths were tested to confirm that the model generally demonstrated a good fit to the data. Finally, the non-significant paths were removed from the model and goodness-of-fit of the obtained model was assessed. According to the guidelines for interpreting the goodness-of-fit by Hu and Bentler (1999), a cutoff value of $<.06$ for the Root Mean Square Error of Approximation (RMSEA), $<.08$ for the Standardized Root Mean Square Residual (SRMR; Hu & Bentler, 1998), and $>.95$ for the Comparative Fit Index (CFI) were taken as indicative of good fit of the model to the data. The fit of the obtained model (see Figure 2), was as follows: $\chi^2_{(6)} = 3.393, p = .76, RMSEA = .000$ (90% CI: .000-.076), $SRMR = .031, CFI = 1.000$. Overall, the model appears to constitute a good fit to the data. The standardized path coefficients for the paths of interest are presented in Figure 2 and explained in the upcoming two sections.

Personality and Impulsivity from Preschool to Late Adolescence

A developmental progression of personality and impulsivity was observed. First, there was a significant relation between neuroticism at age 14 years and age 18 years ($\beta = .56, p < .001$) in the predicted direction: high scores on the Neuroticism factor of the CQ- sort at age 14 years predicted high scores on this factor at age 18 years. Next, drug use ($\beta = .40, p = .003$) and antisocial behaviour ($\beta = .52, p < .001$) loaded significantly on the impulsivity latent variable. Although marginally significant, there was a relation between impulsive decision making at age 14 years and engagement in impulsive acts at age 18 years ($\beta = -.32, p = .087$) in the predicted direction: participants who were more likely to wait during the delay of gratification task at age

14 years (indicated by more money obtained at the end of the task) were less likely to engage in drug use and antisocial acts during age 18 years.

Developmental Association between Impulsivity and Personality

There was also a significant relation between personality and impulsivity at particular ages. Higher score on delay of gratification task at age 14 years (indicating ability to wait for the award) predicted low scores on the Neuroticism factor of the CQ-sort at age 14 years and vice versa ($\beta = -.32, p < .001$). Also, participants who had higher scores on drug use and antisocial behaviour factors at age 18 years were more likely to score higher on Neuroticism factor of the CQ-sort at age 18 years and vice versa ($\beta = .63, p = .006$). Also, a significant relation between personality development and impulsivity was noted from childhood to late adolescence.

Personality style during childhood predicted impulsivity at subsequent ages. In particular, higher score on the Neuroticism factor of CQ-sort at age 4 years predicted lower score on the impulsivity factor (indicating inability to delay gratification) at age 14 years ($\beta = -.25, p = .010$). Furthermore, higher scores on the Neuroticism factor at age 14 years predicted higher scores on impulsivity factor at age 18 years (higher frequency of drug use and antisocial behaviour; $\beta = .36, p = .040$). Similarly, lower scores on impulsivity measure at age 14 years (indicating inability to delay gratification) predicted higher scores on the Neuroticism measure at age 18 years ($\beta = -.19, p = .015$).

Discussion

The primary focus of the present study was on the developmental progression of impulsivity and personality styles as well as the predictive association between these two constructs. Although childhood impulsivity, defined in terms of one's inability to delay gratification and tested by their performance on the candy task, was not revealed as a significant

predictor of inability to delay gratification during early adolescence, analyses showed inability to delay receipt of rewards during early adolescence to be marginally associated with greater drug use and antisocial acts during late adolescence. Similarly, a childhood personality profile characterized by irritability, guilt, need for reassurance, and brittle ego defenses was not predictive of subsequent tendency to present with similar personality profile. However, if these characteristics were present during early adolescence, they persisted into the late adolescence. Importantly, associations were also revealed between personality and impulsivity across time. In particular, individuals who were able to delay gratification during early adolescence were less likely to struggle with irritability, guilt, and seek constant reassurance during late adolescence. Finally, impulsive early adolescents were also less likely to delay gratification during early adolescence as well as more likely to become impulsive late adolescents who engage in drug use and antisocial behaviours. Across adolescence, characteristics such as impulsivity, irritability, and proneness to guilt were likely to co-exist and interact to further adolescents' risk for subsequent adjustment problems.

As an association between childhood impulsivity and early adolescence impulsivity was not found, the hypothesis that impulsive behaviour later in life is related to childhood impulsive decision-making is not supported. This lack of support could be a function of measurement issues or a true lack of association between these constructs given extensive research suggesting that early childhood experiences (e.g., culture) shape one's innate self-regulatory tendencies (Kagan, 2010). Consequently, the course of neurobiological development may be altered from childhood to early adolescence. Furthermore, imaging studies have revealed a non-linear progression of brain development. Although the white matter volume increases throughout the brain, the gray matter volumes seem to follow inverted-U-shaped and area-specific course

(Giedd et al., 2004). Nevertheless, measurement problems will be discussed as one of the limitations of the present study.

The results of the present study can be explained by several research groups who found that childhood externalizing psychopathology is frequently associated with dysfunction later in life (Miller et al., 2008; Murphy & Barkley, 1996). These researchers have found that impulsive decision-making follows a specific developmental progression. In particular, tendency to discount larger delayed rewards appears reduced in young adulthood and reaches stable levels in the thirties (Green et al., 1994). Furthermore, impulsive decision-making has been related to various forms of psychopathology and specific personality styles. For example, childhood indicators of behavioural impulsivity (i.e., ADHD diagnosis) have been associated with reduced conscientiousness in adolescence and young adulthood. If symptoms of impulsivity persist into adolescence, these individuals usually present with increased neuroticism and decreased agreeableness (Miller et al., 2008). In turn, adolescents who are more likely to choose an immediate reward show greater involvement with cigarettes, alcohol, and marijuana, have a poorer self-concept, and underperform academically relative to their peers who are more likely to delay the reward (Green et al., 1994).

Also of note is that an irritable, guilt-prone, and self-defeating personality style during childhood predicts impulsive decision-making during early adolescence. This is an important finding especially given that there is a long span of time between the childhood measure of personality style (age 4) and early adolescence impulsive decision-making (age 14). It speaks to the validity of the CQ-sort as a personality measure across the life span and its predictive power of dysfunctional behaviour later in life. This finding also has important implications for prevention; if clinicians recognize that a child has a tendency to be irritable, has fluctuating

mood, tends to give up easily under frustration, and appears anxious, more support for the child and early intervention may reduce subsequent problems.

Limitations

A major limitation of the present study is that the findings relied on the secondary analysis of the database that was not designed specifically to address the constructs of interest; rather, only certain measures of delay of gratification were available during childhood and early adolescence and correlates of impulsivity were available during late adolescence. It is possible that significant relations were not observed between childhood and early adolescence impulsivity because these constructs were very different. In particular, the ability to delay gratification during childhood and early adolescence was measured by the number of candies eaten and the amount of money obtained following certain tasks, respectively. It is important to note, however, that even when measured by vastly different indicators, the hypothesized association between impulsivity during early and late adolescence were marginally significant, suggesting that a significant effect might be found if more comparable indicators were used. Furthermore, it is possible that the significant effects were not observed between childhood impulsivity and personality constructs due to an inadequate measure of childhood impulsivity. Block and Block (1980) did not provide psychometric properties for the candy and payment delay of gratification tasks and it has not been thoroughly described in the literature. Future research might strive to measure all of the constructs in a way that more closely reflects their interrelatedness through the use of indicators that are more congruent with each other.

Another related limitation focuses on the method of data collection. As the data for the present study was harvested from a large government database, it was not possible to arrange a specific method of questioning the participants and administer tasks best related to our research

question, nor was it possible to interview the original but now deceased scientists that developed the tasks. In addition, the analysis was limited to what was addressed by the initial researchers. In other words, there may have been better indicators of the constructs of interest that were not available for the analysis. Researchers working on the future studies within this line of work might consider using more experimental approaches to measure impulsivity. For example, studies that compare discounting of delayed gains and losses have consistently shown that larger rewards are discounted more steeply than smaller ones (Green & Myerson, 2004). Interestingly, this finding was observed with monetary rewards as well as food and beer (Estle, Green, Myerson, & Holt, 2007), illicit substances (Perry & Carroll, 2008), and medical treatments (Chapman, 1996). Future research should also focus on extending experimental measures of impulsivity across the life span to address the developmental stability and presentation of impulsive decision-making in adulthood.

Finally, there was a large number of missing data points which compromised the power to find smaller effects. It is usually not recommended to conduct structural equation modeling with a sample size less than 100 (Kline, 2011). Considering effects across time, however, like in repeated measures, provided some extra power to compensate for this issue. Also, significant associations that were revealed are notable given that power was compromised to find these effects. Future research should look at the hypothesized associations using a larger sample size (200 or more participants). Nevertheless, the obtained analyses can serve as pilot data to suggest ideas for larger studies in the future. In addition, the benefits of conducting secondary data analysis are numerous and include the convenience of already collected data, the impressive breadth of data available, the long longitudinal design, and the fairly large sample size that make studies such as this one possible.

Conclusions

Impulsivity and personality appear to show a developmental progression and dysfunctional styles can be detected as early as childhood. Children identified as irritable, moody, and easily frustrated with brittle ego defenses and lacking insight are at-risk for becoming young teenagers who are likely to make impulsive decisions for the sake of receiving an immediate reward. Adolescents in their early teens who present with similar dysregulated personality style tend to remain dysregulated in the upcoming years. Additionally, adolescents' anxious and easily-frustrated nature has been significantly associated with impulsive decision-making, illicit drug experimentation, and antisocial tendencies as well as predictive of future tendency for behavioural problems. Finally, adolescents who tend to make impulsive decisions during their early teens are also more likely to grow into easily frustrated, moody, and anxious 18-year olds.

The obtained developmental patterns are important when trying to identify children at-risk for adjustment difficulties later in life. These children and their parents may benefit from extra support and early intervention to reduce the risk of long-term poor outcomes. Also, the finding that scores on CQ-Sort Neuroticism scale (indicative of easily-frustrated, anxious, irritable, and moody individual) and tasks measuring impulsive decision-making can be used to predict each other over time provides evidence that personality and impulsivity are strongly related. Consequently, intervention targeting both domains might be necessary to see behavioural changes within the individual.

Table 1

A summary of instruments and their sequence of administration

	Age 4 years	Age 14 years	Age 18 years
Personality	CCQ-Sort ^a Neuroticism	CQ-Sort ^a Neuroticism	CQ-Sort ^a Neuroticism
Impulsivity	DG ^b – Candy Task	DG ^b – Payment Task	Drug use ^c Antisocial behaviour ^d

^a CQ-Sort – California Q-Sort; CCQ-Sort – California Child Q-Sort

^b DG – Delay of Gratification

^c Drug use – Factor comprised of scores on items inquiring about illicit drug use (e.g., amphetamine, cocaine, heroin, etc.)

^d Antisocial behaviour – Factor comprised of scores on items inquiring about problems in various settings (e.g., school, legal system, family, etc.)

Table 2

Sample size, mean, standard deviation, and range for each construct

Construct	N ^b	# of missing values	M ^c	SD ^d	Range
Age 4: CCQ-Sort ^a Neuroticism	128	32	4.69	.22	1.10
Age 4: Delay of gratification	123	37	29.17	15.67	43.00
Age 14: CQ-Sort ^a Neuroticism	106	54	4.55	.48	2.13
Age 14: Delay of gratification	104	56	24.61	7.39	25.20
Age 18: CQ-Sort ^a Neuroticism	104	56	4.25	.41	1.52
Age 18: Drug use	101	59	.16	.24	1.00
Age 18: Antisocial behaviour	102	58	1.20	.22	1.00

^a California (Child) Q-Sort – personality construct

^b N – sample size for that particular variable

^c M - Mean

^d SD – standard deviation

Table 3

Pearson correlations

	Age 4 DG	Age 14 DG	Age 18 Drugs	Age 18 Antisocial	Age 4 NEU	Age 14 NEU	Age 18 NEU
Age 4 DG	1						
Age 14 DG	.028	1					
Age 18 Drugs	-.011	-.231*	1				
Age 18 Antisocial	-.054	-.143	.185	1			
Age 4 NEU	.090	-.227*	.073	-.134	1		
Age 14 NEU	-.162	-.295**	.193	.235*	-.063	1	
Age 18 NEU	-.056	-.361***	.286**	.370***	.014	.610***	1

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

Age 4 DG – delay of gratification candy task; Age 14 DG – delay of gratification payment task;
 Age 18 Drugs – drug use; Age 18 Antisocial – engagement in delinquent and risky behaviours;
 Age 4, 14, and 18 NEU – Neuroticism score on CQ-sort; higher scores indicate greater ability to
 delay gratification, more drug use, more risk-taking, and more neurotic traits, respectively.

Table 4

CQ-Sort Neuroticism factor items and their loadings on a neuroticism construct based on work by McCrae, Costa and Busch (1986)

Item description	Loading	Item description	Loading
13 Thin skinned	0.58	23 Extrapunitive	0.34
68 Basically anxious	0.58	30 Gives up under frustration	0.33
34 Irritable	0.53	98 Verbally fluent	- 0.30
47 Guilt-prone	0.52	8 Intelligent	- 0.31
19 Seeks reassurance	0.51	70 Behaves ethically	- 0.32
12 Self-defensive	0.48	60 Has insight into own motives	- 0.32
82 Fluctuating moods	0.46	88 Personally charming	- 0.35
72 Concerned with adequacy	0.46	92 Socially poised	- 0.36
45 Brittle ego defenses	0.44	83 Sees to heart of problems	- 0.37
40 Vulnerable to threat	0.43	84 Cheerful	- 0.42
55 Self-defeating	0.42	57 Is interesting person	- 0.44
78 Feels victimized, cheated	0.42	24 Prides self on objectivity	- 0.44
10 Psychosomatic symptoms	0.36	75 Clear-cut personality	- 0.48
50 Unpredictable in behavior	0.35	74 Satisfied with self	- 0.51
89 Compares self to others	0.35	33 Calm, relaxed	- 0.56

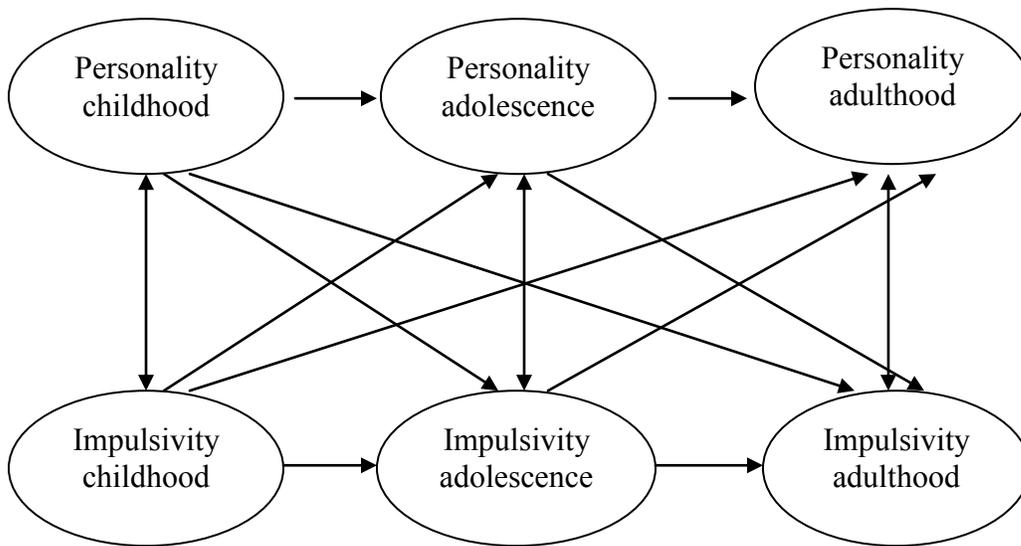


Figure 1. The proposed model of developmental progression of impulsivity and its relation to personality development.

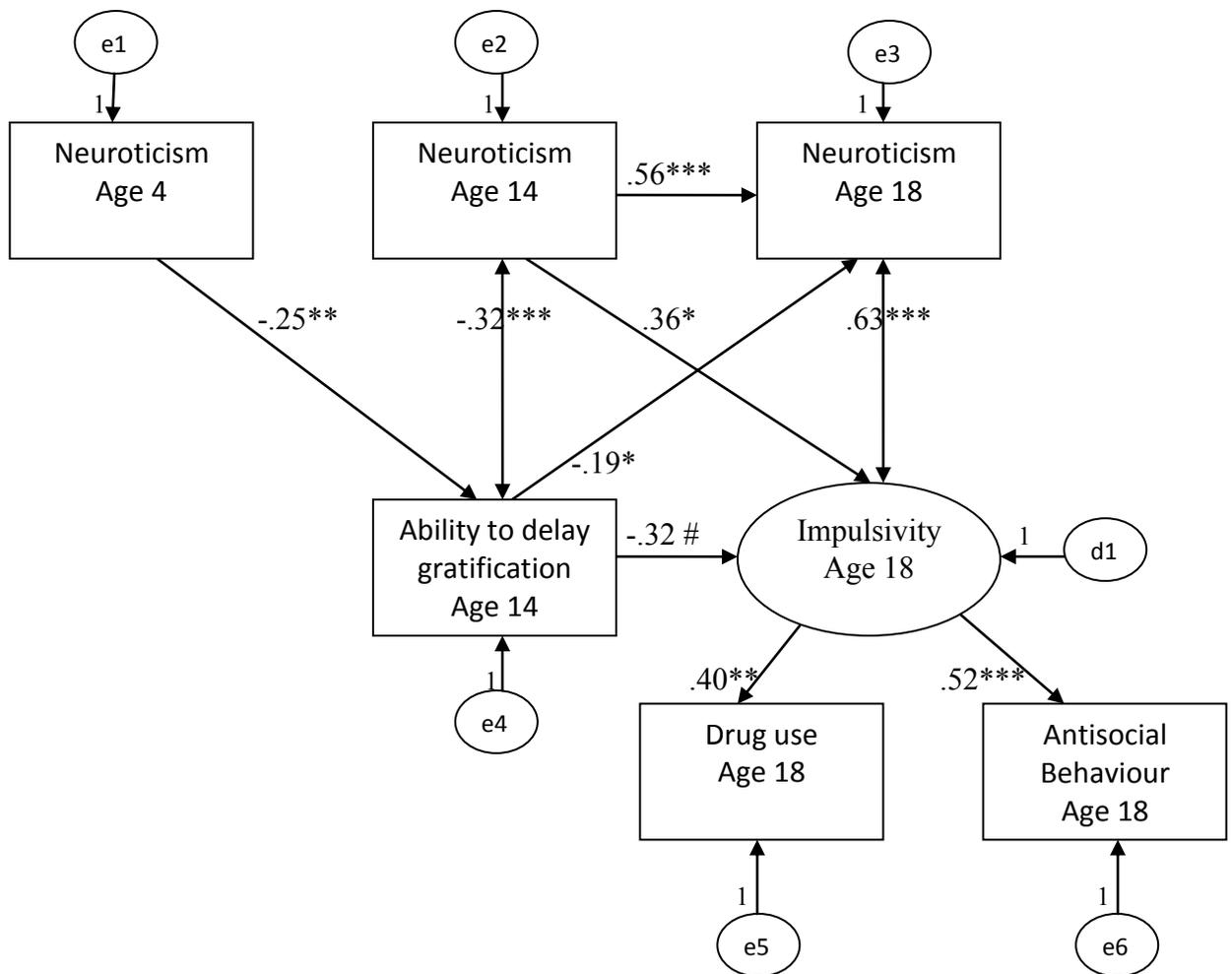


Figure 2. Testing relations between impulsivity and personality across the life span (significant associations are presented with arrows); e – errors; d - disturbances.

