The Development of Addiction-Prone Personality Traits and Substance Use Behaviours in Biological and Adoptive Families

By

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B.A., Nara Women's University, Japan, 1995

M.Ed., The University of British Columbia, 2007

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Supervisory Committee

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Abstract

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Substance use behaviours have been viewed as the end products of a combination of influences. Numerous theories for working with substance use behaviour utilizing a multi-systemic approach have been proposed. In this project, an effort was made to control for limitations and problems that have often beset previous studies utilizing such an approach. The overall objective of the current project was to test, using a multi-systemic approach, the ability of the family socialization framework to explain the development of substance use patterns in youth and young adults. The central hypothesis of this project was that family socialization factors (contextual factors) affect and predict the development of an offspring's personality (individual factors) and substance use behaviour. The behavioural genetic approach (i.e., the adoption design) was utilized to examine the genetic and environmental impacts on associations between

factors.

This project used secondary data analyses of general population data to examine the links between aspects of the family environment, personality, and substance use patterns. The Vancouver Family Survey data set used here contained information on fathers, mothers, and offspring from 405 families (328 biological and 77 adoptive) at two points in time. The development of personality and substance use behaviours over time, and associations with family socialization factors, were examined through three studies. Study 1 focused on the associations between offspring's perspectives of fathers' and mothers' parental socialization and offspring's polysubstance use. Study 2 investigated the development of addiction-prone personality characteristics and the predictive effects of family socialization and demographic variables on these characteristics. Study 3 explored the subscales of the Addiction-Prone Personality scale: impulsivity/recklessness, sensation seeking, negative view of self, and social deviance proneness. The descriptive characteristics of each subscale and changes in subscale scores over time were investigated. Also examined were transgenerational associations on these subscales, and potential relationships between personality subscales and choice of substance.

The results of this project suggest that family socialization may be linked with both substance use behaviour and personality development over time. Nurturing family socialization is negatively associated with the development of addiction-prone personality characteristics. It is also negatively associated with the development of substance use behaviours. These results are consistent with previous studies utilizing a family socialization framework. The findings supporting the family socialization framework are very encouraging for the field of child, youth, and family-related practice. Some of the limitations of the current project, implications of the findings, and future research directions are discussed.

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Chapter 1: Introduction

The abuse and misuse of a wide variety of substances and the consequences of such use have been a major societal problem all over the world (Agrawal & Lynskey, 2014; Kendler et al., 2012). Problematic or harmful substance use leads to serious health and social costs in many societies. In Canada between 1992 and 2002, for example, substance use costs including "all deaths," "potential years of life lost," and "acute care hospital days" attributed to substance abuse increased. In particular, those costs attributed to the use of illegal drugs rapidly increased (0.4% to 0.7%, 1.0% to 1.9%, and 0.1% to 1.5%, respectively) (Rehm et al., 2006). In 2002, the overall social cost related to substance abuse was estimated to be $39.8 billion; 21% of all deaths were attributed to substance use, and 47,000 Canadian deaths were linked to substance abuse annually (Rehm et al., 2006).

Most recently, British Columbia has declared a public health emergency over drug-related overdoses in the province, making it the first province in the country to take such a step. The BC Coroners service published the report *Illicit Drug Overdose Deaths in BC: January 1, 2007 – April 30, 2016* (Office of the Chief Coroner, 2016). This report stated that there were 480 apparent illicit drug overdose deaths in 2015, a 31.1% increase in deaths over 2014 (when 366 deaths were recorded), and a marked increase from the 211 deaths in 2010. The most alarming numbers are the most recent: 256 deaths in the first four months of 2016, and 76 deaths in January 2016 alone (Office of the Chief Coroner, 2016). This was the largest number of deaths in a single month for the examined period. The BC Health Minister, Terry Lake, and the provincial health officer, Perry Kendall, stated in the media that "this is a public health crisis, and it's taking its toll on families and communities across our province" (Harnett, 2016). It is apparent that substance abuse is negatively impacting the wealth and health of the province, and raises urgent

issues for families and communities.