* $p < .05$; ** $p < .01$; *** $p < .001$; # = marginally significant relationship

CHAPTER 3

Impulsivity Across the Life Span: Reward-seeking and Emotion Dysregulation

Most daily decisions are planned in advance, but some decision-making is done on a whim and dependent upon the immediate gratification. Consequently, impulsivity is part of typical human behaviour, and intermittent spontaneous acts are not necessarily problematic. Difficulties may arise, however, when impulsive acts are persistent and adversely affect one's functioning. Although a clear definition of impulsivity remains intensely debated in the literature, the widely accepted conceptualization of impulsivity as a multidimensional construct is evident. Impulsivity is thought to encompass behaviours such as action lacking forethought, risk-taking, sensation- and reward-seeking, lack of reflection, planning and persistence, and inability to delay gratification (Depue & Collins, 1999; Evenden, 1999; Hochhausen, Lorenz, & Newman, 2002; Petry, 2001; Smith, Fischer, Cyders, Annus, & Spillane, 2007; Whiteside & Lynam, 2001). Impulsivity at its extreme has also been proposed as an underlying factor of Cluster B personality disorders characterized by dramatic, emotional, and erratic behaviour (American Psychiatric Association, 2000). Consequently, I wondered whether highly volatile and emotionally erratic style predisposes one to engage in immediately gratifying behaviours (e.g., illicit substance use) leading to impulse control problems. Or, does the underlying impulsive tendency adversely affect emotion regulation? Consequently, I conducted a study that assessed developmental progression of impulsivity conceptualized as reward-seeking and its relation to emotion dysregulation across the life span.

Impulsivity as Reward-Seeking

The developmental neuroscience research has proposed a dual systems model that has been thought to guide engagement in risky behaviour and tendency to make decisions without

forethought (Steinberg, 2008). The cognitive control system comprises the lateral prefrontal cortices and parietal cortices and allows for more advanced control of impulses and self-regulation. In contrast, the socioemotional system includes the limbic and paralimbic areas of the brain (e.g., the amygdala, ventral striatum, orbitofrontal cortex, medial prefrontal cortex, and superior temporal sulcus) and leads to reward-seeking secondary to increased dopaminergic activity in these areas. Interestingly, there is a temporal gap between the development of these two neurobiological systems with socioemotional system development occurring in early adolescence followed by the development of the cognitive control system and its connections to the various areas of the socioemotional system. Therefore, middle adolescence has been identified as the time of increased vulnerability for alcohol and illicit drug abuse as well as engagement in other risky behaviours that provide immediate rewards (Steinberg, 2008; Steinberg et al., 2008).

Additionally, numerous studies have identified a relation between emotion dysregulation and impulsivity including involvement of the prefrontal cortex and amygdala in both, emotion regulation and impulsivity in terms of reward-seeking (Bechara, Damasio, & Damasio, 2000; Zeeb & Winstanley, 2011). It has been postulated that during distressing situations, emotionally dysregulated individuals shift attention from long-term goals (e.g., being educated, successful, and healthy) toward immediate pleasure-seeking behavior (e.g., smoking, drinking, and acting inappropriately towards others) to reduce the feelings of distress (Tice, Bratslavsky, & Beumeister, 2001). A positive association between emotion dysregulation and impulsivity in terms of reward-seeking has also been noted across the life span; during childhood (Musher-Eizenman, et al., 2004), adolescence (d'Acremont & Van der Linden, 2007), and adulthood (Kokkonen & Pulkkinen, 1999). For example, childhood reward-seeking has been related to

poor anger control and aggressive behaviour (Musher-Eizenman et al., 2004) perhaps resulting from limited emotion-regulation strategies (Garnefski, Legerstee, Kraaij, van den Kommer, & Teerds, 2002). Likewise, reward-seeking adolescents are at increased risk of depression, suicidal ideation, and drug abuse in comparison to their typically developing peers (Hutchinson, Patock-Peckham, Cheong, & Nagoshi, 1998). Additionally, reward-seeking in adult men is negatively associated with indicators of emotion regulation including socialization and cognitive control and positively associated with aggression, anxiety, and poor coping with sporadic negative consequences of expressing one's emotions (Kokkonen & Pulkkinen, 1999).

Emotion Dysregulation and its Cognitive and Behavioural Correlates

According to the appraisal theory of emotional states, emotions are elicited by appraisals and/or evaluations of situations and events (Smith, Haynes, Lazarus, & Pope, 1993). In particular, blaming others has been related to anger, blaming oneself has been related to guilt, being satisfied has been related to happiness, and feeling endangered has been related to anxiety. Therefore, cognitions have been proposed as antecedents of emotion (Lazarus, 1982). The appraisal process has been suggested to guide coping because only evaluations with adaptive significance tend to result in emotions (Lazarus & Folkman, 1984). Consequently, for the purpose of this paper, coping is broadly defined as the ability to control personal feelings during emotional events and interchangeably used with the term emotion regulation (Tice & Bratslavsky, 2000). On the other hand, difficulty modulating the expression of emotion in response to the environmental demands or inability to regulate effects of emotions on individual's thoughts and actions is defined as emotion dysregulation (Cole, Michel, & Teti, 1994). Emotion dysregulation usually arises as a result of weak self-regulating skills (Baumeister, Heatherton, & Tice, 1994) and has been positively associated with anxiety,

depression, phobias, and obsessive-compulsive tendencies (King & Emmons, 1991). In addition, high self-control of emotions during adulthood has been negatively related to persistent acting-out types of behaviour that adversely affect functioning and characterize impulsivity (Kokkonen & Pulkkinen, 1999).

As children mature, regulating systems such as attentional effortful control and inhibition of fear develop. Using these systems, children become adults able to choose appropriate strategies to regulate their reactions to emotional events. However, children identified as difficult-to-manage often do not attain such regulatory abilities and are at higher risk for development of psychopathology at subsequent ages (Staudinger, Marsiske, & Baltes, 1995). These children are likely to be fearful, have a limited attention span, and are quick to cry even if the event is only moderately stimulating (Rothbart, 2007). Rothbart, Posner, and Hershey (1995) suggested that individual differences in emotion regulation may influence one's choices of more or less risky settings and relationships. Consequently, these individual differences in self-regulation may lead to a greater or lesser chance of development of psychopathology. They may also interact to influence developmental outcomes.

Furthermore, it is common to define psychopathology by impairments in emotion regulation and presence of impulsive behaviour (American Psychiatric Association, 2000). Consequently, for the purposes of this paper, conceptualization of Negative Affectivity, an aspect of self-regulation posited by Rothbart and Bates (2006), was used to guide the choice of measures with an aim of designing an emotion dysregulation construct across the life span. Negative Affectivity measures the level of negative affect related to interruptions of ongoing tasks, anticipation, distress, stimulation quality, exposure to suffering and disappointment, as well as recovery from general arousal and times when one hits the highest distress point

(Rothbart & Bates, 2006). Furthermore, behaviors and cognitions indicative of reward-seeking such as drug use, inability to delay gratification, poor school performance, inattention, hyperactivity, rule-breaking, and other antisocial tendencies were identified with an aim of comprising the impulsivity construct across the life span.

Neuroanatomical Correlates of Emotion Regulation and Impulsivity

As a result of growing evidence of the relations between emotion regulation, impulsivity, and physical and mental health (Madden & Bickel, 2010; Williams, Suchy, & Rau, 2009), recent functional neuroimaging and lesion studies examined these associations. Interestingly, the prefrontal cortex appears to be a common neuroanatomical correlate of emotion regulation as well as impulsive behaviour. In terms of emotion regulation, studies have examined how people regulate emotion when presented with emotion-evoking images (Duffy, Campbell, Salloway, & Malloy, 2001; Narashima, Kosier, & Robinson, 2003; Ochsner & Gross, 2008). If the aim was to increase an emotional experience, increases in amygdala activation were typically observed (Ochsner, Bunge, Gross, & Gabrieli, 2002) which in turn was correlated with the increased prefrontal activation (Ochsner & Gross, 2008). Lesion studies have found patients with lesions in the ventral frontal areas to be more irritable, aggressive, and more emotionally dysregulated (Duffy et al., 2001) and patients with lesions in dorsolateral and frontotemporal regions are likely to present with depressive symptoms (Narashima et al., 2003). Similarly, data from neuroimaging studies with human participants suggests that the choice of a delayed, larger reward (over an immediate, smaller one) is associated with greater activity in the lateral prefrontal cortex and posterior parietal cortical regions (McClure et al., 2004). Although some researchers propose involvement of separate, but interacting, neural systems in impulsive decision-making (Bechara, 2005), the majority of the functional magnetic resonance (fMRI)

evidence points to a single network including the ventral striatum, medial prefrontal cortex, and posterior cingulate cortex (Kable & Glimcher, 2007).

Taken together, numerous studies have identified dynamic relations between impulsivity conceptualized as reward-seeking, emotion dysregulation, and engagement in risky behaviors. However, research assessing the developmental progression of these interactions is lacking. Consequently, the present study has adopted a neurodevelopmental perspective with an aim of exploring the interactions between impulsivity as reward-seeking and emotion dysregulation as negative affectivity from childhood, across adolescence, to early adulthood.

The Current Study

As previously described, impulsivity has a well-documented relation with emotion dysregulation (Kim, Brody, & Murry, 2003). The ability to regulate emotional states is seen early in development and is influenced by maturation and experience (Rothbart et al., 2001). Consequently, it is important to establish a progression of emotion dysregulation from childhood to early adulthood. The present longitudinal research study design was intended to formulate an integrated model of emotion regulation that includes the additive and/or interactive effects of multiple vulnerability factors. The goal with the study was to explore: (1) interactions between emotion dysregulation and impulsivity as reward-seeking across development, (2) risk factors as well as protective factors in these interactions, and (3) childhood predictors (i.e., propensity to delay gratification, act on a whim, engage in impulsive acts) of subsequent psychopathology including addiction. The main hypothesis centered around the idea that children who are born with certain biological tendencies, such as reward-seeking, are more vulnerable to the negative effects of the environment and less likely to develop appropriate regulating strategies. Therefore, by using an existing longitudinal dataset, measures of impulsivity and emotion

dysregulation were examined as both antecedent and outcome variables obtained at three time points: childhood (four to six years old), adolescence, (15 years of age), and early adulthood (21 years of age). A list of measures can be seen in Table 1.

Research Hypotheses

Prior research has related impulsivity to various forms of psychopathology (American Psychiatric Association, 2000; Takahashi, Makino, Ohmura, & Fukui, 2008) and a specific developmental progression of impulsivity has been identified. For example, the tendency to make impulsive decisions is less likely in early adulthood relative to adolescence (Green et al., 1994). Despite numerous research studies indicating that childhood externalizing pathology is commonly associated with dysfunction later in life (e.g. Miller et al., 2008; Murphy & Barkley, 1996), longitudinal research addressing similar questions is still scant. The current study proposes a neurodevelopmental model to explain the relationship between impulsivity in terms of reward-seeking and emotion dysregulation across the life span. Additional model was also proposed representing a more parsimonious version of the initial model.

Hypothesis 1. Significant positive paths were expected between: (1) childhood, adolescent, and early adulthood impulsivity, (2) childhood, adolescent, and early adulthood emotion dysregulation, (3) childhood impulsivity and subsequent emotion dysregulation, and (4) childhood emotion dysregulation and subsequent impulsivity. Significant positive reciprocal paths were tested between impulsivity and emotion dysregulation at each age group (see Figure 1).

It was assumed that a higher degree of reward-seeking during childhood would predict higher levels of reward-seeking at subsequent ages. In addition, more reward-seeking was expected to be associated with a less adaptive emotion regulation style during childhood as well

as at subsequent ages. It was hypothesized that increased reward-seeking early in life, is a behavioural marker of an underlying neurocognitive propensity to engage in impulsive acts at subsequent ages. In addition, childhood reward-seeking was expected to have a significant, negative influence on the developmental progression of one's ability to regulate emotions.

Hypothesis 2. A second, more parsimonious model was proposed that accounted for two potential issues of the initial model. First, there were more variables explaining the variance of constructs at the later ages relative to childhood constructs of emotion dysregulation and impulsivity. In particular, the proposed model (see Figure 1) has four different variables predicting the emotion dysregulation construct during early adulthood (adolescent emotion dysregulation, childhood impulsivity, adolescent impulsivity, and early adulthood impulsivity) in contrast to only three variables predicting emotion dysregulation construct during adolescence (childhood emotion dysregulation, childhood impulsivity, and adolescent impulsivity), and only one variable predicting emotion dysregulation during childhood (childhood impulsivity). A similar pattern exists for the impulsivity constructs. A greater number of variables explaining the variance in early adulthood emotion dysregulation and impulsivity may lead to a reduced likelihood of obtaining strong relationships. Second, the paths connecting the farthest points in time are thought to be the weakest ones. Taking both of these issues in consideration, the second model excludes these paths.

Methods

Participants

In the current study, data were derived from the Simmons Longitudinal Study: Adaptation and Development across the Lifespan funded by National Institute of Mental Health grant number 5-R01 MH-27458. The study received ethics clearance and all the participants and

their parents gave informed consent. The study utilized a multidisciplinary, multi-method approach in order to: (1) trace the development and course of academic difficulties, behaviour problems, and psychopathology, and (2) identify health promoting factors from early childhood to adulthood. The study was conducted in a working class community in Massachusetts. The initial sample included 777 participants (392 males and 385 females). Nearly all (98%) of the participants were Caucasian. The socioeconomic status of the participating schools was diverse with 200 children attending school in the lower class, 225 in the middle class, and 252 in the upper middle class neighbourhoods. This longitudinal study began in 1977 and tested participants at 5, 6, 9, 15, 18, 21, and 26 years of age. To date, data from the SLS has been published in 50 journal articles and nine book chapters.

Between 1977 and 1998, attrition occurred primarily in the early grades when participants transferred from public to private school sectors. From the initial 777 children registered for kindergarten, 519 remained in the public schools for the subsequent data collection. Statistical analysis showed that all participants remaining in the study did not significantly differ from the initial group on key demographic, behavioural, developmental, or health variables (Simmons Longitudinal Study, Age 26 Data, Wave 7; Reinherz, 1998). It was concluded that the effects of cumulative attrition were not evident. Effects of sequential attrition were also negligible as participants did not differ from participants lost to follow-up on key demographic, academic, or behavioural factors. For the purposes of this study, data on 403 participants (204 males; 199 females) were available at each age group.

Measures

The *Simmons Behavior Checklist* (Reinherz & Gracey, 1991) was initially designed as a brief self-administered parent questionnaire but was transformed over the course of the study to

function as a self-report measure. Initially, it was designed to assess behavioural and emotional functioning in young children. For all, except three items, responses to the Simmons Behavior Checklist were scored on a five-point scale (1=Never, 2=Rarely, 3=Sometimes, 4=Often, and 5=Always). The Simmons Behavior Checklist was part of a longer questionnaire parents completed while their children were tested. The child assessment included measures of cognitive ability, health and developmental history, and family background. The entire questionnaire took 15 to 20 minutes to complete. Internal consistency of the Simmons Behavior Checklist was reported to be .86 with test-retest reliability ranging from .55 to .97 on individual items with an average correlation of .73 (Reinherz & Gracey, 1991). Overall, these levels of reliability are comparable to those of other behavioural measures reported in the literature (Orvaschel, Sholomskas, & Weissman, 1980). Content validity was ensured by the extensive literature review and consultations. Clinical validation was conducted by comparing reports of clinicians, social workers, and children's parents. Little agreement was found between the scores obtained by clinicians and parents, a result similar to those of other researchers (Berg & Fielding, 1979). As there was significant agreement between clinicians' scores and those obtained by the social workers (Reinherz, Walker, Gordon, Belfer, & Ramsey, 1983) the questionnaire was deemed eligible for the present study.

The *NIMH Diagnostic Interview Schedule, Version Three, Revised* (DIS-III-R; National Institute of Mental Health, 1978) was based on the criteria outlines in the Diagnostic and Statistical Manual, Third Edition, Revised (DSM-III-R; American Psychiatric Association, 1980). It identified lifetime presence and clinical significance of all symptoms in the DSM-III-R operational criteria, the frequency and severity of symptoms, temporal clustering of symptoms, whether symptoms occurred in the absence of circumstances under which they would be part of a

normal emotional reaction, whether symptoms occurred in the absence of physical illnesses or conditions that would account for them, and the presence of other psychiatric disorders which might preempt the disorder of interest. The coded responses are entered directly into a computer where the diagnosis is made according to the rules in DSM-III-R. This highly reliable instrument took about one hour to administer to both patients and the members of the general community (Eaton & Kessler, 1985).

Development of Constructs

Impulsivity Constructs. The impulsivity construct was composed of indicators of reward-seeking that conceptualized impulsivity construct across the life span based on parent and self-reports. Items chosen from the Simmons Behavior Checklist questionnaire described participants' inability to actively think, plan for the future, choose an appropriate course of action when in an unpredictable situation, detect any errors, as well as inability to delay gratification. During childhood and adolescence, the score on this subscale of the Simmons Behavior Checklist was obtained via parent report. During early adulthood, participants completed the Simmons Behavior Checklist as a self-report. In addition, a structured clinical interview was conducted based on DSM-III-R criteria and scores regarding drug use were obtained during early adulthood as indicators of engagement in risky behaviours associated with reward-seeking. Specifically, participants were asked whether they used any of the following substances five or more times in their life: (1) stimulants, (2) sedatives, (3) cocaine, (4) heroin, (5) opiates, (6) PCP, (7) psychedelics, (8) inhalants, and (9) other drugs (e.g. nitrous oxide, amyl nitrate, etc.). Alcohol and marijuana were omitted due to their availability and frequent use.

Tables 3 and 4 list items that comprise impulsivity constructs during childhood (ages 4, 5, and 6 years) and adolescence (age 15 years), respectively. Initially, items reflecting reward-

seeking during childhood and adolescence were chosen from the Simmons Behaviour Questionnaire. Next, Cronbach's α scores were calculated and items that were highly intercorrelated producing an internally consistent construct were kept at each age group. In particular, children who obtained high scores on childhood impulsivity construct tended to get into accidents and hurt themselves, throw and break things, lose interest quickly, as well as have trouble delaying gratification, concentrating, and sitting still. Adolescents who obtained high scores on adolescent impulsivity construct tended to fight often with others, and have trouble delaying gratification, concentrating, and sitting still. It is important to note that many of these behaviours could also be conceptualized as antisocial and delinquent. Table 5 lists items that comprise the impulsivity construct during early adulthood (age 21 years). Initially, items reflecting reward-seeking were chosen from the Simmons Behaviour Checklist in addition to drug use from DSM-III. Next, exploratory factor analysis allowed for determination of final indicators of early adulthood impulsivity construct. In particular, young adults who obtained high scores on impulsivity at age 21 years tended to have trouble delaying gratification, as well as tendency to engage in antisocial acts, break rules, demonstrate poor performance at school and work, have trouble concentrating and sitting still, and experiment with illicit drugs.

Drug use was included as an indicator of reward-seeking and engagement in risky behaviours; a frequent characteristic of impulsive individuals 21 years of age. The participant received a score of one if the drug was used at least five times in their life, indicating an interest in prolonged engagement in risky behaviours. Otherwise, a score of zero was assigned. The scores were averaged for drugs such as stimulants, sedatives, cocaine, heroin, opiates, PCP, psychedelics, and inhalants.

Emotion Dysregulation Constructs. Measures of emotion dysregulation were used as antecedent and outcome variables during childhood, adolescence, and early adulthood in order to explore the proposed relationship between reward-seeking and subsequent development of emotion dysregulation. Items similar to those assessing Rothbart and colleague's (2001) Negative Affectivity were chosen from the parent-report (childhood and adolescence) and self-report (early adulthood) Simmons Behavior Checklist questionnaire. These items described participants' tendency to feel frequent emotional discomfort, sadness, fear, anger, and frustration (Rothbart et al., 2001). Next, Cronbach's α was calculated for childhood and adolescent emotion dysregulation constructs. During young adulthood, indicators of emotion dysregulation were identified via exploratory factor analysis.

Tables 3 and 4 list items that comprised behaviours for the emotion dysregulation construct during childhood (ages 4, 5, and 6 years) and adolescence (age 15 years), respectively. In short, children and adolescents who have difficulties regulating their emotions are easily upset, sad, have a bad temper, and tend to be alone. Table 4 lists items that comprised the emotion dysregulation construct during early adulthood (age 21 years). Young adults who obtained high scores on emotion dysregulation construct at age 21 years tend to be shy and internally oriented as well as often afraid and sad with a hot temper.

Procedures

A summary of instruments and their sequence of administration relevant to this study are given in Table 1. For the purposes of present study, data from Wave 1 (childhood), 4 (adolescence), and 6 (early adulthood) were analyzed. This timeline allowed for a developmental assessment of reward-seeking and emotion dysregulation from childhood well into early adulthood when the behaviours become more consistent. In the first wave of data

collection, children had entered preschool in fall 1977. At that time, mothers of respondents completed questionnaires assessing demographics, health history, development, and behaviour of their preschoolers. Research assistants also rated through observation children's behaviour at that time. During 1987, researchers re-contacted study participants for Wave 4 of this project. Participants were generally in the ninth grade at that time. They reported about their current family and peer relations, extracurricular and social activities, and overall adjustment. Mothers also reported on their adolescent's development and behaviour. During Wave 6 in 1993-1994, the participants were 21 years old and were attending college away from home, married and working full-time, and/or still living with their parents. The participants reported on their family, peer, and romantic relationships, career goals, mental health, as well as emotional and behavioural functioning.

Data Analysis

Introduction to and Justification for the Model. The main aim of the current study was to investigate the relations between impulsivity and emotion dysregulation from early childhood to early adulthood. It was hypothesized that children with an innate reward-seeking tendency are more vulnerable to the negative effects of the environment and less likely to acquire efficient emotion regulating strategies as evidenced by consistent impulsive behaviour, drug use, and emotion dysregulation at subsequent ages.

Statistical Analyses. The statistical analysis proceeded in three steps: (1) developing a measurement model using Cronbach's α estimate and the exploratory factor analysis (EFA), (2) conducting structural equation modeling (SEM) to test all hypotheses, and (3) reviewing the Chi-square (χ^2) and other model-fit indices to assess the fit of the model.

During childhood (4, 5, and 6 years of age) and adolescence (15 years of age), Cronbach's α , a coefficient of reliability (Cronbach, 1951), was used to measure the internal consistency of the chosen items for impulsivity and emotion dysregulation constructs. Overall, all the values obtained indicated excellent internal consistency for the chosen items. In particular, Cronbach's α based on standardized values for childhood impulsivity was .806 for 9 items, childhood emotion dysregulation was .704 for 10 items, adolescence impulsivity was .744 for 6 items, and adolescence emotion dysregulation was .775 for 9 items. Tables 3 and 4 list the items for each of these constructs during childhood and adolescence, respectively. In order to focus on reward-seeking and emotion dysregulation, items removed primarily identified antisocial (i.e., destroying own/others' things, disobey parents, etc.) and depressive (i.e., suicidal ideation, trouble sleeping, fatigue, etc.) tendencies. During transition to adulthood (21 years of age), EFA was conducted separately for impulsivity and emotion dysregulation constructs. Several factors (consisting of items with absolute value of loadings of 0.4 or greater) for each construct were obtained. Table 5 lists these factors, the associated items, and their loadings for each construct at age 21 years. The obtained indicators were streamlined by removing items indicative of antisocial and depressive/anxious tendencies. Drug use was also added as an indicator of impulsivity at age 21 years. Following item selection as per aforementioned method, internal item consistency was assessed and found to be high with Cronbach's α of .804.

Second, SEM was utilized to test all hypotheses and determine the relation between impulsivity and emotion dysregulation within and across the three age groups. Path coefficients were estimated using the maximum likelihood estimation method due to its ability to avoid capitalizing on unique item variance. With increasing sample size, the maximum likelihood estimation method allows for increased probability that the estimator is close to the population

parameter making it a highly consistent estimator. It is also an efficient estimator as it has a low error variance among results from random samples (Kline, 2011). Additionally, the observed variables were all continuous and therefore able to satisfy the assumption of multivariate normality necessary for this approach (Kline, 2011). Finally, the goodness of model fit was indicated by Chi Square (χ^2 ; Kline, 2011), Root Mean Square Error of Approximation (RMSEA; Chen, Curran, Bollen, Kirby, & Paxton, 2008), Comparative Fit Index (CFI; Hu & Bentler, 1999), and Standardized Root Mean Residual (SRMR; Hu & Bentler, 1999). An illustration of the obtained, best-fitting model is presented in Figure 2.

Results

Missing Data, Outliers, and the Assumption of Normality

The extent of missing data ranged from 2% to 12% on all variables. However, 60% of the drug use at age 21 years variable was missing. The cases with more than 50% missing data on a variable of interest were deleted. The remaining cases were mostly complete. It was determined that the data were missing completely at random (Little's MCAR test: $\chi^2_{(74368)} = 63424.583, p = 1.000$). Expectation maximization method gives consistent and unbiased estimates of the correlations and covariances when the data are missing completely at random (Howell, 2008). Therefore, it was used to impute the missing data. Using the Explore feature in the SPSS software package, the data were checked to determine whether the assumption of univariate normality had been violated. According to the accepted cutoff values for skewness (within two standard deviations), it was found that drug use and antisocial/destructive indicators at age 21 years were non-normally distributed. Following a removal of outliers, these variables became normally distributed. In particular, several outliers were identified and removed ($|z| > \pm 3.29$): (1) Preschool impulsivity variable contained two outliers, (2) Adolescent impulsivity

variable contained four outliers, (3) Adolescent emotion dysregulation variable contained four outliers, (4) Antisocial/destructive indicator of impulsivity at age 21 years contained eight outliers, (5) Antisocial/rule-breaker indicator of impulsivity at age 21 years contained four outliers, (6) Poor performance indicator of impulsivity at age 21 years contained one outlier, (7) Hyperactive/impulsive indicator of impulsivity at age 21 years contained one outlier, (8) Shy/internal indicator of emotion dysregulation at age 21 years contained two outliers, (9) Immature indicator of emotion dysregulation at age 21 years contained two outliers, and (10) Afraid/sad indicator of emotion dysregulation at age 21 years contained three outliers.

Correlations among variables are presented in Table 2.

Overall Fit of the Model

To confirm that the model generally demonstrated a good fit to the data, it was first tested using all hypothesized paths. Non-significant associations were removed from the model to optimize the model fit. According to the guidelines for interpreting the goodness-of-fit of an SEM by Hu and Bentler (1999), a cutoff values of $<.06$ for the Root Mean Square Error of Approximation (RMSEA), $<.08$ for the Standardized Root Mean Square Residual (SRMR; Hu & Bentler, 1998), and $>.95$ for the Comparative Fit Index (CFI) were taken as indicative of good fit of the model to the data. Furthermore, RMSEA between $.06$ and $.08$ represented adequate fit (Hu & Bentler, 1999). Initially, the fit of this model ranged from poor to good, depending on the fit index examined. The model fit was poor based on RMSEA = $.094$ (90% Confidence Interval = $.082-.108$), $p < .001$, poor based on CFI = $.80$, and good based on SRMR = $.066$. The Chi Square value was significant, $\chi^2_{(45)} = 206.75$, $p < .001$. To improve the fit of the model, the observed indicators within each construct were correlated according to the modification indices (i.e., antisocial/destructive with antisocial/rule breaker and antisocial/rule breaker with poor

performance). The fit of the obtained model was much improved and ranged from adequate to good. The model fit was borderline adequate based on RMSEA = .081 (90% Confidence Interval = .066-.097), $p < .001$, approaching adequacy based on CFI = .89, and good based on SRMR = .053. The Chi Square value was also much improved, $\chi^2_{(33)} = 119.78$, $p < .001$. However, a negative association was noted between antisocial/destructive indicator and other indicators of impulsivity construct at age 21 years. Therefore, this indicator was removed as well as the autocorrelations. The fit of the obtained model was further improved based on individual values of the model fit indices and continued to range from adequate to good. A new association between childhood and early adulthood impulsivity emerged. The model fit was borderline adequate based on RMSEA = .081 (90% Confidence Interval = .064-.098), $p < .001$, approaching adequacy based on CFI = .89, and good based on SRMR = .052. The Chi Square value was also much improved, $\chi^2_{(27)} = 98.11$, $p < .001$. See Figure 2 for the visual presentation of the standardized path coefficients.

Early Adulthood: Impulsivity and Emotion Dysregulation Constructs

According to the obtained model, impulsivity in terms of reward-seeking behavior was characterized by one's tendency to seek immediate gratification and shift attention away from long-term goals such as becoming successful. Indicators that best loaded on the reward-seeking latent variable were drug use ($\beta = .45$, $p < .001$), antisocial tendencies and rule-breaking ($\beta = .87$, $p < .001$), and poor academic performance ($\beta = .62$, $p < .001$). Emotion dysregulation latent variable was indicated by one's internal focus and timidity ($\beta = .61$, $p < .001$), tendency to act immaturity and in a highly volatile manner ($\beta = .68$, $p < .001$), and exhibition of undue fear and sadness ($\beta = .55$, $p < .001$).

Impulsivity and Emotion Dysregulation from Childhood to Early Adulthood

A developmental progression of impulsivity and emotion dysregulation was observed. First, there was a significant relation between impulsivity during childhood and adolescence ($\beta = .091, p = .043$) as well as between childhood and early adulthood ($\beta = .16, p = .006$) in the predicted direction: high scores on the impulsivity construct early on in life predicted high scores on the impulsivity constructs at subsequent ages. Similarly, there was a significant relation between emotion dysregulation constructs from childhood to adolescence ($\beta = .28, p < .001$), from adolescence to early adulthood ($\beta = .15, p = .008$), and from childhood to early adulthood ($\beta = .23, p < .001$) in predicted direction: high scores on the emotion dysregulation construct early in life predicted high scores on the emotion dysregulation constructs at subsequent ages. Overall, impulsivity and inability to regulate emotional states identified during childhood appear to be persistent characteristics across time and predict one's difficulties at subsequent ages.

Developmental Association between Impulsivity and Emotion Dysregulation

There was also a significant relation between impulsivity and emotion dysregulation at particular ages as well as across time. First, there was a significant, reciprocal relation between the impulsivity and emotion dysregulation earlier in life: higher scores on impulsivity measures were associated with higher scores on emotion dysregulation measures during childhood ($\beta = .10, p = .034$) and adolescence ($\beta = .10, p = .032$). Second, predictive relations between the impulsivity and emotion dysregulation constructs were noted across time: higher impulsivity scores during childhood also predicted higher emotion dysregulation scores during adolescence ($\beta = .14, p = .003$) and early adulthood ($\beta = .43, p < .001$). Similarly, higher emotion

dysregulation scores during childhood predicted higher impulsivity scores during adolescence ($\beta = .42, p < .001$).

Discussion

The focus of the present study was on the developmental progression of impulsivity in terms of reward-seeking and emotion dysregulation, as well as the predictive association between these two constructs. These concepts of self-regulation describe the initial stages of child development, point to subsequent difficulties adjusting, and tie underlying neural networks to externalizing behaviour (Rothbart, 2007). The obtained neurodevelopmental model revealed a developmental progression of impulsivity in terms of reward-seeking from childhood to early adulthood. In particular, childhood reward-seeking was a significant predictor of engagement in reward-seeking during adolescence as well as associated with drug use, poor school performance, and rule-breaking during early adulthood. Similarly, the model revealed a developmental progression of emotion dysregulation from childhood to early adulthood: inability to regulate emotions in childhood predicted emotion dysregulation during adolescence that in turn predicted emotion dysregulation characterized by sadness, hot temper, and excessive fear during early adulthood. Predictive associations were also revealed between impulsivity in terms of reward-seeking and emotion dysregulation across time. First, participants who were likely to engage in reward-seeking behaviours were also more likely to have difficulties regulating emotions and vice versa during childhood and adolescence. Next, excessive reward-seeking during childhood was predictive of emotion dysregulation during adolescence as well as lack of coping skills during early adulthood. Finally, childhood emotion dysregulation in terms of poor coping skills and emotional lability was predictive of the need for immediate gratification and consequential reward-seeking during adolescence.

Important predictive associations were found between childhood impulsivity and adolescent impulsivity as well as association between childhood impulsivity and engagement in impulsive behaviors (e.g., drug use) during early adulthood. Consequently, the hypothesis that childhood reward-seeking is related to early adulthood reward-seeking and engagement in risky behaviour was supported. In particular, children who tended to get into accidents, hurt themselves, break things, and had trouble delaying gratification, concentrating and sitting still were more likely to become adolescents who fought with others, and had difficulty delaying gratification, concentrating, and sitting still. Furthermore, children who engaged in extensive reward-seeking as an approach to self-regulation were likely to become young adults who struggled delaying gratification and were likely to engage in antisocial acts, demonstrate poor performance at school/work, have trouble concentrating and sitting still, as well as experiment with illicit drugs. These findings are in line with previous research that has shown a relation between early childhood tendency for reward-seeking and adolescent reward-seeking behaviour (Green et al., 1994). Furthermore, drug use during transition to adulthood tends to remain a problem throughout the rest of early adulthood (Cicchetti & Rogosch, 1999).

The hypothesis that a childhood inability to properly cope with distress and associated emotions is predictive of emotion dysregulation at subsequent ages was also supported. In particular, children who get upset easily and have a hot temper are at an increased risk for growing up to be emotionally dysregulated young adults who often feel isolated and also have a hot temper. These results are in line with previous research that showed children who are fearful, have limited attention span, and cry frequently to be at a higher risk for development of psychopathology later in life (Rothbart, 2007). This is in contrast to their typically-developing

peers who, as they mature, develop regulating systems to inhibit fear and utilize attention to ensure effortful control (Rothbart, 2007).

In accord with the results of the present study, previous research has also identified an association between impulsivity and difficulties regulating emotions across the life span (d'Acremont & Van der Linden, 2007, Kokkonen & Pulkkinen, 1999, Musher-Eizenman, et al., 2004). For example, childhood impulsivity has been related to poor anger control (Musher-Eizenman et al., 2004), impulsive adolescents are highly likely to become depressed and abuse drugs (Hutchinson et al., 1998), and impulsive adults tend to present with poor coping strategies and experience negative consequences of expressing one's emotions (Kokkonen & Pulkkinen, 1999). The model partially replicated these findings, but also introduced new ideas. Positive, reciprocal associations were obtained between impulsivity in terms of reward-seeking and emotion dysregulation during childhood and adolescence indicating that difficulties regulating emotions and reward-seeking interact to create further risk for psychopathology. In addition, young adults who had difficulties regulating emotions and presented with a reward-seeking tendency were also more likely to have problems at school and work as well as struggle with addiction.

Finally, the model supports several ways in which reward-seeking might be involved in children's cognitive, emotional, and behavioural development. First, we see evidence for the presence of individual differences in self-regulation that may identify children with a predisposition toward psychopathology later in life. For example, children who demonstrate antisocial tendencies and have difficulty delaying gratification (therefore seeking immediate rewards) are more likely to become dysregulated adolescents and young adults who demonstrate heterotypically continuous antisocial behaviours, such as poor school/work performance and

experimentation with illicit drugs, in line with Moffitt's work on life-course persistent antisocial behaviour (Moffitt, 1993). Rothbart and colleagues (1995) also introduced the idea that one's approach to self-regulation can influence one's choices of more or less risky settings and relationships that may lead to a greater or lesser chance of development of psychopathology. For example, adolescents who get into fights with others are likely to continue to do so at a later age in addition to stealing and destroying others' property. These choices likely increase the opportunities to interact with delinquent peers, commit crimes, and develop antisocial personality style (Rothbart, 2007). Finally, Rothbart and colleagues (1995) also reviewed the idea that the relationship between temperament and dysfunctional states is mutual with one influencing the other to create additional risk for psychopathology. As noted, reward-seeking and emotion dysregulation were positively and reciprocally related during childhood and adolescence. These findings support the idea that lack of coping strategies in the first place may lead to reward-seeking behaviour such as experimentation with drugs to regulate one's emotions. In addition, inability to exert effortful control makes it difficult for the individual to accrue coping strategies in the first place.

Limitations and Future Directions

A major limitation of the present study is that the analysis relied on a database that was not designed specifically to address the constructs of interest. It is possible that significant effects were not observed between the impulsivity constructs during adolescence and early adulthood because these constructs were very different. In particular, the impulsivity construct during adolescence focused primarily on one's performance and inability to delay gratification while the impulsivity construct during transition to adulthood referred to antisocial-type of behaviour and drug use. Consequently, it is uncertain whether the lack of relationship between

adolescent impulsivity and early adulthood impulsivity and drug use is a function of measurement issues or a true lack of association. However, given previous research findings that have identified impulsivity to be an underlying neurocognitive characteristic of antisocial behaviour and substance use, the latter possibility is thought to be less likely. It is important to note, however, that even when measured by vastly different indicators, the hypothesized association between impulsivity during childhood and adolescence was significant in the predicted direction, suggesting that a significant effect might be found between impulsivity during adolescence and early adulthood if more reliable indicators were used. Future research might strive to measure all of the constructs in a way that more closely reflects their interrelatedness through the use of indicators that are more congruent with each other.

Another related limitation focuses on the method of data collection. As the data for the present study were harvested from a large government database, it was not possible to arrange a specific method of questioning the participants and administer tasks best related to our research question. In addition, the analysis was limited to what was addressed by the initial researchers. In other words, there may have been better indicators of the constructs of interest that were not available for the analysis. Researchers working on the future studies within this line of work might consider administering the Children's Behaviour Questionnaire (Rothbart et al., 2001) and the Adult Temperament Questionnaire (Rothbart, Ahadi, & Evans, 2000) to assess different aspects of self-regulation across the life span. Also, self-report and objective measures of impulsivity should be included such as Barratt Impulsivity Scale (Barratt, 1959; Patton et al., 1995), Eysenck Impulsivity Questionnaire (Eysenck & Eysenck, 1978), Delay Discounting task (Madden & Bickel, 2010), and Stop-Signal Task (Logan et al., 1984). In order to better understand the types of decisions individuals struggling with emotion regulation make, their

performance should be compared on delay discounting tasks across the life span. Impulsive decision-making, such as choosing a smaller, immediate award over a larger, delayed one, has been demonstrated with monetary rewards as well as food and alcohol (Estle, Green, Myerson, & Holt, 2007), illicit substances (Perry & Carroll, 2008), and medical treatments (Chapman, 1996). Such studies would provide evidence to suggest whether the primary cause of adult psychopathology is (1) the underlying neurocognitive characteristic of impulsive decision-making, or (2) the lack of coping strategies, or (3) the dynamic and life-long interaction of both of these risk-factors.

Conclusions

Impulsivity in terms of reward-seeking and emotion dysregulation in terms of negative affectivity appear to show a developmental progression, and dysfunctional styles can be detected as early as childhood. Children who have an excessive tendency for reward-seeking and are emotionally dysregulated tend to continue experiencing these difficulties during adolescence. They are also more likely to become young adults who engage in antisocial acts, demonstrate poor delay of gratification and school/work performance, have trouble concentrating and sitting still, as well as experiment with illicit drugs. In addition, children who tend to seek immediate rewards in order to cope with their emotions and distress are also highly likely to be difficult to please and hot tempered. They tend to cry and get upset frequently. Interestingly, these emotion regulating difficulties are likely to persist during adolescence and into young adulthood.

It is important to note that the developmental patterns obtained here allow for identification of childhood risk-factors for later development of regulatory difficulties and impulsive behaviour such as drug use. These children and their parents may benefit from extra support and early intervention to reduce the risk of long-term poor outcomes. Also, the finding

that scores on impulsivity and emotion dysregulation constructs can be used to predict each other over time provides gripping evidence that early reward-seeking tendencies and lack of coping skills are strongly related and predictive of psychopathology at later ages. Consequently, intervention targeting both domains might be necessary to see behavioural changes within the individual.