Research shows that adolescence and young adulthood is a period when most people have their first experience of drinking alcohol, smoking cigarettes, and using other substances (Visser, de Winter, Vollebergh, Verhulst, & Reijneveld, 2013). For most young people, this use is experimental or occasional, but a substantial number of individuals will become regular users and put their wellbeing at risk (Paglia-Boak & Adlaf, 2007). Recent Canadian data shows that the age profile of regular users is changing, and with increasing numbers of young regular users. Sixty percent of illicit drug users in Canada are between the ages of 15 and 24 (Canadian Centre on Substance Abuse, 2007). Analyses of the 2012 Canadian Community Health Survey – Mental Health data found that youth (ages 15–24) had higher rates of substance use disorders than all other age groups (Pearson, Janz, & Ali, 2013). The same data also shows that the prevalence of past-year marijuana use was highest among 18- to 24-year-olds, at 33.3%, followed by 20.0% at ages 15 to 17 (Rotermann & Langlois, 2015). Substance use in young people is problematic in two ways; not only can it escalate and develop into substance abuse and addiction at older ages, but it is already a serious current problem affecting many young people. There is an urgent need to establish the potential predictors of substance use behaviours. In order to understand the nature of substance use problems and their development, and to develop effective prevention strategies, it is necessary to identify the multiple overlapping factors that affect young people's substance use as opposed to focusing on any supposed single cause of this behaviour.

Numerous researchers from psychology, sociology, biology, epidemiology, medicine, and other disciplines have incorporated and integrated strengths from each discipline to develop more multidimensional, holistic perspectives from which to investigate substance use behaviours (e.g., psychosocial, social neuroscience, social epidemiology, behavioural genetics, etc.). In 1980,

the National Institute on Drug Abuse (NIDA) published *Theories of Drug Abuse* (Lettieri, Sayers, & Wallenstein Pearson, 1980). This book consists of categorizations and descriptions of more than 40 theories of substance use extant at the time. The list of disciplinary foci of these theories shows that the vast majority draw on more than one disciplinary perspective. In other words, researchers have hypothesized and theorized for decades that multiple factors mutually influence each other in causing substance abuse. These factors are neither independent from nor competing with each other. Rather, substance use behaviours are viewed as the end products of a combination of influences involving multiple factors (Zucker, 2000).

For this study, I adopted a multi-systemic approach to understand substance use behaviours, and to investigate the multiple overlapping factors that affect young people's substance use. The term multi-systemic refers to the nature of a system comprised of various multilevel subsystems (the micro, mezzo, and macro levels). Therefore, multi-systemic approaches incorporate multiple factors from multiple systems with particular emphasis on relationships, interactions, and connections between systems at multiple levels to capture a holistic picture of individuals' and environments' issues and strengths (Johnson & Grant, 2005).

Multi-systemic approaches have been widely used in various areas of research, treatment programs (preventions and interventions), and program evaluations. Several examples of research using a multi-systemic approach can be found in the literature on substance use (e.g., Bender, Rock, & Tripodi, 2013), adolescent sexual offences (e.g., Borduin, Henggeler, Blaske, & Stein, 1990), same-sex domestic violence (e.g., Potoczniak, Murot, Crosbie-Burnett, & Potoczniak, 2003), and cyberbullying (e.g., Ang, 2015). Despite the variations of target behaviours or phenomena, existing studies have indicated that these issues are multidetermined and multidimensional (Borduin et al., 1990), and have found multi-systemic approaches

particularly useful.

Johnson and Grant (2005) specified several general perspectives that could be incorporated into multi-systemic approaches for understanding substance use behaviours. Some of the core perspectives are the sociological perspective, the ecological systems perspective (e.g., Bronfenbrenner, 1994), social constructionism (e.g., Gergen, Lightfoot, & Sydow, 2004), and the biopsychosocial perspective (e.g., Zucker & Gomberg, 1986). Although each multi-systemic approach may address issues with a unique framework, multi-systemic studies of adolescent substance use commonly focus on risk and protective factors at more than one level (e.g., individual, environmental, social, family, etc.).

For testing theories and explaining the nature of substance use behaviours (antecedents, predictors, mechanisms, etc.), fine-grained well-designed studies need to be conducted because of the complexity of this topic (e.g., Ball, 2005; Schuckit, 2014). Ideally, studies in substance use behaviours based on multi-systemic perspectives will provide meaningful results; however, conducting high-quality studies of this type appears particularly challenging. So far, because of the problematic and challengeable design of such studies, only a limited number have provided the empirical evidence and proofs of significance necessary to support the multi-systemic perspective. On the basis of my review of the literature, I have identified several relatively common issues in multi-systemic studies on substance use conducted to date. These issues include:

- Reliance on small, unrepresentative samples.
- Failure to employ longitudinal designs.
- Failure to include multiple measurement sources, particularly for family socialization influences.

- Failure to use reliable and valid measures of family socialization, personality and substance use.
- Failure to use genetically informed designs to control for genetic confounds.
- Failure to use sophisticated data analytic strategies that would allow for the examination of mediated effects and moderator influences.

In this project, the overall objective was to test, using a multi-systemic approach, the ability of the family socialization framework to explain the development of substance use patterns in youth and young adults from a psychosocial perspective. An effort was made to control for all of the limitations listed above. As a study of this kind had never been done before, this project has the potential to make a unique contribution to our understanding of the nature of the relationships between social psychological variables and the development of substance use behaviours.

The personal motivation for this project originated from several aspects of my life experiences and learning. As a former elementary school teacher and a current child and youth care (CYC) practitioner, I possess intuitive knowledge about the extent to which the social environment, especially one's family, can affect individuals. In the field of Child and Youth Care, one of the main foci of research and practice is the family-centred approach. A wide variety of CYC studies have hypothesized the importance to an individual's wellbeing of a nurturing social and family environment, not only during the earlier years, but also in late childhood, adolescence, and emerging adulthood. CYC practitioners "know" that family socialization is a key to the resilience, wellbeing, and future success of the children and young people with whom they work. However, what is missing from the field is empirical research confirming such practitioners' practical knowledge regarding the importance of family. To improve public policy and to

educate stakeholders on the best practices for providing child and youth services, the CYC field needs more empirical studies with statistical analyses of family socialization and target outcomes. Without these studies, the importance and impact of the family and social environment can be regarded as no more than notions or personal beliefs regarding CYC practice. I anticipated that this project could provide strong support for the ways in which CYC practitioners are already helping children, youths, and families.

Other aspects of my personal motivation for this project were strengthened and supported by the availability of suitable data. I have been questioning what parents are, and what family is, throughout my entire graduate career. I have found that it is extremely difficult for me to accept the idea that parents = caregiver = mother. I saw this equation as embodying a fundamental logic for mother-blaming and mother-crediting with regard to whatever befalls an individual, including biological and social environmental impacts, while it ignores the role of fathers. I therefore chose the Vancouver Family Survey (VFS) data for this project. In the VFS, both the father and mother from each family participated. This project could shed light on the importance for their child of either the father or the mother, or both, and help us see family and parents as co-creations of multiple agents. Another reason for selecting the VFS data was that it was a longitudinal data set collected from both biological and adoptive families in a large community-based sample. This dataset enabled me to control genetic impacts; as a result, I could examine the environmental impact in isolation. It would be particularly meaningful for individuals who are in statutory care, aging-out youth, former foster youth, adoptive families, and foster families if the project could address the importance of environment and its protective effect in adolescence and young adulthood. Lastly, the VFS is a local survey in BC. As I summarized earlier, BC is under a state of emergency regarding deaths arising from substance use. The results of this project would

indicate factors for the prevention of substance use problems and related deaths that particularly apply in this province.

Brief historical overview of substance use research. Studies relating to substance use have been conducted in some shape or form for centuries, not only in Europe and North America but all over the world. The trends in study topics track the history of substance use itself, including traditional medicinal use of plants, preservation (fermentation) of food, ceremonial use of substances, discovering and encountering substances in different parts of the world, treating wounded soldiers, and recreational substance use (European Monitoring Centre for Drugs and Drug Addiction [EMCDDA], 2008). For the last half the century, rapid progress of technology, changes in societal and political views regarding substance use, and the introduction of newer or advanced synthetic substances, have transformed substance use studies. Research has embraced a greater variety of disciplines, from early medical and pharmacological research to current biological, genetic, social, psychological, epidemiological, educational, or interdisciplinary research. According to the EMCDDA, for example, social and criminological research into substance use epidemiology and related social problems began in the UK in the 1960s. A tradition in psychiatry and addiction research also emerged. At about the same time, illegal drugs became a focus of sociological research in the Nordic countries, which already had a long history of research into alcohol and alcohol policy (EMCDDA, 2008). In the 1960s, the behavioural genetic approach (adoption and twin design) came into use in studies of the role of heredity in psychopathology including alcoholism (Cadoret, 1986). In the U.S., war veterans' problems with substances provided a strong motivation for substance use research. In 1970, the Ford Foundation initiated the Drug Abuse Survey Project to pinpoint more precisely what should be done to combat drug abuse. Its final report analysed in detail the large gaps in basic knowledge

of drug actions within the body, psychological factors involved in deciding to use drugs, and the role of drugs in contemporary society (Musto, 1996).