Table 1

Measures at each time point

Construct	Childhood (4, 5, 6 years)	Adolescence (15 years)	Early adulthood (21 years)
Impulsivity	SBCL ^a	SBCL ^a	SBCL ^a DIS-III-R ^b
Emotion Dysregulation	SBCL ^c	SBCL ^c	SBCL ^c

^a Items chosen to reflect reward-seeking

^b The NIMH Diagnostic Interview Schedule, Version three, Revised – drug use section

^c The Simmons Behavior Checklist – items chosen to reflect Negative Affectivity scale (Rothbart et al., 1995)

Table 2

Pearson correlations

	Preschool	Age 15	Age 21	Preschool	Age 15	Age 21
	IMP	IMP	IMP	ED	ED	ED
Preschool IMP	1					
Age 15 IMP	.135	1				
Age 21 IMP	.158	.002	1			
Preschool ED	.104	.002	.002	1		
Age 15 ED	.167	.020	.003	.036	1	
Age 21 ED	.477	.003	.001	.006	.006	1

ED – emotion dysregulation; IMP – impulsivity; Introvert – Shy/Internal focus; Temperament – Immature/Temperamental; Mood – Afraid/Sad; Drugs – Drug use; Antisocial – Antisocial/rule-breaking tendencies; Performance – Poor performance at work/school

Table 3

Parent report: Items comprising impulsivity and emotion dysregulation constructs during childhood based on Cronbach α scores (Cronbach, 1951)

Impulsivity ($\alpha = .806$)	Emotion Dysregulation ($\alpha = .704$)
Gets into accidents, hurts oneself	Gets upset unless everything is in its place
Throws and breaks things	Has a bad temper
Cannot sit still	Turns head away when people pay attention
Has to have something the minute asked	Fears new things and situations
Loses interest quickly	Clings to you or other adults
Has trouble paying attention	Is overly serious and sad
Fights with other children	Is a loner
Gives up easily if things seem hard	Has many fears
Considered to have behaviour problems	Would rather be left alone
	Nothing seems to please him

Table 4

Parent report: Items comprising impulsivity and emotion dysregulation constructs during adolescence based on Cronbach α scores (Cronbach, 1951)

Impulsivity ($\alpha = .744$)	Emotion Dysregulation ($\alpha = .775$)
Trouble paying attention	Gets upset unless everything is in its place
Cannot sit still	Cries easily
Fights with others	Has many fears
Loses interest quickly	Turns away when people pay attention to him
Has to have something immediately	Is overly serious and sad
Considered to have behaviour problems	Would rather be left alone
	Is a loner
	Nothing seems to please him/her
	Fears new things and situations
	Feels inferior and worthless

Table 5

Self-report: Impulsivity and emotion dysregulation constructs during early adulthood based on factor analysis

Impulsivity		Emotion Dysregulation	
Factor/Item description	Loading	Factor/Item description	Loading
Antisocial/Destructive Factor		Shy/Internal Factor	
Destroy own things	.44	Feel lonely	.65
Destroy others' things	.47	Jealous of others	.64
Get in many fights	.59	Afraid might do bad things	.30
Physically attack others	.74	Rather be alone	.47
Set fires	.76	Nervous or tense	.54
Steal	.70	Shy	.63
Antisocial/Rule-breaker Factor		Immature/Temperamental Factor	
Use drugs	.74	Act too young for one's age	.42
Break school/work rules	.56	Scream a lot	.58
Hang with others in trouble	.61	Stubborn and irritable	.67
Trouble with the law	.80	Mood changes suddenly	.59
Poor Performance Factor		Hot temper	
Lie or cheat	.52		
Trouble finishing things	.62	Afraid/Sad Factor	
Poor school/job performance	.73	Cry a lot	.77
Trouble making decisions	.51	Afraid of	.34
Hyper/Poor Concentration Factor		Unhappy/sad	
Trouble concentrating	.70		
Trouble sitting still	.70		
Acting without thinking	.42		

AGE 4/5/6

AGE 15

AGE 21

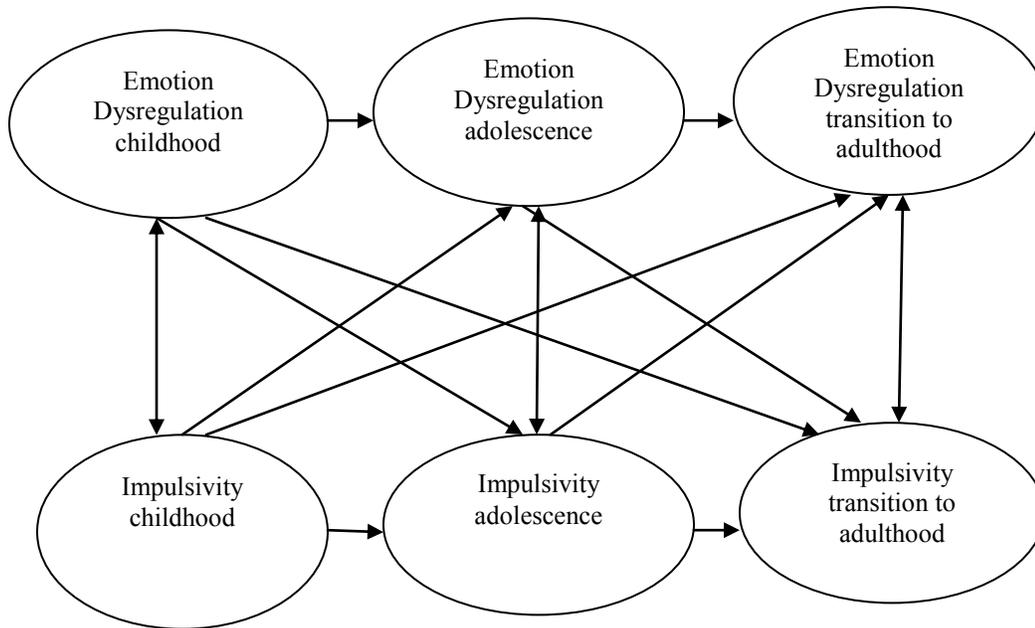


Figure 1. The proposed model of developmental progression of impulsivity and its relation to emotion dysregulation.

AGE 4/5/6

AGE 15

AGE 21

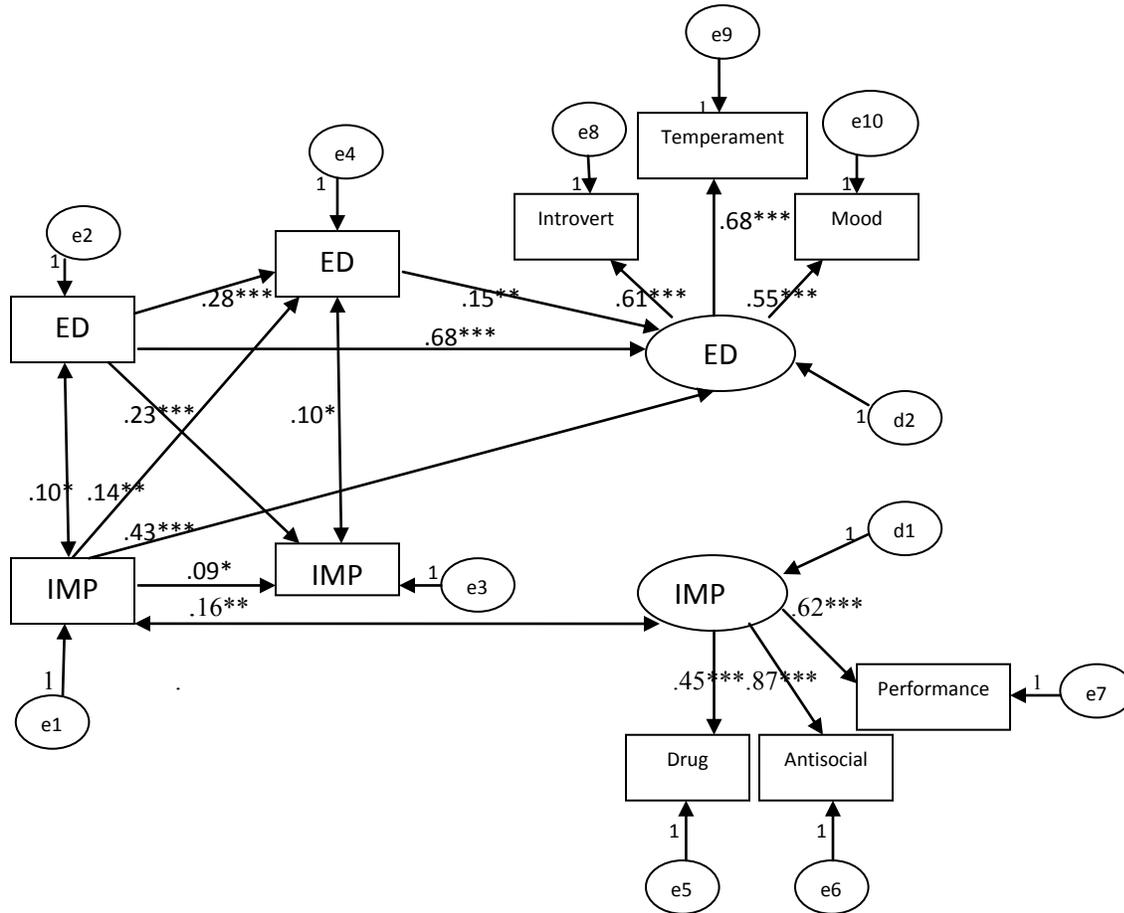


Figure 2. Testing relations between impulsivity and emotion dysregulation across the life span (significant associations are presented with arrows); ED – emotion dysregulation; IMP – impulsivity; Introvert – Shy/Internal focus; Temperament – Immature/Temperamental; Mood – Afraid/Sad; Drugs – Drug use; Antisocial – Antisocial/rule-breaking tendencies; Performance – Poor performance at work/school; * $p < .05$; ** $p < .01$; *** $p < .001$.

CHAPTER 4

A Measurement Model of Impulsivity: Can Impulsivity be Modeled as a Macroconstruct?

The definition of impulsivity remains hotly debated and varies somewhat across disciplines. Personality theorists and clinicians have related high levels of impulsivity to engagement in risky behaviour, lack of task persistence, a preference for immediate gratification, and being quick to react, as well as seeking out novel and stimulating activities (Evenden, 1999). In the behavioural literature, impulsivity is defined as a preference for a smaller, immediate reward over a larger, delayed reward (Ainslie, 1975; Rachlin, 1995). Across definitions, impulsive behaviour is typically viewed as dysfunctional. For example, individuals who score high on personality and behavioural measures of impulsivity are more likely to present with antisocial personality disorder (Fossati, Coyette, Ergis, & Allilaire, 2002) and Attention Deficit/Hyperactivity Disorder (ADHD; Johansen, Aase, Meyer, & Sagvolden, 2002), smoke cigarettes (Jenks, 1992), experiment with alcohol (Kirby & Petry, 2004) and illicit drugs (Coffey, Gudelski, Saladin, & Brady, 2003), and engage in pathological gambling (Petry, 2001). The purpose of the current study was to identify a measurement model of impulsivity using multiple theoretical perspectives. A secondary purpose was to examine the relations of impulsivity to symptoms associated with mental health problems in a population of typically-developing young adults enrolled in university classes.

Impulsivity as a Construct

Impulsivity was initially studied as a broad unitary construct. More recently, researchers have begun to focus on different elements of impulsivity, which may include more specific behaviours, such as inability to delay gratification, sensation-seeking, risk-taking, acting without forethought, and susceptibility to boredom (Madden & Bickel, 2010; Depue & Collins, 1999;

Evenden, 1999; Petry, 2001; Whiteside & Lynam, 2001). As a result of these varied perspectives, scales measuring impulsivity cited in the research literature are likely targeting different aspects of the construct.

Furthermore, factor analyses of self-report measures (Dawe, Gullo, & Loxton, 2004), animal and human behavioural models (De Wit & Richards, 2004; Dickman, 1990; Winstanley, Theobald, Dalley, & Robbins, 2003), and psychological studies (Smith et al., 2007) support a model of impulsivity with several underlying factors. For example, Dickman (1990) distinguished between two unrelated types of problematic impulsivity: dysfunctional impulsivity leading to actions without forethought and functional impulsivity leading to actions with limited forethought in optimal situations. In personality research, Eysenck and Eysenck (1985) developed a questionnaire which led to identification of a two-factor solution of impulsivity where one factor was labeled as Impulsiveness and the second factor was labeled as Venturesomeness. White and colleagues (1994) conducted a multi-method, multi-source assessment of impulsivity of more than 400 participants and presented a model with two distinct, yet related types of impulsivity. Cognitive impulsivity, as measured by inability to delay gratification, was more strongly related to IQ. Conversely, behavioural impulsivity as measured by tasks of inhibitory control, was more strongly related to externalizing behaviour.

More recently, Verheul and colleagues (Verheul, van den Brink, & Geerlings, 1999; Verheul, 2001) have argued for a three-pathway model of impulsivity including behavioural disinhibition, stress reactivity, and reward sensitivity. In experimental research, studies suggest that inhibition is not a unitary construct. In particular, although measures within the executive domain were found to correlate, such correlation did not exist among the measures in the motivational domain (Shuster & Toplak, 2009). Evenden (1999) wrote a review that attempted

to incorporate findings on impulsivity from various theoretical orientations including personality, experimental, psychiatric, and neurobiological research. He proposed several related phenomena, each leading to different sorts of impulsive behaviour, that are frequently classified under an overarching construct called impulsivity.

ADHD and Impulsivity

Attention Deficit/Hyperactivity Disorder (ADHD) is one of the most common childhood psychiatric disorders (Lahey, Applegate, McBurnett, & Biederman, 1994), with 3-7% of the population estimated to meet diagnostic criteria. It causes significant impairment in multiple environments (American Psychiatric Association, 2000) and is the primary reason for a large number of referrals for psychological evaluations (Demaray, Schaefer, & Delong, 2003). For many individuals diagnosed with ADHD in childhood, symptoms persist into adolescence and adulthood, resulting in significant impairment in multiple life domains (Barkley, 2000). In addition, Barkley (2000) stated that the symptoms of ADHD are normally distributed in the population, but are only considered pathological when they exceed the diagnostic threshold and cause impairment.

ADHD has been defined as a multifactorial disorder (Barkley, 2000; Nigg, 2005) including problems with distractibility, hyperactivity, and impulsivity (American Psychiatric Association, 2000). Previously, impulsivity was viewed as a core feature of ADHD (Johansen et al., 2002; Sonuga-Barke, Taylor, Sembi, & Smith, 1992). However, research on trait-like impulsivity has alluded to “varieties” of impulsivity (Evenden, 1999) wherein children with ADHD are more likely to perform poorly on measures of response suppression (Rubia, Smith, & Taylor, 2007). Therefore, a specific facet of impulsivity referred to as behavioural disinhibition has been proposed to be at the core of ADHD. Consequently, these individuals are thought to be driven

more by the immediate actions and outcomes as well as to have poor internal representations of time (Barkley, 1997). As a result, individuals with ADHD exhibit lower grades, fail more courses, perform worse on standardized tests, have fewer friends, and are rated less adequate in psychosocial functioning (Barkley, 1997). Impulsivity may underlie the significant problems with driving, such as speeding, vehicular crashes, and license suspensions (Barkley, 2002), in those with ADHD, as well as greater risk for substance abuse (Flory, Milich, Lynam, Leukefeld, & Clayton, 2003).

Substance Misuse and Impulsivity

According to the Diagnostic and Statistical Manual of Mental Disorders (4th ed.; DSM-IV; American Psychiatric Association, 2000), substance abuse is characterized by recurrent and maladaptive consumption of alcohol, medication, and illicit substances, including cocaine, heroin, cannabis, hallucinogens, and other drugs that leads to functional impairment. Approximately nine percent of the population is estimated to meet the diagnostic criteria for substance use disorders, either abuse or dependence, making it one of the most prevalent adult psychiatric disorders in the United States (Grant et al., 2006). Furthermore, substance use disorders are highly comorbid with mood and anxiety disorders and often lead to physical, legal, and interpersonal problems (American Psychiatric Association, 2000).

The relationship between impulsivity and addiction has also been extensively studied. One of the unresolved research questions in the area of impulsivity and substance use relates to the classic “chicken-and-the-egg” phenomenon. Specifically, it is not clear if more impulsive individuals, as measured by their performance on delay discounting tasks and personality questionnaires, are more likely to become addicts/substance abusers or if impulsivity is a side effect of drinking and abusing drugs. If the former is true, then impulsivity may be an initiating

factor for alcoholism, smoking, and/or illicit substance use. Several studies support the former premise. First, early experimentation with drugs and alcohol as well as a high susceptibility to substance abuse have been associated with impulsivity (Tarter et al., 2003). Second, high levels of impulsivity have been reported to negatively influence the course and treatment of substance use disorders (Moeller, Barratt, Dougherty, Shmitz, & Swann, 2001).

However, alcohol misuse presents as a highly etiologically and phenotypically heterogeneous disorder with less consistent findings. For example, Kirby and Petry (2004) reported that alcoholics were not more likely to engage in impulsive decision-making relative to healthy controls. But, when more homogeneous groups of alcoholics were tested in a separate study, the relationship between alcohol abuse and impulsivity was more evident. In particular, researchers found that early-onset alcoholism (before age 25) was linked to higher scores on measures of impulsive decision-making as well as impulsive personality traits, novelty-seeking, and sensation-seeking relative to late-onset alcoholism (Dom, D'Haene, Hulstijn, & Sabbe, 2006). Additionally, early-onset alcoholism has been associated with central serotonergic dysregulation (Hallman et al., 1996), which has in turn been linked with impulsive behaviour (Soubrie, 1986). Furthermore, alcoholics with Cluster B personality disorders scored higher on self-report measures of impulsivity than alcoholics without personality disorders (Dom, De Wilde, Hulstijn, Van Den Brink, & Sabbe, 2006). It is also important to note that research has shown that relative to healthy controls, heroin-dependent (Madden et al., 1997; Kirby et al., 1999), cocaine-dependent (Coffey et al., 2003; Kirby & Petry, 2004), and nicotine-dependent (Bickel et al., 1999) individuals are more likely to make impulsive decisions and choose more immediate, smaller rewards over larger, delayed ones.

Gambling and Impulsivity

Pathological gambling is an impulse control disorder characterized by recurrent and maladaptive gambling behaviour that leads to interpersonal problems, inability to stop gambling, and irritability and preoccupation with the task (DSM-IV-TR; American Psychiatric Association, 2000). With the increasing availability of legalized gambling, approximately 1 in 20 adults experience some sort of gambling problem during the course of their life (Shaffer, Hall, & Vander Bilt, 1999). It often occurs in conjunction with substance abuse (Petry et al., 2005), and psychosocial problems such as divorce, incarceration, bankruptcy, and overall reduced quality of life (Blaszczynski & McConaghy, 1989; Petry, 2005; Potenza et al., 2000), as well as higher rates of antisocial personality traits (Ibanez et al., 2003). Furthermore, in Canada 20.0% of pathological gamblers relative to only 12.4% of the non-pathological gamblers meet criteria for major depression (Suurvali, Hodgins, Toneatto, & Cunningham, 2008) and up to 20% of pathological gamblers attempt suicide (Potenza et al., 2002).

Pathological gambling usually occurs in combination with high levels of impulsivity (Ledgerwood, Alessi, Phoenix, & Petry, 2009). One longitudinal study highlighted childhood impulsivity as a risk factor for subsequent development of gambling problems (White et al., 1994). Furthermore, Jaffe and Archer (1987) have shown that adolescents and young adults who engage in pathological gambling score higher than healthy controls on personality measures (e.g., self-report questionnaires) of impulsivity. Research utilizing behavioural definitions of impulsivity as one's propensity to discount a larger, but delayed reward and consequentially prefer an immediate, smaller outcome (Ainslie, 1975), revealed similar findings. Petry (2001) evaluated the performance of pathological gamblers and substance abusers on tasks that measure the participant's ability to choose a delayed, but greater reward via Iowa Gambling Task

(Bechara, Damasio, Damasio, & Anderson, 1994) and impulsive personality traits via Eysenck Personality Questionnaire (EPQ; Eysenck & Eysenck, 1978) and Barratt Impulsiveness Scale (Patton et al., 1995). Principal component analyses revealed that Iowa Gambling Task performance measured a separate construct of impulsivity which loaded on a unique factor and that personality inventories revealed three distinct aspects of impulsivity including novelty seeking, time orientation, and impulse control in this population.

Personality, Personality Disorders, and Impulsivity

Personality has been characterized by relatively stable behavioural patterns during one's life (Eisenberg et al., 2007) that are influenced by one's experiences (Scherer & Peper, 2001) and biology (McCrae & Costa, 1996; 1999; McCrae et al., 2000). The Five Factor Model (Costa & McCrae, 1992) of personality proposed five factors that have become acknowledged as relevant and valid dimensions of personality in several areas, including job performance (Barrick & Mount, 1991), health (Smith & Williams, 1992), and psychotherapy (Miller, 1991). Neuroticism and Extraversion were initially introduced by Wiggins (1968) as the "Big Two" factors. The model was soon expanded to include Openness to Experience, Agreeableness, and Conscientiousness (Costa & McCrae, 1976; 1985). As the early dominant model of personality, the Five Factor Model has served as a basis for the development of other personality models.

Impulsivity is a component in several models of personality. For example, Buss and Plomin's (1975) model refers to lack of inhibitory control and an inability to persist on tasks. In addition, Neuroticism has been highly related to dysregulated behaviour (Soldz & Vaillant, 1999). Whiteside and Lynam (2001) utilized the Five Factor Model of personality to identify distinct facets of personality that have been frequently combined under the overarching definition of impulsivity as a multidimensional construct. The four-factor solution (urgency,

lack of premeditation, lack of perseverance, and sensation seeking) was obtained. More recently, Smith and colleagues (2007) assessed similarities and distinctions between related personality constructs and identified a hierarchical model of impulsivity with three distinct personality factors. Lack of planning and lack of persistence were identified as facets of a common, higher order construct, while urgency and sensation seeking were identified as two separate constructs. High scores on each one of these facets were proposed to be related to pathological patterns such as borderline and antisocial personality disorders. Research in the domain of personality disorders has focused on distinct aspects of personality traits that characterize each cluster and has identified impulsivity as a main predictor of dysregulated behaviour common to Cluster B personality disorders (Fossati et al., 2007).

Personality disorders have been described as enduring patterns of internal experiences and behaviours that are pervasive and inflexible, are stable across the life span, have an onset in adolescence or early adulthood, are not in concordance with the individual's culture, and lead to significant distress and functional impairment (American Psychiatric Association, 2000). In one of the largest epidemiological studies assessing mental illness and the co-occurring factors, the estimated incidence of all personality disorders was approximately 15% (Grant et al., 2004). Prevalence rates remained high (9.1% of the population) even when more significant distress or impairment was required as one of the criteria for diagnosing personality disorders (Trull et al., 2010). Individuals diagnosed with Cluster B personality disorders such as antisocial, borderline, histrionic, or narcissistic personality disorder often present as dramatic, erratic, and emotional. Such individuals with personality disorders often experience difficulty with employment, personal relationships, and romantic attachments as well as demonstrate difficulties conforming to social norms (American Psychiatric Association, 2000).

Impulsivity has been considered as an underlying neurobiological factor of Cluster B personality disorders (Fossati et al., 2007). For example, patients with borderline (Gardner & Cowdry, 1986; McCloskey et al., 2009) and antisocial (Dolan & Park, 2002) personality disorders report more impulsivity than healthy controls. In more recent studies, the focus has shifted from studying of broad personality domains to more specific aspects of personality. In one such study, Fossati and colleagues (2007) found that Cluster B personality disorders “stemmed from the same trunk”, or a latent variable, that differentiated them from the other personality disorders. In particular, each Cluster B personality disorder was a unique blend of various forms of impulsivity such as motor impulsivity, sensation-seeking, and/or planning impulsivity. Taken together, these findings are consistent with the view that Cluster B personality disorders are uniquely different from other personality disorders and highly associated with various forms of impulsive traits.

Limitations of the Current Research

Thus far, a limited number of studies have explored impulsive behaviour combining a variety of behavioural, observational, self-report, and performance measures. Instruments assessing impulsivity usually consist of personality self-reports most commonly derived from an interpersonal perspective on the DSM-IV personality disorders (Klein & Benjamin, 1996) or the Five Factor Model of personality (Costa & McCrae, 1992). The aim of these measures is primarily to assess multiple facets of impulsivity such as self-discipline, deliberation, planning, sensation-seeking, as well as other constructs.

Several specific behavioural tasks have also been employed to measure various dimensions of impulsivity (Winstanley et al., 2003) including tasks measuring impulsive decision-making (impulsive choice) and those measuring impulsive action (behavioural

disinhibition). An example of the former is the delay discounting task that has been studied in animal models as well as human subjects (e.g., Mazur, 1987; Madden & Bickel, 2010). It assesses the participant's preference for smaller, immediate, and more certain rewards over larger, delayed, and less certain ones. Impulsive individuals are more likely to choose the more immediate and more certain rewards and given a certain delay, discount the larger and less certain reward faster relative to healthy controls (Rachlin & Green, 1972). Other behavioural measures of impulsivity are Go/No-Go paradigms that are widely used to test the behavioural-disinhibition of impulsivity. During these tasks, the participant is required to inhibit a prepotent behaviour or response. Consequently, the task provides a measure of behavioural control. Although various methods for assessing impulsivity have been employed in individual studies, research exploring the multifactorial nature of impulsivity using a variety of approaches simultaneously has been scarce.

The Current Study

Based on the majority of psychological and biological studies as well as neuroimaging and electrophysiological research, impulsivity is viewed as a multifactorial construct encompassing several independent factors. However, studies have been primarily focused on understanding the precise distinctions among related personality constructs of impulsivity. The present study assessed impulsivity using a variety of methods and theoretical paradigms, including self-report and objective performance measures of impulsivity. Areas assessed included (1) presence of adult ADHD symptoms, (2) planning and organizational skills, (3) impulsive personality traits, (4) impulsivity characterized by risk-taking behaviour, (4) behavioural disinhibition, and (5) delay discounting. The following research questions were addressed: (1) How do personality, cognitive, and behavioural measures of impulsivity relate to each other? (2) Is there a singular,

overarching impulsivity construct or are there subfactors that can be identified? and (3) What is the most reliable combination of measures for clinical purpose when assessing symptoms of ADHD, cluster B personality disorders, and substance and behavioural addictions in relation to impulsivity?

Research Hypotheses

Various measurement tools assess aspects of impulsivity that are qualitatively different from each other (Ervenden, 1999). The current study proposed an all-encompassing model that incorporated a variety of impulsivity facets stemming from personality, behavioural, and cognitive research. The aim was to explain the relations among these facets describing the impulsivity macroconstruct. Exploratory factor analysis was utilized to identify the relations among various impulsivity factors. The most parsimonious, theoretically-sound, model was adopted and interpreted.

Hypothesis 1. A hierarchical model was proposed in which each obtained factor was considered a facet of an overall impulsivity macroconstruct. In particular, significant positive paths were expected between the overarching impulsivity construct and the obtained facets of impulsivity in terms of (1) poor organization/planning, (2) personality, (3) risk-taking behaviour, (4) disinhibition, and delay discounting. Furthermore, measured variables (scores on the individual questionnaires and tasks) were expected to significantly load on their respective factors.

It was expected that a higher degree of organization and planning problems (e.g., presence of ADHD symptoms, poor organization, poor planning, and poor attention), a higher degree of impulsive personality traits (e.g., sensation seeking, antisocial personality traits, etc.), a tendency to engage in risky behaviours (alcohol, nicotine, and illicit drug use) as well as increased

behavioural disinhibition and delay discounting would produce a stronger relation within the Impulsivity construct.

Hypothesis 2. If the paths connecting latent variables to an overall impulsivity macroconstruct were non-significant, the hierarchical model would be adjusted to a multifactorial model that would allow indicators to load on only one factor. In this case, the obtained factors would be allowed to co-vary. This approach was the logical alternative to the hierarchical view of impulsivity. Consequently, the multifactorial model of impulsivity-like constructs was the proposed alternative model and presented the next step in the assessment of the model fit. An impairment in impulse control, as measured by personality and behaviour self-report questionnaires, performance tasks, and objective measures, was assumed to possibly reflect underlying neurocognitive impairment that might affect one's performance across numerous functional domains.

Methods

Participants and Procedure

Following approval from the Research Ethics Board and a Monte Carlo power analysis suggesting adequate power to detect the hypothesized statistical effects, 175 full-time and part-time students at the University of Windsor were surveyed using a computerized administration of questionnaires and performance tasks. This assumed at least medium effects for all paths, adequate reliability across measures, and power of 0.80 or greater for all paths. The participants were at least 18 years of age ($M = 23.71$, $SD = 7.65$). There were no restrictions based on race, socio-economic status, marital status, or neighborhood of residence. An invitation to participate in the study was sent via participant pool system within the Department of Psychology at the University of Windsor. Upon arrival at the testing session and as part of the informed consent

process, the participants were told that they would be asked to complete a series of questionnaires and performance tasks. They were told that the session would last approximately two and a half to three hours and that they would receive three psychology class bonus points following the completion of the questionnaires and tasks. If they agreed to continue, the following questionnaires and tasks were presented in randomized order: (1) demographics form, (2) Adult ADHD questionnaire, (3) Risk-Taking Behavior questionnaire, (4) On Time, Organization, and Planning questionnaire (ON-TOP), (5), Wisconsin Personality Disorders Inventory (WISPI-IV), (6) UPPS-P Impulsive Behavior Scale, (7) Barratt Impulsiveness Scale (BIS), (8) The Big Five Inventory (BFI), (8) a delay discounting questionnaire, (9) a delay discounting task, and (10) a Go/No Go task.

Measures

The process of choosing variables for the analysis relied on the “lexical hypothesis” (Goldberg, 1981) assuming that the most important variables in the impulsivity research are those that assess constructs used frequently in the communication among professionals and their clients. As such, these variables are inadvertently becoming part of our natural language. Additionally, we considered that the better the measures of the factors (e.g., they have high factor loadings) the fewer variables are needed to produce robust solutions (with a minimum of three variables per factor; Goldberg & Velicer, 2006).

Self-report questionnaires. The *demographic form* was used to collect basic demographic information (e.g. gender, age, race, employment, etc.) and substance use information (e.g. marijuana and smoking).

The *Attention Deficit/Hyperactivity Disorder Questionnaire-Report Scale-IV with Adult Prompts* (ADHD-RS-IV; Adler et al., 2006) is a self-rating scale designed to measure behaviours

commonly associated with ADHD in clinical settings. ADHD is a disorder defined by difficulty paying attention, inhibiting inappropriate responses, and hyperactivity (Barkley, 2002). ADHD-RS-IV is an upward age extension of a psychometrically valid measure primarily used for children and adolescents (DuPaul, Power, Anastopoulos, & Reid, 1998).

The *Risk-Taking Behavior Questionnaire* (see Appendix A) is a self-report measure of participants' engagement in and frequency of risky behaviour across five domains including (1) driving, (2) drugs/alcohol/cigarettes, (3) law breaking, (4) family, and (5) sexual behaviour. This unpublished measure was developed for the purposes of surveying about risk-taking behaviour in a related study of younger adolescents. For the purposes of this paper, sexual behaviour section was reduced to four from seven questions in order to tailor the questionnaire to the university population. The sample retained questions are a) Have you been paid for sexual activity? and b) Have you had sexual activity with more than one person in a 24-hour period?. Current population scores can be seen in Appendix A; Table 6.

The *On Time, Management, Organization, and Planning scale* (see Appendix B; ON-TOP; Marks, Wasserstein, & Solanto, 2011) is a self-report questionnaire that assesses the time management, planning, and organizational skills of adults at home and in professional settings. These skills are thought to be related to impulse control. Psychometric properties were analyzed via factor analysis that yielded a five factor solution that accounted for 48% of the variance (Marks et al., 2011). Factors were labeled as (1) Occupational Management – ability to meet deadlines, (2) Home Management – organization of the specific areas at home, (3) Neatness/Organization – organization of the living and working space in general, (4) Planning – ability to schedule activities and engage in exercise, and (5) Punctuality – arriving promptly to

work and social engagements. Furthermore, Planning factor was significantly and negatively associated with the DSM-IV ADHD Inattention subscales (Marks et al., 2011).

The *Wisconsin Personality Disorders Inventory* (WISPI-IV; Klein & Benjamin, 1996) is a self-report questionnaire derived from an interpersonal perspective on the DSM-IV personality disorders. It contains 214 items and provides scores for 11 personality scales including (1) Paranoid – fear that someone will attack you, (2) Schizoid – no fears of or wishes about others, (3) Schizotypal – fear of attacking others, (4) Histrionic – strong fear of being ignored and wish to be loved, (5) Narcissistic – extreme vulnerability to being ignored or criticized, (6) Antisocial – inappropriate desire to control others in detached manner, (7) Borderline – extreme fear of abandonment and need for nurturance, (8) Avoidant – strong fear of rejection and humiliation, (9) Dependent – significant submissiveness to dominant yet nurturing other, (10) Obsessive-Compulsive – fear of being accused of being imperfect or making a mistake, and (11) Passive-Aggressive – belief that others are incompetent and cruel in addition to seeing any form of authority as neglectful and inconsiderate. These scales coincide with DSM-IV Axis II Personality Disorders. When Smith, Klein, and Benjamin (2003) considered the Structured Clinical Interview for Axis II (SCID-II) and WISPI-IV dimensional scores, five of the eleven WISPI-IV scales were found to have good convergent and discriminant validity (the average r between profiles was .61 [median = .58] and correlations between corresponding PD scales were: a) mean diagonal $r = .48$ and b) mean off-diagonal $r = .18$). Furthermore, all but one of the effect sizes for the differences in WISPI-IV means between the groups with and without SCID-II diagnoses were large ($>.80$). For the purpose of this paper, only Cluster B scales were included in the analyses.

The *UPPS-P Impulsive Behavior Scale* (see Appendix C; Whiteside & Lynam, 2001) is a 59-item self-report inventory designed to assess four distinct pathways to impulsive behaviour including (1) Urgency – tendency to engage in impulsive acts while under negative affect, (2) Lack of premeditation – inability to think about and reflect upon negative consequences of behaviour, (3) Lack of perseverance – inability to remain focused on a task, and (4) Sensation seeking – tendency to seek out and enjoy new, exciting activities. For analysis, scores on each one of the measures, in addition to the total score, were obtained. To test the validity of the UPPS conceptualization of impulsivity, Whiteside, Lynam, Miller, and Reynolds (2005) administered the UPPS scale to individuals with borderline personality disorders (BPD), pathological gamblers (PG), individuals with alcohol abuse (AA) problems, and community controls. The findings supported the construct validity of four UPPS impulsivity-related traits and demonstrated that UPPS can adequately distinguish amongst the pathological groups as well as between those clinical groups and the community controls.

The *Barratt Impulsiveness Scale* (BIS; Barratt, 1985; Patton, Stanford, & Barratt, 1995) was administered to assess overall impulsivity. It is a self-report questionnaire composed of 30 items that are answered on a 4-point scale (4 indicating the most impulsive response). The total possible score ranges from 30 to 120 and the higher total scores correspond to higher impulsivity levels. BIS also contains three impulsivity subscales with good reliability and validity: (1) Motor impulsiveness involves acting without thinking, (2) Non-planning impulsiveness involves lack of planning for the future, and (3) Attentional impulsiveness is defined as an inability to focus attention or concentrate.

The *Big Five Inventory* (see Appendix D; BFI; John, Donahue, & Kentle, 1991; John, Naumann, & Soto, 2008) is a 44-item self-report questionnaire that assesses core elements of the

Big Five dimensions of personality. It uses short phrases based on the trait adjectives known to be prototypical markers of the Big Five and each dimension includes eight to ten items (John et al., 2008). It has been used frequently in research settings with limited administration time (Benet-Martinez & John, 1998). In U.S. and Canadian samples, the alpha reliabilities of the BFI scales range from .75 to .90 an average above .80 with three-month test-retest reliabilities ranging from .80 to .90, with an average of .85 (Rammstedt & John, 2007). The average validity correlation has been reported to be .55 (.67 for Extraversion, .60 for Openness, .52 for Neuroticism, .48 for Agreeableness, and .47 for Conscientiousness (John et al., 2008).

The *Delay Discounting Questionnaire, "Now or Later"* (see Appendix D; Kirby, Petry, & Bickel, 1999) is a hypothetical monetary-choice questionnaire asking individual preferences between smaller, immediate rewards and larger, delayed rewards varying in their value and time to be delivered. It contains a fixed set of 27 choice alternatives randomly presented and takes about five minutes to complete. Following administration, an interpolation of an estimate of the discounting rate (k) from the pattern of choices was calculated (Kirby et al., 1999).

Behavioural tasks. *Computer-based delay discounting task* (Myerson, Green, & Warusawitharana, 2001) is a computer-administered delay discounting task that requires the participants to choose between immediate and delayed outcomes. In addition, this procedure allows for the determination of the indifference points for different time lags between immediate and delayed reward. The time delays consist of one week, two weeks, one month, six months, one year, five years, and 25 years. Myerson and colleagues (2001) used area under the curve (AUC) technique to compute the dependent variable (the rate of discounting). The formula that was used is $(x_2 - x_1)[(y_1 - y_2)]$. y_1 and y_2 are subjective values associated with the successive

delays labeled as x_1 and x_2 . This calculation method is frequently reported in studies assessing delay discounting in substance abuse populations (e.g. Field, Christiansen, & Goudie, 2007).

The *computerized stop-signal task* is a modified version of the tasks used in the work of Logan and colleagues (Logan & Cowan, 1984; Williams, Ponesse, Schachar, Logan, & Tannock, 1999) and is presented on a computer. For the go-task, participants were presented with an “X” or “O” on the computer screen and had to press the corresponding button on the keyboard (left for “X” and right for “O”) as quickly as possible after seeing the symbol. Each go trial is preceded by a 500 ms fixation point (i.e., small square) presented at the center of the computer screen, followed by the letter, which remains on the screen for 1000 ms. The participants are instructed to not press O if four X’s appear in the row. These are stop-signal trials and occur approximately 25% of the trials. The experimental task consists of 192 trials divided into six 32-trial blocks. An equal number of X’s and O’s are presented in each block. The order of trial presentation is randomized separately for each individual. The reaction time and variability in responding were the dependent variables.

Data Analysis

Introduction to and justification for the model. The main aim of the current study was to identify a measurement model of impulsivity using a diverse set of assessment tools. Overall, it was hypothesized that impulsivity is a multifactorial construct that can be assessed in various ways within different areas of research including personality, behavioural, experimental, and cognitive studies. An illustration of the obtained, best-fitting model is presented in Figure 2.

Statistical analyses. The statistical analyses proceeded in three steps: (1) identifying the initial number of factors using the Principal Component Analysis (PCA), (2) finding the

measurement model using exploratory factor analysis (EFA), and (3) assessing model fit indices in order to ascertain the best fitting model.

First, PCA was conducted in order to identify variable clusters. This was necessary to understand the structure of the variables within the data set. The correlation matrix (see Table 2) was analyzed in order to ensure that the variables correlated well, but not perfectly. A four-component solution was chosen as a baseline model as per Kaiser-Guttman criterion of eigenvalues of at least 1 and upon examination of the Scree plot.

Second, EFA was conducted in order to identify the relation between the variables and the obtained clusters. It allowed for the assessment of the best fitting measurement model of impulsivity within the population of undergraduate students. The maximum likelihood estimation method was utilized to estimate the loadings of observed variables onto the latent factor due to its ability to identify latent factors and avoid capitalizing on unique item variance. With increasing sample size, maximum likelihood estimation method allows for increased probability that the estimator is close to the population parameter making it a highly consistent estimator. It is also an efficient estimator as it has a low error variance among results from random samples (Kline, 2011). Additionally, the observed variables were all continuous and therefore able to satisfy the assumption of multivariate normality necessary for this approach (Kline, 2011). Oblimin rotation was utilized as the factors were expected to correlate. Items that failed to load on any one factor, with loadings of less than 0.33, and those that significantly cross-loaded were removed from the final model. The goodness-of-model-fit was indicated by a Chi-Square (χ^2 ; Kline, 2011), the Root Mean Square Error of Approximation (RMSEA; Chen, Curran, Bollen, Kirby, & Paxton, 2008), the Comparative Fit Index (CFI; Hu & Bentler, 1999), the Tucker-Lewis Index (TLI; Hu & Bentler, 1999), and the Akaike Information Criterion (AIC;

Hu & Bentler, 1999). The final model retained two factors with 8 items, explaining 57.47% of the variance (see Figure 2). Finally, the fit of the alternative models was assessed using the RMSEA, CFI, TLI, and AIC: if dropping a factor reduced the goodness of fit (i.e. RMSEA and AIC increased; CFI and TLI decreased), the factor was retained in the model; otherwise, the more parsimonious model was chosen.

Results

Missing Data, Outliers, and the Assumption of Normality

The extent of missing data ranged from 1.7% (Delay Discounting task) to 17.1% (GoNo-Go task). The missing value analysis in the SPSS was conducted to describe the pattern of missing data. It was identified that the data were missing completely at random (Little's MCAR test: $\chi^2_{(90)} = 100.524, p = .210$). Expectation Maximization method gives consistent and unbiased estimates of the correlations and covariances when the data are missing completely at random (Howell, 2008). Therefore, it was used to impute the missing data. Using the Explore feature in the SPSS software package, the data were checked to determine whether the assumption of univariate normality had been violated. According to the accepted cutoff values for skewness (within two standard deviations), it was found that WISPI Cluster B total score and Kirby k had to be transformed using Log10 transformation due to extreme skewness. Finally, the data were also screened for outliers. Following an analysis of the lowest and highest values, several outliers were identified ($|z| > \pm 3.29$): (1) ADHD variable contained four outliers, (2) BIS Motor Impulsiveness variable contained one outlier, and (3) WISPI Cluster B variable contained 1 outlier. Since all of the z scores deviated by less than three standard deviation from the mean and the variables were normally distributed with the outliers included, the identified outliers were not removed. As such, we did not have to impute arbitrary values and were also better able

to preserve the true sample response style. Table 2 presents descriptive values for all the variables in the analysis.