In the mid-1980s, substance use research in many European countries widened in scope with the emergence of HIV infection and AIDS (EMCDDA, 2008). Substance users who injected their drugs were considered to be the group at highest risk for acquiring and spreading the virus. Therefore, this group became subject to qualitative investigations of the social meanings and contexts of risky behaviours and of interventions, in addition to the epidemiological studies of drug injection.

From the 1970s until the turn of the century, more studies were conducted to identify genetic and environmental determinants of substance use disorders by means of the behavioural quantitative genetics approach (adoption and twin studies), biological neuroscientific studies, and family studies (e.g., Rutter, Moffitt, & Caspi, 2006). In the present century, we see advancements in molecular genetic science that enable us to identify specific genes that contribute to the risk of developing a substance use disorder (e.g., Plomin, DeFries, Knopik, & Neiderhiser, 2013).

Establishing potential predictors of substance use behaviours has been the goal of several areas of applied research. Substance use disorders are often considered the most complex genetically influenced medical and psychiatric conditions (Schuckit, 2014). Genes can explain the risk of developing substance use disorder; however, they cannot be its sole cause. Personality, for another example, can contribute to and explain the risk of having substance use problems, but there may be no personality trait that solely and directly causes these problems. The factors that convert those risks into phenotype might prove to be environmental factors (e.g., Clapper, 1992; Hicks et al., 2013). Numerous psychological and epidemiological studies have found that substance use behaviour is a complex phenotype resulting from the interplay of contextual

(social environment), individual (personality traits), and multiple genetic and other biological risk factors (e.g., G. M. Barnes, Hoffman, Welte, Farrell, & Dintcheff, 2006; Hicks et al., 2013). For this project, the most fundamental and life-long social environment, family socialization, was examined by following Grace Barnes' model of family socialization framework (G. M. Barnes, 1990).

Contextual (Social Environmental) Factors: Family Socialization

Today, the importance and impact of the family environment in the lives of individuals are widely acknowledged. Parents and family are the essential components of human socialization and key components of individual development (Becoña et al., 2012). They are the foremost sources for learning and acquiring values, norms, societal expectations, and manners during childhood and adolescence (Visser et al., 2013). The concept of family socialization has been described in detail by Grace Barnes (1990).

Family socialization framework. Although families vary in size, composition, and other characteristics, the family is a basic social unit. We learn social behaviours by ongoing interactions with significant others, and this occurs first within the family. Socialization within the family is the mechanism that fosters the internalization of the cultural system and social order so that offspring[1] can learn to carry out their role in society (Parsons, 1955, as cited in G. M. Barnes, 1990). Developmental psychologists such as Vygotsky and Bronfenbrenner have also emphasized the function of social interaction in human development. Vygotsky's social development theory argues that social interaction precedes development, and that consciousness and cognition are the end products of socialization and social behaviour (Vygotsky, 1978). Bronfenbrenner's ecological system theory proposes that human development takes place through a process of complex reciprocal interaction between an individual and persons, objects,

[1] The term offspring is used to refer to children of both biological and adoptive parents in this report.

and symbols in the environment (Bronfenbrenner, 1994). In short, sociological, developmental, and psychological theories all agree that socialization within the family is of critical importance to the development of human behaviour. There is strong theoretical and empirical evidence showing the importance of parent–offspring relationships and socialization within the family on the development of a wide range of behaviours (e.g., G. M. Barnes, 1990; Branstetter & Furman, 2013; Vieno, Nation, Pastore, & Santinello, 2009).

In early development, parent–offspring relationships are seen as particularly strong and crucial. The tie between parents and offspring normally endures throughout the offspring's development, and even after adulthood is attained it is seldom disconnected completely; this bond is unique among human relationships (Maccoby & Martin, 1983 as cited in G. M. Barnes, 1990). Moreover, parent–offspring interactions may serve as a basis for the individual's choice of friendships with peers and intimate relationships with partners later in development (G. M. Barnes, Hoffman, Welte, Farrell, & Dintcheff, 2006; Flouri & Buchanan, 2002; Maccoby, 1992; Tornay et al., 2013).