Determination of the Best Fitting Model

The data were analyzed using both procedures, PCA and EFA, in order to ascertain the robustness of the structure to procedural variations (Goldberg, 1990). PCA was conducted in order to determine the number of clusters formed by 14 variables. According to the correlation matrix (see Table 2), all the variables significantly correlated with at least one other variable. Additionally, none of the correlations coefficients themselves were greater than .9, thus eliminating the problem of singularity within the data. The determinant of the correlation matrix was .015, which is greater than the necessary value of .0001, thus also ensuring that multicollinearity is not a problem for these data. Therefore, all measures of impulsivity correlated well with all others, none of the correlation coefficients were extreme, and there was no need to consider eliminating any variables at this stage. According to the Bartlett's test of sphericity ($KMO = .72, p < .001$), recommended to be at least .5, several relationships between the variables were obtained and could be appropriately explored with PCA (Kaiser, 1974). Following an oblique rotation, five components were obtained explaining 67.23% of the variance. EFA was conducted comparing one-, two-, three-, and four-factor models (see Table 4).

EFA identified a problem with stop-signal task reaction time variable that was producing negative residual variance. After setting the negative residual variance to 0 and 1, the model was not improved. Therefore, the stop-signal task was removed from the analysis. According to the EFA utilizing 13 variables (Model 1), the best fitting model with most theoretical consistency contained three factors (see Table 3). Six variables loaded on factor 1, five variables loaded on

factor 2, and four variables loaded on factor 3 (3 variables cross-loaded; see Figure 1). Table 5 summarizes subsequent analyses and associated model fit indices that yielded the best fitting model containing two factors. Within this table, Model 1 represented the previously obtained model with 13 variables (excluding stop-signal task reaction time) used as a baseline to move forward with the analysis. First, delay discounting AUC variable was removed because it did not load on any of the obtained factors (Model 2). Second, the delay discounting k variable was removed for the same reason (Model 3). Third, the stop-signal task reaction time variability variable was removed because it did not load on any of the factors in Model 3 (Model 4). Fourth, the BIS motor impulsiveness variable was removed due to its cross-loading and a poor-fitting model was obtained (Model 5). Fifth, the BIS motor impulsiveness variable was reintroduced to the model, but BFI neuroticism was removed due to its cross-loading on two factors. At this time, a poor-fitting model with two distinct factors was obtained (Model 6). Finally, the UPPS-P sensation seeking variable was removed due to its low loading on factor 2 (less than .33). The obtained model contained eight variables (five loaded on factor 1 and 3 loaded on factor 2) loading on two distinct, yet related factors (Model 7). This was a good-fitting model to the obtained data (see Figure 2). It is important to note that hierarchical model of impulsivity was tested (with two factors loading on the overarching latent variable), however, it did not converge. Therefore, the multidimensional nature of impulsivity was not demonstrated. Instead, impulsivity appears to be a multifactorial construct that spans several research domains including behavioural, personality, cognitive, and clinical facets.

The Best-Fitting Model

The final model, termed Model 7, pointed to two separate, yet related factors of impulsivity (see Figure 2). Observed variables that significantly loaded ($p < .001$) on the

obtained latent variables were kept. Factor 1 was significantly associated with Factor 2. Factor 1, termed Cognitive/Behavioural Impulsivity, included (1) cognitive aspects of impulsivity characterized by symptoms of ADHD and poor planning/organizing (ON-TOP) as well as (2) behavioural aspects of impulsivity characterized by impulsive decision-making (BIS Nonplanning), difficulties focusing on one task at a time (BIS Attentional), and acting on a whim (BIS Motor). Factor 2, termed Emotional/Relational Impulsivity, included symptoms of cluster B personality traits, tendency to act rashly when experiencing negative emotions, and tendency to engage in risky behaviour (e.g., drug and alcohol abuse, and unsafe sex), usually to cope with those negative emotions. Cognitive/Behavioural Impulsivity and Emotional/Relational Impulsivity although separate, were related. Therefore, impulsive decision-making, acting on a whim, and poor organizational skills were highly related to emotional dysregulation and vice versa.

Discussion

The focus of the present study was to extend the previous research to reveal a measurement model of impulsivity by utilizing a variety of measurement methods, including clinical tools for assessment of various syndromes, personality and risk-taking self-report questionnaires, behavioural tasks, and cognitive assessment of decision-making processes. The aim was also to identify how clinical, personality, behavioural, and cognitive measures of impulsivity relate to each other and to discuss the findings in terms of clinical implications for assessment and treatment of psychopathology. In support of the previous studies (Dawe et al., 2004; De Wit & Richards, 2004; Dickman, 1990; Smith et al., 2007; Winstanley et al., 2003), the model revealed unique facets of impulsivity. As an extension of the previous research, the obtained model revealed impulsivity to be multifactorial, combining work from clinical,

personality, behavioural, and cognitive research. In particular, two separate, yet related factors were termed cognitive/behavioural impulsivity and emotional/relational impulsivity suggesting that impulsivity taps into one's cognition and behaviour as well as temperament. It was important to create a new measurement model of impulsivity and to parse the construct of impulsivity into different components because each of these factors predicts different behavioural outcomes.

The Measurement Model of Impulsivity

These findings support the multifactorial model of impulsivity; the second hypothesis. In particular, impulsivity is conceptualized in cognitive/behavioural and emotional/relational terms. In addition, these two factors of impulsivity, although distinct, are positively related (see Figure 2). In particular, cognitive/behavioral impulsivity is thought to underlie many disorders including ADHD (Johansen et al., 2002; Sonuga-Barke et al., 1992), personality disorders (Buss & Plomin, 1975; Soldz & Vaillant, 1999; Whiteside & Lynam, 2001), and addiction (Coffey et al., 2003; Madden et al., 1999; Kirby et al., 1999; Kirby & Petry, 2004). Similarly, emotional/relational impulsivity is related to a variety of similar clinical presentations in addition to identifying adverse effects of dysregulated affect on interpersonal relationships. Thus far, a number of definitions of impulsivity and related concepts have been proposed. These “varieties of impulsivity” might be influenced by different biological mechanisms and consequently lead to different types of impulsive behaviour (Evenden, 1999). In his review, Evenden (1999) introduced the idea of a multifactorial nature of impulsivity and discussed reasons why various studies typically demonstrate (and seek out) a monolithic definition of impulsivity. In particular, he criticized the work of personality, experimental, psychiatric, and neurobiological researchers for the lack of communication across the fields that may have led to isolated views of impulsivity

construct. The current study extended Evenden's (1999) postulations about the "varieties of impulsivity" by conducting a comprehensive assessment of the many facets of impulsivity. In particular, measures of impulsivity were borrowed from personality, behavioural, experimental, cognitive, and clinical paradigms. The obtained model clearly demonstrated the multifactorial nature of impulsivity with two distinct, yet related factors.

Two Impulsivity Factors

Cognitive/behavioural impulsivity. In accordance with the obtained model, impulsivity can be defined and measured in several ways. First, measures of restlessness and inattention, poor planning and disorganization, as well as tendency to act on the spur of the moment composed a distinct aspect of impulsivity termed cognitive/behavioural impulsivity. In particular, impulsive individuals are highly likely to have difficulties with careful thinking and planning, experience lack of success during challenging mental tasks, and describe their lives as disorganized in various settings (e.g., room, office, kitchen, etc.). Furthermore, symptoms of inattention, hyperactivity, and impulsivity, characteristic of adults with ADHD, were associated with poor planning and organization and, by extension, are indicative of the overarching impulsivity construct. The usefulness of this finding is two-fold. First, it replicates previous findings that define impulsivity as an underlying neurocognitive characteristic of individuals with ADHD. These findings play an important role in the light of diagnostic changes for ADHD that will emerge with DSM-V as well as the need for better diagnostic criteria for Adult ADHD. In particular, poor planning and organization seem to be highly prevalent among the adults with symptoms of ADHD. Pursuing a career, raising a family, and running a household create greater demands on one's abilities to organize, focus, and remain poised. Consequently, assessment of these skills should be a common practice when screening for ADHD among adults. In addition,

treatment of impulsive traits in this population should target individual's planning and organization skills especially in stressful or highly demanding situations.

Emotional/relational impulsivity. A second facet of impulsivity, termed emotional/relational impulsivity, highlighted the importance of affect when assessing impulsivity. It was characterized by negative urgency, cluster B personality traits, and engagement in risky behaviour. These findings are in agreement with previous studies that have shown negative urgency to coincide with negative expectations (i.e., a belief that engagement in a certain activity would decrease negative emotions; Fischer & Smith, 2008) and, as an extension, predict a variety of problematic outcomes including aggression, alcohol abuse to reduce negative affect, substance use disorders, binge eating, and compulsive buying (Vardejo-Garcia, Bechara, Recknor, & Perez-Garcia, 2007). Furthermore, individuals who obtained high scores on the urgency subscale tend to act rashly while in positive or negative mood. Consequently, a dysregulated personality style was another indicator of impulsivity. This finding points to a link between emotion dysregulation and impulsivity. Measures of one's emotional stability should be incorporated in every assessment of psychopathology in order to inform treatment. It appears that certain individuals present with impulsive tendencies which are likely exacerbated during highly emotional events. As such, teaching coping strategies in this case are essential in order to target one's tendency to act without forethought.

In clinical studies, persistent desire or unsuccessful efforts to cut down or control substance abuse and spending a great deal of time in activities necessary to obtain the substance are indicative of the underlying impulsivity (DSM-IV; APA, 2000). Also, impulsivity is an underlying neurocognitive characteristic of individuals diagnosed with cluster B personality disorders who tend to have difficulty controlling their impulses, regulating emotions, and who

constantly seek attention and approval (DSM-IV; APA, 2000). The obtained model furthered these findings by linking one's propensity to engage in risky acts (e.g., substance abuse, drunk driving, unprotected sex, etc.) to characteristics of individuals with cluster B personality traits. In terms of assessment, individuals diagnosed with cluster B personality disorder should be screened for various types of substance and behavioural addictions as well as daily living skills. As a result of the underlying impulsivity, they would benefit from highly structured and goal-focused interventions that would equip them with strategies to overcome their behavioural problems before addressing the erratic personality style.

Relation between two factors of impulsivity. Although the obtained factors are separable, they are correlated, indicating a positive relationship between cognitions, behaviours, affect, and daily functioning. According to our model, individuals at risk for ADHD, who present with planning/organizing difficulties, and tend to act without thinking are likely to engage in risky behavior and have difficulties regulating their emotions. As such, tasks within all these different domains of one's performance assess a common, underlying, neurocognitive trait that can manifest itself in various ways. Previous researches have postulated that individuals with ADHD are driven more by the immediate actions and outcomes and have poor internal representations of time (Barkley, 1997). Our findings support such reasoning and agree that impulsivity may underlie the significant problems people with ADHD have with driving, such as speeding, vehicular crashes, and license suspensions (Barkley, 2002) as well as have greater risk for substance abuse (Flory et al., 2003).

Clinical Implications

The obtained multifactorial measurement model of impulsivity has significant implications for the treatment of impulsive behaviours. First, it enhances the understanding of

impulsivity in normal behaviour. Second, it provides links between several symptoms of psychopathology including cluster B personality traits, ADHD symptoms, and engagement in risky behaviour (e.g., substance abuse). Our results highlight the importance of utilizing multiple measures to examine the multifaceted construct of impulsivity and raise questions about how to best assess psychopathology in young adults.

Perhaps most interesting is the unique association between symptoms of adult ADHD and difficulties planning/organizing within the multifactorial model of impulsivity. This link bears a clear connection to Barkley's (2010) model of ADHD that introduces executive functioning as "those neuropsychological processes needed to sustain problem-solving toward a goal". Based on these results, an emphasis of treatment for adults with ADHD should be on learning organizational strategies and planning for the future events in order to enhance their functioning. In addition, behavioural changes necessitate environmental adjustments and accommodations as well (Barkley, 2010); these are all situations one needs to plan and organize for. It is also important for clinicians to be aware of how such behaviours (e.g., poor planning and organization) may affect treatment adherence and premature termination of therapy services.

Importantly, the obtained model identifies measures of obviously different kinds of impulsivity that can be used in a clinical practice. In particular, it is important to differentiate between cognitive/behavioural and emotional/relational impulsivity when conducting assessments and devising a treatment plan for a multitude of reasons. For example, engagement in risky-behaviour such as drug use and drunk driving seems to be associated with quick and irrational decision-making. Similarly, emotional experiences could also lead to behavioural manifestations of impulsivity, such as drug use. However, approaches to intervention for irrational decision-making tendencies and inability to regulate emotions differ significantly. For

example, cognitive-behavioural psychotherapeutic approach would attend to one's behavioural presentation by addressing client's cognitive style and delineating pros and cons of each decision. On the other hand, a clinician may take up a primarily emotion-focused approach to treating clients with excessive need for dangerous and stimulating acts in order to develop coping strategies.

Considering impulsivity as a result of these interacting factors may help clinicians and researchers better understand psychopathology. For example, if future research continues to support a two-factor model of impulsivity, theories of relations between psychopathology and impulsivity will be required to specify to which factor of impulsivity they are referring. As such, different facets of impulsivity might be associated with different aspects of substance abuse, antisocial behaviour, and impulsive decision-making. Clinically, this would help crystallize the understanding of the underlying impulsive style associated with each psychopathological presentation in order to inform intervention.

Limitations and Future Directions

The primary limitation of the current study is its use of an undergraduate student population largely without significant or severe psychopathology. As a result, no conclusions about the relation of this measure to psychopathology including pathological gambling, alcohol abuse, and severe personality disorders can be offered. Although we believe that impulsivity may make the individual more susceptible to these behaviours and personality traits, concrete evidence could not be obtained with the student population. It would be beneficial to replicate these findings amongst participants with clinical diagnoses of ADHD, substance abuse, and personality disorders.

Another limitation of the current study is that the majority of the assessment measures relied on self-report questionnaires in addition to two performance tasks. As such, certain factors could reflect two methods of measurement instead of different facets of impulsivity. Although this concern is attenuated by the presence of different measures within each factor, future studies should gather data on organizational, affective, personality, behavioural, and cognitive impulsivity using a balanced set of instruments with multiple reporters. This would avoid methodological issues common to self-report questionnaires and diversify the measurement method. For example, parent, teacher, and significant other ratings could help with clinical assessment of hyperactivity, inattention, and impulsivity in addition to performance measures such as stop tasks. Also, additional performance measures would better assess one's propensity to act impulsively and provide confirmatory data.

Although delay discounting has been associated with impulsivity (Dalley et al., 2007), discounting of delayed rewards did not load on the obtained impulsivity factors. This lack of association might be due to the conceptualization of delay discounting as higher order decision-making. Consequently, it involves separate biological processes and neuronal systems (Bickel et al., 2007) that most likely involve both, Cognitive and Emotional Impulsivity, factors. For example, McClure and colleagues demonstrated that preference for immediate reinforcement was associated with greater relative activation of aspects of the limbic and paralimbic brain regions, while preferences for delayed reinforcers were associated with greater relative activation by aspects of the prefrontal cortices (see Bickel, Pitcock, Yi, and Angtuaco, (2009) for a systematic replication).

Conclusions

Thus far, research has shown little unanimity as to what factors make up the overarching impulsivity construct (Evenden, 1999). By making use of measures from several different areas of research areas, we have demonstrated multifactorial nature of impulsivity construct across the different areas of psychological research and identified two separate, yet related factors of impulsivity. Taken together, the present findings and previous literature suggest that impulsivity may represent a core neurocognitive dysfunction contributing to a range of problems that can be manifested as (1) poor planning and organization, inattention, hyperactivity, acting on a whim, as well as (2) dysregulated affect and personality style, and engagement in risky and addictive behaviours. As such, this study is among the first to provide concrete evidence of multifactorial nature of impulsivity across theoretical orientations and point to importance of multisource assessment of impulsivity in clinical settings.

Table 1

Sample size, mean, standard deviation, and range for each variable

Measures/Observed variables	N ^a	# of missing values prior to imputation	M ^b	SD ^c	Range
BIS ^d Nonplanning impulsiveness	175	5	23.55	4.88	25.00
BIS ^d Attentional impulsiveness	175	5	16.75	4.06	21.00
BIS Motor impulsiveness	175	5	21.16	4.10	24.00
ON-TOP ^e Poor organization	175	5	89.07	23.80	137.00
BFI ^f Neuroticism	175	6	23.91	6.36	29.00
UPPS-P Urgency	175	5	27.08	6.50	33.00
UPPS-P Sensation seeking	175	5	33.31	7.86	36.00
Risk-taking questionnaire	175	6	16.33	9.62	46.00
WISPI ^g – Cluster B (log10)	175	8	2.16	.14	.75
Delay Discounting – Reversed AUC ^h	175	3	.58	.26	.98
Delay Discounting – k ⁱ (log10)	175	7	-1.72	.68	3.19
GoNo-Go RT ^j	175	30	349.26	60.79	403.66
GoNo-Go RT ^j variability	175	30	205.68	57.66	316.16
ADHD ^k Symptoms	175	5	81.37	44.26	251.00

^aN – sample size following imputation; ^bM – Mean; ^cSD – standard deviation

^dBIS – Barratt's Impulsiveness Scale; ^eON-TOP - On Time, Management, Organization, and Planning Scale (reversed scoring); ^fBFI – The Big Five Inventory; ^gWISPI - Wisconsin Personality Disorders Inventory (4th edition) – Cluster B style (log10); ^hAUC – Area under the curve (reversed scoring); ⁱk – Rate of discounting (log10); ^jSSRT – reaction time; ^kADHD – Attention Deficit/Hyperactivity Disorder

Table 2

Correlation matrix

	ADHD	BIS NP	BIS A	BIS M	ONTOP	WISPI B	BFI N	UPPS U	UPPS SS	DD AUC	DD k	RT	RT Var	Risk Q
ADHD	1													
BIS NP	.522	1												
BIS A	.694	.566	1											
BIS M	.403	.436	.485	1										
ONTOP	.308	.398	.287	.253	1									
WISPI B	.363	.198	.333	.289	.079	1								
BFI N	.304	.222	.242	-.150	.150	.171	1							
UPPS U	.384	.407	.390	.189	.168	.458	.479	1						
UPPS SS	.038	.078	.105	.271	-.019	.147	-.312	.065	1					
DD AUC	-.019	.067	-.044	.064	.073	.090	.040	.062	-.097	1				
DD k	-.127	-.098	-.046	.071	-.053	.027	-.149	-.139	.084	.178	1			
RT	.339	.233	.214	.131	.086	-.015	.224	.152	.060	-.131	-.143	1		
RT Var	.261	.084	.120	.146	.164	.103	.127	.119	-.033	-.002	-.088	.614	1	
Risk Q	.227	.243	.201	.240	.091	.336	.048	.324	.348	-.113	.069	.197	.046	1

Bolded numbers indicate significant correlation ($p \leq .05$)

ADHD – Attention Deficit/Hyperactivity Disorder ; BIS – Barratt’s Impulsiveness Scale (1) NP – Nonplanning, (2) A – Attentional, (3) M – Motor; ONTOP - On Time, Management, Organization, and Planning Scale (reversed scoring); WISPI - Wisconsin Personality Disorders Inventory (4th edition); BFI N – The Big Five Inventory – Neuroticism total score; UPPS-P U – Urgency; UPPS-P SS – Sensation Seeking; DD AUC – Delay Discounting Area under the curve (reversed scoring); DD k – Rate of discounting – Kirby’s k; RT – Reaction time; RT Var – Reaction time variability; Risk Q – Risk-taking questionnaire.

Table 3

Loadings on three factors following the initial EFA with 13 variables (Model 1)

Variable name	Sign	F1		F2		F3	
		β	<i>P</i>	β	<i>p</i>	β	<i>p</i>
Adult ADHD	Y1	.788	.000				
BIS Nonplanning	Y2	.647	.000				
BIS Attentional	Y3	.846	.000				
BIS Motor	Y4	.653	.000	.442	.000		
ON-TOP	Y5	.454	.000				
WISPI Cluster B (log10)	Y6					.538	.000
BFI Neuroticism	Y7			-.788	.000		
UPPS-P Urgency	Y8			-.343	.004	.708	.000
UPPS-P Sensation seeking	Y9			.524	.000	.338	.024
DD AUC Reversed	Y10						
Kirby k (log10)	Y11			.205	.022		
Stop-signal task RT Var.	Y12	.219	.048				
Risk-taking questionnaire	Y13					.595	.000
F1 with F3		.563	.000				

Y1 – ADHD symptoms total score; Y2 – BIS Nonplanning total score; Y3 – BIS Attentional total score; Y4 – BIS Motor total score; Y5 – ON-TOP Total score; Y6 – WISPI – Cluster B total score (log10); Y7 – BFI – Neuroticism total score; Y8 – UPPS-P Urgency total score; Y9 – UPPS-P Sensation seeking total score; Y10 – Delay discounting – Area under the curve (reversed); Y11 – Delay discounting – Kirby k (log10); Y12 – Stop-signal task reaction time variability; Y13 – Risk-taking questionnaire total score.
n – indicates a negative loading

Table 4

Model fit indices (Initial EFA: The best-fitting model with 3 factors – Model 1; see Figure 1)

Model	χ^2	Df	<i>p</i> value	RMSEA	RMSEA 90% C.I.	CFI	TLI	AIC
1 factor	222.299	65	.000	.118	.101-.135	.701	.641	13065.06
2 factors	125.413	53	.000	.088	.068-.108	.862	.798	12992.18
3 factors	66.910	42	.009	.058	.030-.084	.953	.912	12955.67
4 factors	45.985	32	.052	.050	.000-.080	.973	.935	12954.75

χ^2 – Chi Square; Df – degrees of freedom; *p* – significance value; RMSEA – Root Mean Square Error of Approximation; RMSEA 90% C.I. – 90% confidence interval; CFI – Comparative Fit Index; TLI – Tucker Lewis Index; AIC – Akaike Information Criterion

Table 5

Model fit indices (Second set of EFAs: Models 1-7)

Model	χ^2	Df	<i>p</i>	RMSEA	RMSEA 90% C.I.	CFI	TLI	AIC	# of factors
Model 1 (remove RT)	66.910	42	.009	.058	.030- .084	.953	.912	12955.67	3
Model 2 (remove AUC)	46.503	33	.060	.048	.000- .079	.974	.948	12927.96	3
Model 3 (remove k)	40.336	25	.027	.059	.020- .092	.970	.935	12562.40	3
Model 4 (remove RT var.)	29.728	18	.040	.061	.013- .099	.977	.942	10646.11	3
Model 5 (remove BIS motor)	24.564	12	.017	.077	.032- .121	.970	.911	9734.38	3
Model 6 (return BIS motor; remove BFI)	49.503	21	.000	.088	.056- .120	.932	.883	9592.19	2
Model 7 (remove UPPS-P SS; Figure 2)	33.460	19	.021	.066	.025- .102	.963	.945	8378.17	2

χ^2 – Chi Square; Df – degrees of freedom; *p* – significance value; RMSEA – Root Mean Square Error of Approximation; RMSEA 90% C.I. – 90% confidence interval; CFI – Comparative Fit Index; TLI – Tucker Lewis Index; AIC – Akaike Information Criterion

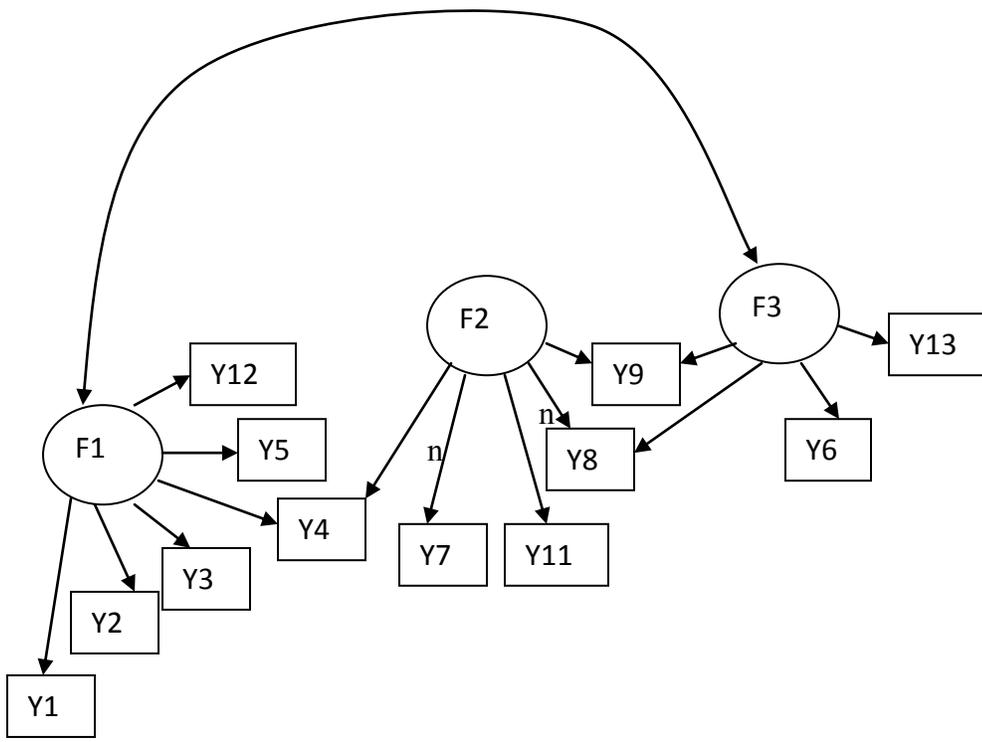


Figure 1. Exploratory factor analysis pointed to at least three facets of impulsivity (Model 1). Y1 – ADHD symptoms total score; Y2 – BIS Nonplanning total score; Y3 – BIS Attentional total score; Y4 – BIS Motor total score; Y5 – ON-TOP Total score; Y6 – WISPI – Cluster B total score (log10); Y7 – BFI – Neuroticism total score; Y8 – UPPS-P Urgency total score; Y9 – UPPS-P Sensation seeking total score; Y10 – Delay discounting – Area under the curve (reversed); Y11 – Delay discounting – Kirby k (log10); Y12 – Stop-signal task reaction time variability; Y13 – Risk-taking questionnaire total score. n – indicates a negative loading

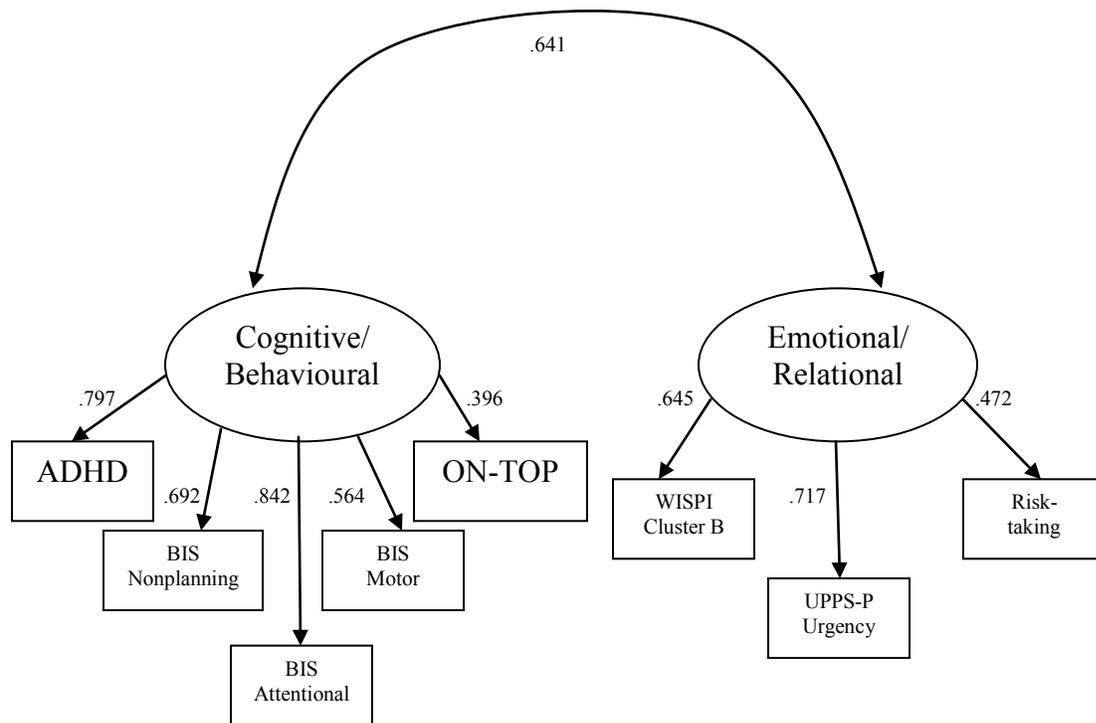


Figure 2. Exploratory factor analysis yielded a well-fitting, two-factor model (Model 7). Two factors are distinct, yet related; ADHD questionnaire total score – high scores indicate high levels of symptoms of ADHD; BIS Nonplanning – Barratt Impulsivity Scale Nonplanning Impulsiveness total score – high scores indicate impulsive decision-making; BIS Attentional – Barratt Impulsivity Scale Attentional Impulsiveness total score – high scores indicate inability to pay attention to detail and focus; BIS Motor – Barratt Impulsivity Scale Motor Impulsiveness total score – high scores indicate inability to resist temptation and tendency to act on a whim; ON-TOP questionnaire total score – high scores indicate poor planning and organizing; WISPI Cluster B total score (log10) – high scores indicate endorsement of traits typical of people with Cluster B personality disorders; UPPS-P Urgency total score – people with high scores are likely to act on the spur of the moment without premeditation about the consequences; Risk-taking questionnaire total score – high scores indicate one’s propensity to engage in risky behaviour (e.g., drug and alcohol use, speeding, unsafe sex, etc.)

* $p < .001$ (for all loadings and relations in the model)

CHAPTER 5

General Discussion

The overall aim of this research project was to assess the relations between impulsivity and mental health across the life span. Specifically, I hoped to identify early risk factors for the development of personality disorders, affective problems, ADHD, substance abuse, behavioural addictions, and other dysfunctional outcomes. Next, I sought to inform assessment and treatment by identifying various impulsive behaviours and tendencies that may differ in their relation to psychopathology. Finally, I hoped to add to the research literature about the multifactorial nature of impulsivity across theoretical orientations. Consequently, three studies were conducted in order to (1) assess developmental progression of impulsivity and personality using an extensive and already existing data set, (2) assess developmental progression of impulsivity in terms of reward-seeking and emotional dysregulation using a separate, but equally extensive and well-documented secondary data set, and (3) conduct a multidimensional study to assess the nature of impulsivity construct.

The primary aim of the first study was to explore the developmental progression of impulsivity and personality factors, as well as the predictive association between these two macroconstructs. The obtained model was consistent with the previous research studies that have found childhood externalizing psychopathology to be associated with difficulties later in life (Miller et al., 2008; Murphy & Barkley, 1996). It extended previous work by identifying specific early life behaviours, cognitions, and personality styles that present as risk factors for psychopathology within a developmental context. The results suggested that young adolescents who had difficulties with delaying gratification were likely to become older adolescents who used illicit drugs and engaged in antisocial acts. Additionally, the model identified that children

with tendencies to be irritable, give up easily under frustration, and appear anxious are more likely to make impulsive decisions during early adolescence that, in turn, may lead to drug use and antisocial behaviour later in life. This finding has important implications for prevention programs and treatment development. Specifically, educating parents about early identification of problem behaviours may help to recognize children at-risk and provide early intervention with an aim of reducing adjustment difficulties later in life. Finally, the model revealed that at any point during adolescence, impulsivity may lead to irritable and guilt-prone personality style that in turn can enhance one's propensity to engage in risky behaviour and substance abuse.

The primary goal of the second study was to formulate an integrated model of emotion regulation that would include the additive and/or interactive effects of multiple vulnerability factors. In particular, the exploration of the developmental progression of impulsivity, conceptualized as reward-seeking, and emotion dysregulation, as well as the predictive association between these two constructs was conducted. Overall, the obtained developmental model revealed childhood reward-seeking as a risk factor that predicts subsequent difficulties with adjustment and functioning. These results can be broken down into several more specific findings. First, the developmental progression of reward-seeking and emotion dysregulation from childhood to early adulthood was obtained. According to the model, children who had trouble delaying gratification and actively sought out the immediate rewards as a coping method were highly likely to become reward-seeking adolescents. These difficulties continued into young adulthood and were associated with illicit drug use. Similarly, children who were emotionally dysregulated, as evidenced by becoming upset easily and having a bad temper, were at substantial risk for becoming emotionally dysregulated adults who often feel isolated and have many fears. Second, predictive associations between these two constructs were obtained across

the life span. Specifically, reward-seeking and emotion dysregulation were likely to co-occur and interact to enhance risk for psychopathology among impulsive children and adolescents. Finally, predictive associations between these constructs were also obtained across the life span indicating that impulsive and emotionally dysregulated adolescents who were transitioning into adulthood were more likely to become young adults who have problems at school/work and who may experiment with illicit drugs.

In summary, the obtained models provide evidence for a developmental progression of personality disorders and emotion dysregulation secondary to an underlying neurocognitive propensity termed impulsivity. In particular, the analyses identified early life risk factors such as inability to delay gratification and reward-seeking for development of psychopathology at subsequent ages. According to the models, these childhood characteristics may lead to persistent difficulties at school/work as well as addiction. Parents and children would benefit by being able to identify children as early as possible and target specific behaviours to reduce the risk for subsequent psychopathology. In particular, children can be taught various coping strategies to regulate their responses in frustrating situations and reduce fearfulness, as well as improve their ability to sustain attention. These strategies should be age appropriate and the skills learned during childhood could be bolstered with additional training sessions as the child becomes older. Furthermore, the obtained models could inform the prevention programs that, in turn, are employed for parent education about child development and indicators of future risk. As such, parents would become knowledgeable about often subtle differences between typical and atypical child development. Finally, once parents identify their children as being at-risk for poor adjustment later in life, they should monitor the choices their children and adolescents make. Inappropriate decisions may lead to involvement with delinquent peers and/or participation in

risky settings; both situations may, in turn, exacerbate one's probability of development of psychopathology.

A major limitation of the two studies using secondary data was that the analysis relied on the databases that were not designed specifically to address the constructs of interest. In terms of the first study that assessed the developmental progression of impulsivity and personality development, only certain measures of delay of gratification were available during childhood and early adolescence and correlates of impulsivity were available during late adolescence. In terms of the second study that assessed the developmental progression of impulsivity/reward-seeking and emotion dysregulation, only certain items addressed negative affectivity during childhood, adolescence, transition to adulthood, and young adulthood. It is possible that significant effects were not observed between childhood and early adolescence impulsivity in the first study and between impulsivity during adolescence and transition to adulthood in the second study because the measurement of these constructs were very different. Specifically, in the first study, the ability to delay gratification during childhood and early adolescence was measured by the number of candies eaten and the amount of money obtained following certain tasks, respectively. In the second study, the impulsivity construct during adolescence focused primarily on reward-seeking while the impulsivity construct during transition to adulthood referred to antisocial-type of behaviour and drug use. Consequently, it is uncertain whether the lack of relationship is a function of measurement issues or a true lack of association. However, given previous research findings that have identified impulsivity to be an underlying neurocognitive characteristic of antisocial behaviour and substance use, the latter possibility is thought to be less likely.

Nevertheless, it is important to note that even when measured by vastly different indicators, the hypothesized associations between impulsivity during other age groups in both

studies were significant in the predicted direction, suggesting that a significant effect might have been found between impulsivity during adolescence and transition to adulthood if better indicators were used. Future research should strive to measure all of the constructs in a way that more closely reflects their interrelatedness through the use of indicators that are more congruent with each other. In addition, a number of definitions of impulsivity and related concepts have been proposed (Evenden, 1999). These “varieties of impulsivity” might be influenced by different biological mechanisms and consequently lead to different types of impulsive behaviour (Evenden, 1999). Future studies should explore developmental progression of impulsivity and its relation to personality development and emotion dysregulation utilizing yet another approach to conceptualizing impulsivity. Prior to conducting such well-designed, longitudinal studies of pathological behaviour and cognitive style, a model employing measures from various theoretical orientations to assess the proposed “varieties of impulsivity” should be obtained.

Following the acknowledged limitations of the first two studies, I conducted the third study that explored the multifactorial nature of impulsivity by utilizing a variety of measurement methods including clinical tools for assessment of various syndromes, personality and risk-taking self-report questionnaires, behavioural tasks, and cognitive assessment of decision-making processes. The obtained model revealed two distinct, yet related impulsivity factors. Cognitive/Behavioural factor comprised measures of planning and organizing, impulsive personality characteristics, as well as symptoms of ADHD. Emotional/Relational factor comprised engagement in risky behaviour, rashness in decision-making, as well as symptoms of Cluster B personality disorders. Overall, the factors differentiated between underlying cognitive and behavioural tendencies for poor planning/organizing, behavioural disinhibition, engagement in risky behaviour, and affective dysregulation.

In relation to the initial two studies, results from the third study provide evidence for multiple conceptualizations of impulsivity and methods of determining childhood risk for psychopathology later in life. First, future researchers should be clear about whether they are tracking the developmental progression of cognitive (difficulty delaying gratification or rewards) or behavioural (disinhibition and risk-taking behaviours) impulsivity. Second, they should utilize the most appropriate dysfunctional behaviours as indicators of each variety of impulsivity (e.g., symptoms of ADHD with planning/organizing measures and risk-taking with measures of Cluster B personality traits). Finally, although the obtained model supports the existence of two distinct factors, it is important to remember that they are related. As such, they are assessing a common, underlying, neurocognitive trait that can manifest itself in various ways across the life span (e.g., dysfunctional personality style and/or emotion dysregulation).

Overall Limitations and Future Directions

Although the third study addressed the most significant limitation of the first two studies, several limitations and suggestions for the future research remain. First, researchers assessing longitudinal relations between impulsivity and development of human regulatory systems should consider using more experimental approaches to measure impulsivity. For example, studies that compare discounting of delayed gains and losses have consistently shown that larger rewards are discounted more steeply than smaller ones (Green & Myerson, 2004). Interestingly, this finding was observed with monetary rewards as well as food and beer (Estle et al, 2007), illicit substances (Perry & Carroll, 2008), and medical treatments (Chapman, 1996).

Second, in the first study specifically, there was a large number of missing data points which compromised the power to find smaller effects. It is usually not recommended to conduct structural equation modeling with a sample size less than 100 (Kline, 2011). Consideration of

the effects across time, however, like in repeated measures, provided some extra power to compensate for this issue. Also, highly pragmatic missing data estimation approaches for structural equation modeling were utilized, such as FIML for the first study and EM for the second study, which have been shown to produce unbiased parameter estimates and standard error when the data is missing at random or completely at random. Nonetheless, significant associations that were revealed are notable given that power was compromised to find these effects. Future research should look at the hypothesized associations using a larger sample size with complete data and the obtained findings can serve as pilot data to suggest ideas for larger studies.

In terms of the third study, the primary limitation is its use of an undergraduate student population largely without significant psychopathology at a single time-point. As a result, no conclusions about the relation of this measure to pathological gambling, alcohol abuse, and severe personality disorders can be offered. Additionally, the study could not assess longitudinal relations within the data. Although we believe that impulsivity may make the individual more susceptible to these behaviours and personality style, concrete evidence could not be obtained with the student population. It would be beneficial to replicate these findings amongst participants with clinical diagnoses of ADHD, substance abuse, and personality disorders. Finally, the third study relied primarily on the self-report assessment measures in addition to two performance tasks. As such, certain factors could reflect two methods of measurement instead of different facets of impulsivity. Although this concern is attenuated by the presence of two factors comprising various assessment tools within each, future studies should gather data on organizational, affective, personality, behavioural, and cognitive impulsivity using a balanced set of instruments with multiple reporters. This would avoid methodological issues common to self-

report questionnaires and diversify the measurement method. For example, parent, teacher, and friend ratings could help with clinical assessment of hyperactivity, inattention, and impulsivity in addition to performance measures such as stop tasks. Also, additional performance measures would better assess one's propensity to act impulsively and provide confirmatory data.