Another important social-developmental perspective is the problem behaviour theory (Donovan, 2005; Jessor, 1991). The problem behaviour theory is a psychosocial framework that was developed to explain the development of adolescent problem behaviours including alcohol abuse, illicit substance use, and others. The theory focuses on the psychosocial relationships that exist within and between each of three systems: the personality system, the perceived environment system, and the behaviour system. The framework has also been expanded to articulate the important social contexts of young adult life — family, work, and friends (Donovan, 2005). Problem behaviour theory states that substance use behaviours are learned behaviours shaped by norms, expectations, and experiences in the everyday context (G. M.

Barnes, 1990; Jessor, 1991).

The biopsychosocial process theory (Zucker & Gomberg, 1986) emphasizes that the development of drinking behaviour (and quite possibly other substance use behaviours) occurs in a social world and is influenced by the biopsychosocial process. The biopsychosocial perspective integrates aspects of biological (genetic) functioning, individual functioning (including personality and attitudinal components), and social functioning, particularly the family environment, along with the developmental perspectives (Zucker, 2000; Zucker & Gomberg, 1986).

The Grace Barnes' model of family socialization framework (G. M. Barnes, 1990, see Figure 1) is based on theories of socialization and general human development (e.g., Parsons, Maccoby, and Martin) and on theoretical frameworks more directly connected to the development of substance use behaviours (e.g., Jessor and Zucker). However, Barnes' model particularly emphasizes the centrality of family and the socialization process within it. The socialization process within the family is the mechanism responsible for the internalization of the cultural system, societal expectations, and social appropriateness (G. M. Barnes, 1990). Internalization is a process of integrating and incorporating values, beliefs, standards, and the opinions of others into one's view of self (one's identity). These internalized values, beliefs, mores of family/culture/society, and the view of self, which have been acquired through family socialization, might function as reasons and motivations for the decisions and actions of individuals (G. M. Barnes, 1990). In other words, family socialization will affect various behaviours in various contexts and continuously affect individuals' behaviours even in young adulthood and later (e.g., Flouri & Buchanan, 2002). Moreover, family socialization is positioned as a nexus for all other social, psychological, and biological factors that either promote or protect

from the risk of substance use behaviours (G. M. Barnes, 1990). Family socialization is more than just one of multiple factors. It could be the one that can modify the influences of all predictive factors.