For the purposes of future research, a clear delineation of impulsivity concepts such as delay of gratification, delay discounting, and reward-seeking should be available. Within the delay of gratification paradigm, impulsivity is viewed as an inability to resist an immediate reward despite the more desirable delayed reward. Delay discounting measures one's inability to delay gratification with increasing delay. It takes into account the diminishing value of a reward with an increasing delay of its receipt. In other words, weighs in the possibility that some consequences are delayed and hence must be anticipated and discounted. Finally, reward-seeking is conceptualized as a personality characteristic and a dimension of Cloninger's tridimensional personality theory. As such, it has been found to play an important part in one's predisposition to as well as maintenance of certain disorders. The research field would benefit from imaging studies that assess the neuroanatomical underpinnings of decision-making. Identified overlaps would suggest areas most significant for prevention and intervention purposes.

Overall Clinical Implications

Despite the limitations of the three studies, the results present three models with important clinical implications. First, there is a heterotypic continuity of impulsivity across the life span. If someone is impulsive as a child, they probably will present with problems later in life. According to the first model, children identified as easily frustrated, with brittle ego defenses, and lacking insight are at-risk for becoming young teenagers who are likely to make

impulsive decisions for the sake of receiving an immediate reward. Adolescents in their early teens who present with similar dysregulated personality style tend to remain dysregulated in the upcoming years. Similarly, the second model defines an association between childhood inability to regulation emotions and impulsivity in terms of reward-seeking across the life span. In particular, anxious and fearful children who tend to get into accidents, cannot delay gratification, and have trouble paying attention are at an increased risk of becoming adolescents and young adults with similar issues.

Second, there are numerous ways to measure impulsivity and clinicians should target the method that fits best with the question they are asking. According to results from the third study, the multifactorial model of impulsivity links specific facets of impulsivity to various forms of psychopathology including personality disorders, ADHD, and engagement in risky behavior. Importantly, the obtained model identifies measures of evidently different types of impulsivity that can be used in a clinical practice. In particular, it is important to differentiate between cognitive and behavioural impulsivity when conducting assessments and devising a treatment plan for a multitude of reasons. For example, approaches to intervention of sensation-seekers who tend to drink and drive would be highly different from those offered to individuals who use illicit substances because they most likely have difficulties delaying gratification.

Finally, the obtained models demonstrate that impulsivity is not just a behaviour. In addition to primarily behavioural manifestations, impulsivity can also present as a dysfunctional cognitive style, inability to plan and organize, dysregulated affect, and neurotic personality style. As such, impulsivity impacts multiple areas of functioning, which deserve assessment and well-tailored treatment. For example, early identification of a particular impulsive style can allow for implementation of the prevention programs to teach children various coping strategies such as

organizational skills, emotion regulation strategies, and cognitive reframing depending on each child's needs. These children and their parents would benefit from extra support and early intervention to reduce the risk of long-term poor outcomes such as difficulties at school/work, engagement in risky behaviours, and addiction.

Conclusions

Thus far, research has primarily employed cross-sectional methodology (Green et al., 1994) or obtained only two time points during one's development (Anokhin et al., 2010; Miller et al., 2008) to address the developmental progression of impulsivity and the associated mental health problems. Within this document, the initial two studies employed data that spanned 30 years of one's development in order to explore the same questions. The models obtained provided compelling evidence to show that childhood difficulties are likely to persist during adolescence and early adulthood. Specifically, impulsive children tend to become impulsive adolescents and young adults. During their development, they are also more likely to engage in dysfunctional relationships and enter risky situations that may further exacerbate their underlying impulsive tendencies. Unless proper interventions are implemented in a timely manner, impulsive children are less likely to learn proper coping strategies to regulate their emotions. As such, they are at an increased risk of becoming emotionally dysregulated adults with fearful and anxious personality style.

The third study assessed the proposed "varieties of impulsivity" spanning several theoretical orientations. Measures were borrowed from research areas including personality, experimental, clinical, and neurobiological studies. The third model revealed a multifactorial nature of impulsivity. In particular, two distinct, yet related factors assessed one's planning/organizing skills, symptoms of ADHD, affect, personality, disinhibition, and

engagement in risky behaviours. As such, this study is among the first one's to provide concrete evidence of multifactorial nature of impulsivity across theoretical orientations and point to importance of multisource assessment of impulsivity in clinical settings. Together, the three studies identify early childhood risk factors for subsequent problems functioning and adjustment problems, inform clinical practice by providing areas during child development that could be targeted for prevention, and inform future research about the complex nature of impulsivity.

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Appendix A

Risk-Taking Behaviour Questionnaire

Please indicate which behaviours you have engaged in over the LAST **SIX MONTHS**.

N / Y

HOW OFTEN?

DRIVING

Have you exceeded the speed limit? [1] NO [2] YES Never Once

2-5 times 6-10 times 11 or more times

Have you NOT worn a seatbelt in a moving car? [1] NO [2] YES Never Once

2-5 times 6-10 times 11 or more times

Have you driven without a license? [1] NO [2] YES Never Once

2-5 times 6-10 times 11 or more times

Have you been a passenger with a drunk driver? [1] NO [2] YES Never Once

2-5 times 6-10 times 11 or more times

Have you ever driven after drinking? [1] NO [2] YES Never Once

2-5 times 6-10 times 11 or more times

DRUGS/ALCOHOL/CIGARETTES

Have you smoked marijuana? [1] NO [2] YES Never Once

2-5 times 6-10 times 11 or more times

Have you used cocaine or crack? [1] NO [2] YES Never Once

2-5 times 6-10 times 11 or more times

Have you used heroine or another illegal opiate? [1] NO [2] YES Never Once

2-5 times 6-10 times 11 or more times

Have you used inhalants (e.g. "huffing") [1] NO [2] YES Never Once

2-5 times 6-10 times 11 or more times

Have you used prescription drugs not prescribed by a doctor or that were not prescribed for you?

[1] NO [2] YES Never Once

2-5 times 6-10 times 11 or more times

Have you consumed alcohol? [1] NO [2] YES Never Once

2-5 times 6-10 times 11 or more times

Have you smoked cigarettes? [1] NO [2] YES Never Once

2-5 times 6-10 times 11 or more times

Have you used any other illegal drug? [1] NO [2] YES Never Once

2-5 times 6-10 times 11 or more times

LAW BREAKING

Have you broken any laws with non-violent behaviour (e.g., shoplifting)?

[1] NO [2] YES Never Once

2-5 times 6-10 times 11 or more times

Have you broken any laws with violent behaviour (e.g., assault with or without a weapon)?

[1] NO [2] YES Never Once

2-5 times 6-10 times 11 or more times

Have you ever broken probation or other legal agreement?

[1] NO [2] YES Never Once

2-5 times 6-10 times 11 or more times

Have you had an interaction with the police that resulted in arrest or detainment?

			[1] NO	[2] YES	Never	Once
2-5 times	6-10 times	11 or more times				
FAMILY RULES BROKEN						
Have you broken any rules set by your family (e.g., curfew)?						
			[1] NO	[2] YES	Never	Once
2-5 times	6-10 times	11 or more times				
SEXUAL BEHAVIOUR						
Have you had sexual intercourse?						
			[1] NO	[2] YES	Never	Once
2-5 times	6-10 times	11 or more times				
Have you had oral sex?						
			[1] NO	[2] YES	Never	Once
2-5 times	6-10 times	11 or more times				
Have you had anal sex?						
			[1] NO	[2] YES	Never	Once
2-5 times	6-10 times	11 or more times				
Have you NOT used a condom or any other barrier method when engaged in sexual activity with a partner?						
			[1] NO	[2] YES	Never	Once
2-5 times	6-10 times	11 or more times				
Have you been paid for sexual activity?						
			[1] NO	[2] YES	Never	Once
2-5 times	6-10 times	11 or more times				
Have you had sexual activity with more than one person in a 24-hour period?						
			[1] NO	[2] YES	Never	Once
2-5 times	6-10 times	11 or more times				
Age at first sexual intercourse? _____ years						
Total life-time number of sexual partners? _____						

Table 6

Mean (standard deviation) scores on risk-taking behaviour questionnaire

	Driving	Drugs/Alcohol/ Cigarettes	Law breaking	Sexual Behaviour	Risk-taking total score
Gender					
Female	6.01 (3.69)	5.24 (4.24)	.30 (.86)	3.01 (2.74)	15.91 (9.48)
Male	6.80 (5.33)	6.67 (4.14)	.70 (1.12)	3.07 (2.73)	19.07 (10.54)
Employed					
Yes	6.71 (3.87)	6.01 (4.30)	.41 (1.00)	3.29 (2.74)	17.91 (9.28)
No	5.35 (4.14)	4.75 (4.09)	.31 (.80)	2.61 (2.69)	14.40 (10.03)
Education					
High School	5.49 (4.25)	4.78 (4.46)	.40 (.96)	1.68 (2.01)	13.78 (9.84)
Some college	10.00 (2.94)	8.25 (2.87)	.00 (.00)	4.00 (1.15)	23.00 (7.70)
College	5.06 (2.66)	6.82 (4.17)	.12 (.48)	3.88 (3.00)	17.29 (8.34)
Some university	6.38 (4.02)	5.44 (4.18)	.42 (.98)	3.24 (2.82)	16.99 (9.89)
University	6.70 (4.88)	5.30 (4.50)	.30 (.95)	3.90 (2.77)	17.40 (9.61)

Appendix B

ON-T.O.P. Questionnaire:

On Time management, Organization, and Planning

Compared to other adults, how well do you feel you do each of the following?

Please check NA for “Not Applicable” if the item does not apply to you (e.g., if you do not work) or if you are not the person primarily responsible for maintaining the organization or neatness of a given area within your home.

	Far below	below	Slightly below	average	slightly above	far above	NA
Organize the following areas at home							
1. Study/Desk/Work Space	_____	_____	_____	_____	_____	_____	_____
2. Kitchen	_____	_____	_____	_____	_____	_____	_____
3. Bedroom	_____	_____	_____	_____	_____	_____	_____
4. Closets	_____	_____	_____	_____	_____	_____	_____
5. Living/Family Room	_____	_____	_____	_____	_____	_____	_____
Remember social engagements	_____	_____	_____	_____	_____	_____	_____
Meet long-term (e.g., monthly) deadlines at work	_____	_____	_____	_____	_____	_____	_____
Meet weekly deadlines at work	_____	_____	_____	_____	_____	_____	_____
Maintain neatness of the following areas at home							
1. Study/Desk/Work Space	_____	_____	_____	_____	_____	_____	_____
2. Kitchen	_____	_____	_____	_____	_____	_____	_____
3. Bedroom	_____	_____	_____	_____	_____	_____	_____
4. Closets	_____	_____	_____	_____	_____	_____	_____
5. Living/Family Room	_____	_____	_____	_____	_____	_____	_____
Arrive promptly for business appointments	_____	_____	_____	_____	_____	_____	_____
Locate personal belongings at home	_____	_____	_____	_____	_____	_____	_____
Remember business appointments	_____	_____	_____	_____	_____	_____	_____
Have a plan for each day	_____	_____	_____	_____	_____	_____	_____
Maintain quality of long-term projects at work	_____	_____	_____	_____	_____	_____	_____
Pay bills promptly and accurately	_____	_____	_____	_____	_____	_____	_____
Take care of personal grooming	_____	_____	_____	_____	_____	_____	_____
Locate materials at work	_____	_____	_____	_____	_____	_____	_____
Engage in regular exercise	_____	_____	_____	_____	_____	_____	_____
Stick to a budget for spending money	_____	_____	_____	_____	_____	_____	_____
Complete daily to do list	_____	_____	_____	_____	_____	_____	_____
Make progress toward personal goals	_____	_____	_____	_____	_____	_____	_____
Maintain quality of daily work (e.g., complete/accurate)	_____	_____	_____	_____	_____	_____	_____
Meet daily deadlines at work	_____	_____	_____	_____	_____	_____	_____
Complete long-term projects at home	_____	_____	_____	_____	_____	_____	_____
Do your daily work efficiently	_____	_____	_____	_____	_____	_____	_____
Arrive promptly for social engagements	_____	_____	_____	_____	_____	_____	_____

Appendix C

UPPS-P

Below are a number of statements that describe ways in which people act and think. For each statement, please indicate how much you agree or disagree with the statement. If you **Agree Strongly** write **1**, if you **Agree Somewhat** write **2**, if you **Disagree somewhat** write **3**, and if you **Disagree Strongly** write **4**. Be sure to indicate your agreement or disagreement for every statement below. Also, there are questions on the following pages.

1. I have a reserved and cautious attitude toward life.
2. I have trouble controlling my impulses.
3. I generally seek new and exciting experiences and sensations.
4. I generally like to see things through to the end.
5. When I am very happy, I can't seem to stop myself from doing things that can have bad consequences.
6. My thinking is usually careful and purposeful.
7. I have trouble resisting my cravings (for food, cigarettes, etc.).
8. I'll try anything once.
9. I tend to give up easily.
10. When I am in great mood, I tend to get into situations that could cause me problems.
11. I am not one of those people who blurt out things without thinking.
12. I often get involved in things I later wish I could get out of.
13. I like sports and games in which you have to choose your next move very quickly.
14. Unfinished tasks really bother me.
15. When I am very happy, I tend to do things that may cause problems in my life.
16. I like to stop and think things over before I do them.
17. When I feel bad, I will often do things I later regret in order to make myself feel better now.
18. I would enjoy water skiing.
19. Once I get going on something I hate to stop.
20. I tend to lose control when I am in a great mood.
21. I don't like to start a project until I know exactly how to proceed.
22. Sometimes when I feel bad, I can't seem to stop what I am doing even though it is making me feel worse.
23. I quite enjoy taking risks.
24. I concentrate easily.
25. When I am really ecstatic, I tend to get out of control.
26. I would enjoy parachute jumping.
27. I finish what I start.
28. I tend to value and follow rational, "sensible" approach to things.
29. When I am upset I often act without thinking.
30. Others would say I make bad choices when I am extremely happy about something.
31. I welcome new and exciting experiences and sensations, even if they are a little frightening and unconventional.
32. I am able to pace myself so as to get things done on time.

33. I usually make up my mind through careful reasoning.
34. When I feel rejected, I will often say things that I later regret.
35. Others are shocked or worried about the things I do when I am feeling very excited.
36. I would like to learn to fly an airplane.
37. I am a person who always gets the job done.
38. I am a cautious person.
39. It is hard for me to resist acting on my feelings.
40. When I get really happy about something, I tend to do things that can have bad consequences.
41. I sometimes like doing things that are a bit frightening.
42. I almost always finish projects that I start.
43. Before I get into a new situation, I like to find out what to expect from it.
44. I often make matters worse because I act without thinking when I am upset.
45. When overjoyed, I feel like I can't stop myself from going overboard.
46. I would enjoy the sensation of skiing very fast down a high mountain slope.
47. Sometimes there are so many little things to be done that I just ignore them all.
48. I usually think carefully before doing anything.
49. Before making up my mind, I consider all the advantages and disadvantages.
50. When I am really excited, I tend not to think of the consequences of my actions.
51. In the heat of an argument, I will often say things that I later regret.
52. I would like to go scuba diving.
53. I tend to act without thinking when I am really excited.
54. I always keep my feelings under control.
55. When I am really happy, I often find myself in situations that I normally wouldn't be comfortable with.
56. I would enjoy fast driving.
57. When I am very happy, I feel like it is ok to give in to cravings or overindulge.
58. Sometimes I do impulsive things that I later regret.
59. I am surprised at the things I do while in a great mood.

Appendix D

The Big Five Inventory

How I am in general

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who *likes to spend time with others*? Please write a number next to each statement to indicate the extent to which **you agree or disagree with that statement.**

1	2	3	4	5
Disagree Strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly

I am someone who....

- ___ is talkative.
- ___ tends to find fault with others
- ___ does a thorough job
- ___ is depressed, blue
- ___ is original, comes up with new ideas
- ___ is reserved
- ___ is helpful and unselfish with others
- ___ can be somewhat careless
- ___ is relaxed, handles stress well
- ___ is curious about many different things
- ___ is full of energy
- ___ starts quarrels with others
- ___ is a reliable worker
- ___ can be tense
- ___ is ingenious, a deep thinker
- ___ generates a lot of enthusiasm
- ___ has a forgiving nature
- ___ tends to be disorganized
- ___ worries a lot
- ___ has an active imagination
- ___ tends to be quiet
- ___ is generally trusting
- ___ tends to be lazy.
- ___ is emotionally stable, not easily upset
- ___ is inventive
- ___ has an assertive personality
- ___ can be cold and aloof
- ___ perseveres until the task is finished
- ___ can be moody
- ___ values artistic, aesthetic experiences
- ___ is sometimes shy, inhibited
- ___ is considerate and kind to almost everyone
- ___ does things efficiently
- ___ remains calm in tense situations
- ___ prefers work that is routine
- ___ is outgoing, sociable
- ___ is sometimes rude to others
- ___ makes plans and follows through with them
- ___ gets nervous easily
- ___ likes to reflect, play with ideas
- ___ has few artistic interests
- ___ likes to cooperate with others
- ___ is easily distracted
- ___ is sophisticated in art, music, or literature

Appendix E

Now or Later? (DD)

We are interested in determining your preferences for amounts of money over time. For each of the 27 choices below, please indicate which reward you would prefer: the smaller reward today, or the larger reward in the specified number of days. On the right hand side, circle the choice you prefer.

Please think about each option carefully and choose the one that you would really prefer, as if you were really going to receive the option you select.

EXAMPLES:

- A. Would you prefer \$100 today, or \$101 in 300 days? \$100 today \$101 in 300 days
B. Would you prefer \$1 today, or \$100 in 2 days? \$1 today \$100 in 2 days

Circle one answer here.

- | | | |
|---|------------|------------------|
| 1. Would you prefer \$54 today, or \$55 in 117 days? | \$54 today | \$55 in 117 days |
| 2. Would you prefer \$55 today, or \$75 in 61 days? | \$55 today | \$75 in 61 days |
| 3. Would you prefer \$19 today, or \$25 in 53 days? | \$19 today | \$25 in 53 days |
| 4. Would you prefer \$31 today, or \$85 in 7 days? | \$31 today | \$85 in 7 days |
| 5. Would you prefer \$14 today, or \$25 in 19 days? | \$14 today | \$25 in 19 days |
| 6. Would you prefer \$47 today, or \$50 in 160 days? | \$47 today | \$50 in 160 days |
| 7. Would you prefer \$15 today, or \$35 in 13 days? | \$15 today | \$35 in 13 days |
| 8. Would you prefer \$25 today, or \$60 in 14 days? | \$25 today | \$60 in 14 days |
| 9. Would you prefer \$78 today, or \$80 in 162 days? | \$78 today | \$80 in 162 days |
| 10. Would you prefer \$40 today, or \$55 in 62 days? | \$40 today | \$55 in 62 days |
| 11. Would you prefer \$11 today, or \$30 in 7 days? | \$11 today | \$30 in 7 days |
| 12. Would you prefer \$67 today, or \$75 in 119 days? | \$67 today | \$75 in 119 days |
| 13. Would you prefer \$34 today, or \$35 in 186 days? | \$34 today | \$35 in 186 days |
| 14. Would you prefer \$27 today, or \$50 in 21 days? | \$27 today | \$50 in 21 days |
| 15. Would you prefer \$69 today, or \$85 in 91 days? | \$69 today | \$85 in 91 days |
| 16. Would you prefer \$49 today, or \$60 in 89 days? | \$49 today | \$60 in 89 days |
| 17. Would you prefer \$80 today, or \$85 in 157 days? | \$80 today | \$85 in 157 days |
| 18. Would you prefer \$24 today, or \$35 in 29 days? | \$24 today | \$35 in 29 days |
| 19. Would you prefer \$33 today, or \$80 in 14 days? | \$33 today | \$80 in 14 days |
| 20. Would you prefer \$28 today, or \$30 in 179 days? | \$28 today | \$30 in 179 days |
| 21. Would you prefer \$34 today, or \$50 in 30 days? | \$34 today | \$50 in 30 days |
| 22. Would you prefer \$25 today, or \$30 in 80 days? | \$25 today | \$30 in 80 days |
| 23. Would you prefer \$41 today, or \$75 in 20 days? | \$41 today | \$75 in 20 days |
| 24. Would you prefer \$54 today, or \$60 in 111 days? | \$54 today | \$60 in 111 days |
| 25. Would you prefer \$54 today, or \$80 in 30 days? | \$54 today | \$80 in 30 days |
| 26. Would you prefer \$22 today, or \$25 in 136 days? | \$22 today | \$25 in 136 days |
| 27. Would you prefer \$20 today, or \$55 in 7 days? | \$20 today | \$55 in 7 days |

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