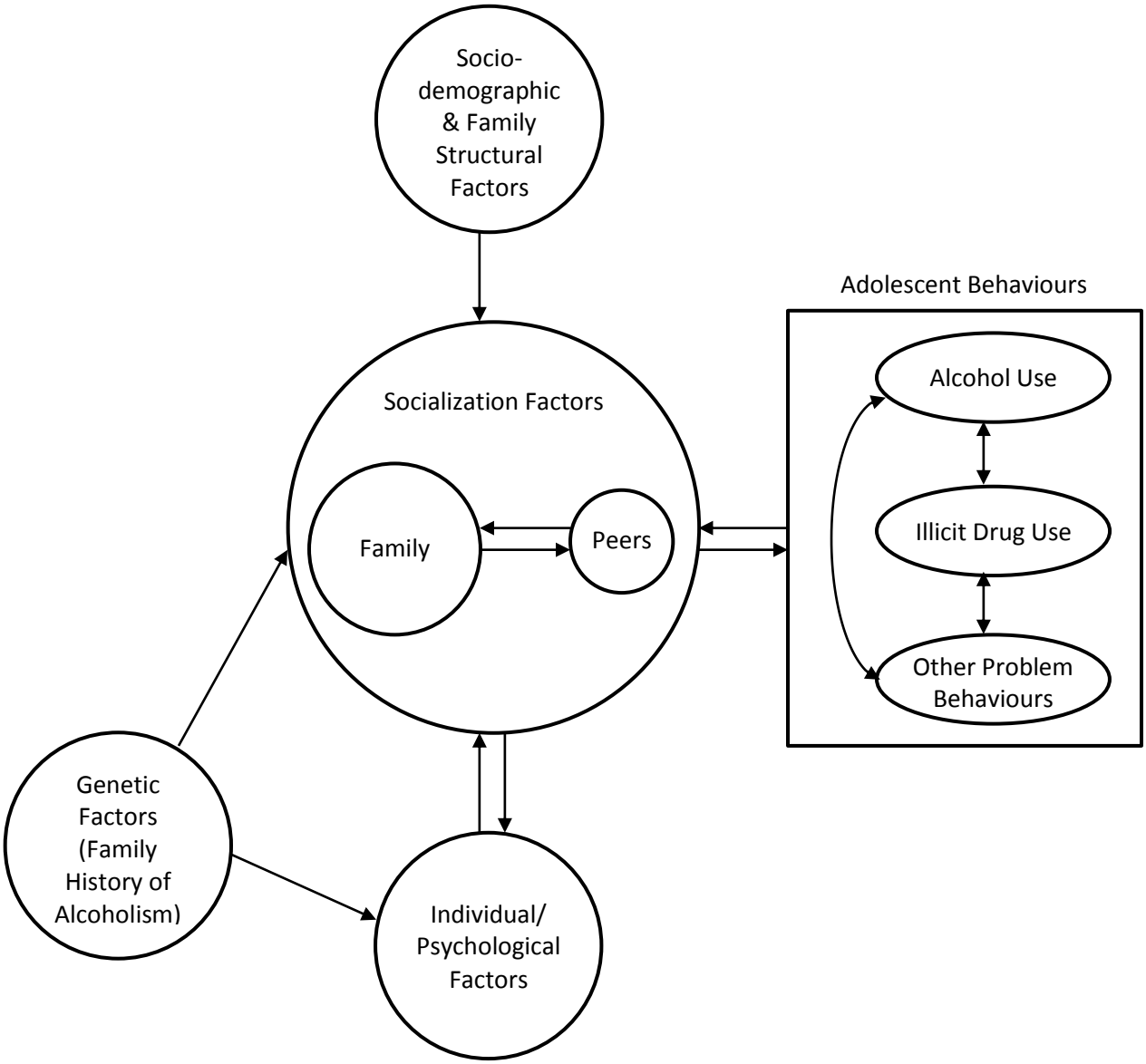


Figure 1. Grace Barnes' model of family socialization framework.[2]

The family socialization framework is particularly relevant for understanding individual differences in the development of substance use behaviour. It regards the socialization process as

[2] This model was titled as "Figure 5.1. Model of the development of adolescent drinking behaviors" in the original article (G. M. Barnes, 1990, p. 138).

a focal point for the integration of potentially important factors having an influence on substance use behaviours. An individual's genetic and psychological characteristics are acted upon and shaped in the process of interaction within the family, and factors that may be related to adolescent behaviours will thus be moderated or enhanced. From the perspective of family socialization, the environment that parents create and develop through parental socialization has been hypothesized to be one of the strongest predictors of the development of substance use behaviours (e.g., G. M. Barnes et al., 2006). Family socialization not only directly predicts the offspring's substance use, but is also hypothesized to influence personality development, decision making, and choice of peers, and can in these ways indirectly affect later substance use.

Family socialization and substance use. Family socialization is a broad concept that consists of numerous components of the family environment that can have a major role in predicting offspring substance use patterns. For example, based on their systematic review of longitudinal studies of adolescent alcohol use, Ryan, Jorm, and Lubman (2010) identified a number of significant factors for both initiation and the levels of drinking in late adolescence and young adulthood: parental role-modelling, monitoring, disapproval of drinking, general discipline, and parental support, as well as parent–child relationship quality and communication. Other studies have examined different aspects of family socialization or similar aspects under different terms such as cohesion, overprotection, care, warmth, autonomy granting, and so on (e.g., G. M. Barnes et al., 2006; Creemers et al., 2011; Jiménez-Iglesias, Moreno, Granado-Alcón, & López, 2012; Latendresse et al., 2010). Such studies have found that all of these aspects of parental socialization are significantly associated with adolescent substance use.

Another common approach to examining the influence of parental socialization on offspring outcomes employs the four general categories of parenting style: authoritative,

authoritarian, permissive, and neglectful (Bahr & Hoffmann, 2010; Patock-Peckham, King, Morgan-Lopez, Ulloa, & Moses, 2011; Piko & Balázs, 2012; Zeinali, Sharifi, Enayati, Asgari, & Pasha, 2011). Research by Bahr and Hoffmann (2010) shows that authoritative parenting (highly demanding, highly responsive, monitoring closely, providing high levels of support and warmth) diminished the likelihood of adolescents choosing to engage in risky forms of substance use, even when peers or friends were already doing so, thus showing that parents can be a significant influence on the risk-taking behaviours of their adolescent children.

The influence of parents, and particularly fathers, has been discussed by Padilla-Walker, Bean, and Hsieh (2011) in a study that highlighted the benefits of positive fathering. Their results suggest the unique importance of fathers, particularly in relation to externalizing and internalizing behaviours. The family socialization patterns created in the child by both mothers and fathers were not only predicted by the parenting styles in the preadolescent years, but appeared to represent distinct and important aspects of socialization during adolescence (Hair, Moore, Garrett, Ling, & Cleveland, 2008). These findings suggest that despite the increased distance between children and parents during adolescence, family socialization continues to be strongly related to adolescents' personal characteristics and behaviours. In other words, the quality of the parent–offspring relationship matters, not just for small children but even for adolescents beginning the transition to adulthood.

Several studies have suggested that association with deviant peers may play a more important role than parents in adolescents' polysubstance use (PSU); however, additional research has also found that parental socialization remains a primary determinant of PSU across adolescence (Cleveland, Feinberg, & Greenberg, 2010), and that parents have a significant influence on their offspring's substance use even after controlling for association with deviant

peers (G. M. Barnes et al., 2006; Dorius, Bahr, Hoffmann, & Harmon, 2004; Piko & Kovács, 2010). Additional support for the importance of parental influence is provided by Grace Barnes and her colleagues (2006), who examined six waves of longitudinal data from 506 adolescents about their alcohol use, illicit drug use, delinquency, family parenting style (support, communication, cohesion, and monitoring), and peer deviance. G. M. Barnes et al. (2006) concluded that the effects of parental socialization do indeed buffer the influence of peer deviance during adolescence, when these problem behaviours are on an upward trajectory. There is also strong evidence that "positive parenting" (i.e., high levels of parental knowledge or low levels of inconsistent discipline) affects the types of friends that adolescents associate with, and further protects the child from engaging in substance use (Cleveland, Feinberg, Osgood, & Moody, 2012). In brief, research indicates that parental behaviour may decrease — or increase — the likelihood of their offspring's initiation of substance use, and may influence their trajectories of substance use, even in young adulthood (Lac, Alvaro, Crano, & Siegel, 2009). Additionally, based on their review of research on parental styles and substance use, Becoña et al. (2012) concluded that parental nurturing socialization helps to cushion the influence of peers or reduce personal problems connected to substance use. In other words, family socialization can increase the risk of substance use or help to protect against it.

In summary, parental socialization factors are consistently associated with adolescents' and young adults' substance use (G. M. Barnes et al., 2006), and studies indicate that young people who have or had supportive and caring family environment are less likely to use substances (e.g., G. M. Barnes et al., 2006; Samek, Rueter, Keyes, McGue, & Iacono, 2015). At the same time, the etiology of the associations between family socialization (environment) and young people's substance use may be multifaceted and likely involves an interplay between

genetic and environmental influences (Samek et al., 2015). Some genetically informed studies (twin and adoption designs) have found that genetic influences satisfactorily explain the associations between family socialization and substance use behaviours (e.g., Cloninger, 1983). Others (e.g., Samek et al., 2015) have suggested that this association between family socialization and substance use is more consistent with a purely environmental explanation than with gene–environment correlations (i.e., passive and evocative *r*GE).

Perceived family socialization. Socialization within a family and any individual behaviour contributing to this socialization are at the centre of family studies. Today, it is well accepted that each individual in a family may perceive the family's socialization differently. Leung and Shek (2014) summarized that the difference between parents' and offspring's perceptions may be considered a normative developmental process. As parents have invested much time and effort in creating a nurturing environment, parents might tend to report higher levels of positive parenting and lower levels of negative parenting behaviours than their offspring do. Such differences may also be an outcome of parent–offspring conflict and stress. In existing studies, offspring and their parents have demonstrated overlapping but distinct perceptions of the parent–offspring relationship (e.g., Pasch, Stigler, Perry, & Komro, 2010), and of each other's behaviours (e.g., Cottrell et al., 2003).

There are three approaches to comparing parents' and offspring's perceptions. The first is to examine whether those perceptions are correlated. Pasch et al. (2010) point out that little research has been conducted on how parents' and adolescents' perceptions of parenting practices are correlated with each other. The findings of such studies as have been undertaken are contradictory. Pasch et al. (2010) found that parents' and adolescents' perceptions of parental monitoring were significantly correlated cross-sectionally and longitudinally, whereas Cottrell et

al. (2003) found no significant correlation between those perceptions of parental monitoring. The second approach is to examine how perceptions are associated with the targeted outcome (i.e., young people's substance use), and which party's perceptions are more strongly associated with that outcome. Research that follows this approach is also sparse. Some investigators have found that offspring's perceptions show a stronger association with actual adolescent alcohol use than do parents' perceptions (e.g., Cottrell et al., 2003; Latendresse et al., 2009); whereas, others have found the opposite (e.g., Pasch et al., 2010). The third approach is to identify discrepancies in perceptions and to use them as predictors of targeted outcomes (e.g., De Los Reyes, 2011). Recent studies suggest that discrepancies in parents' and adolescents' perceptions of parenting may be linked with a variety of developmental outcomes (e.g., Leung & Shek, 2014). Based on those studies, it is safe to assume that the measured influence of parental and family socialization on the targeted outcome may differ depending on whether the parents' or offspring's perceptions are used. As a result, it may not be suitable to combine the reports of offspring and parents for analysis, nor to substitute one for the other (Pasch at al., 2010). For this reason, parents' and offspring's perceived socialization factors were not aggregated in the current project. Offspring's perceptions were used in Study 1, while parents' midpoint and offspring's perceptions were used to examine their association patterns separately, and to compare them with outcomes and other factors in Study 2.

Individual Factors: Personality

Personality and substance use. Various studies have found significant associations between personality and substance use behaviours (e.g., G. E. Barnes, Murray, Patton, Bentler, & Anderson, 2000; Hicks, Durbin, Blonigen, Iacono, & McGue, 2012; Malmberg et al., 2012). Personality characteristics have been shown to be important determinants, critical predictors, or

significant risk factors for various substance use behaviours (Hicks, Schalet, Malone, Iacono, & McGue, 2011; Martinotti et al., 2009; Nees et al., 2012; Turiano, Whiteman, Hampson, Roberts, & Mroczek, 2012). Moreover, an increasing number of studies have shown that personality traits play an important role in the development, duration, and prognosis of problematic substance use behaviours (G. E. Barnes, Murray, Patton, et al., 2000; Lackner, Unterrainer, & NeuBauer, 2013; Woicik, Stewart, Pihl, & Conrod, 2009). In recent years, more studies on personality and substance use have been conducted in the general population of both adults and youth. Several of these have utilized longitudinal research methodology, allowing researchers to investigate not only the personality of those individuals who are addicted to substances, but also how personality predisposes certain individuals to future substance use (e.g., Anderson, Barnes, & Murray, 2011; Krank et al., 2011). Over the last two decades, certain dimensions of personality underlying under-controlled or disinhibited behaviour (i.e., impulsivity and sensation seeking) have been identified as correlates of substance use and other forms of externalizing behaviours (Quinn & Harden, 2013).

Personality batteries. Personality has been recognized as being ordered hierarchically from a large number of specific traits to a much smaller number of more general or synthesized traits (Kotov, Gamez, Schmidt, & Watson, 2010). Several researchers have developed personality measures to describe normal personality traits (see Table 1). Eysenck (Eysenck Personality Questionnaire [EPQ]), Zuckerman (Zuckerman-Kuhlman Personality Questionnaire [ZKPQ]), and Cloninger's (Tridimensional Personality Questionnaire [TPQ]; and Temperament Character Inventory [TCI]) models all have psychobiological bases, and were developed by consideration of the underlying biological and social determinants of individual differences (De Fruyt, Van De Wiele, & Van Heeringen, 2000). For example, both Cloninger and Zuckerman

focus on monoamine neurotransmitter systems as the origins of fundamental personality traits (Zuckerman & Cloninger, 1996). Costa and McCrae's NEO Five-Factor Inventory (NEO-FFI) is lexically based: fundamental individual differences are represented in the natural language by trait adjectives (De Fruyt et al., 2000; Zuckerman & Cloninger, 1996). In other words, this model emerged out of a series of attempts to understand the organization of trait descriptors in natural language.

Table 1

Personality Batteries

Model	The Big Five	The Big Three (PEN)	The Alternative Five	Temperament and Character
Battery	NEO Five-Factor Inventory (NEO-FFI)	Eysenck Personality Questionnaire (EPQ)	Zuckerman-Kuhlman Personality Questionnaire (ZKPQ)	Tri-dimensional Personality Questionnaire (TPQ) & Temperament Character Inventory (TCI)
Authors	Costa & McCrae	Eysenck	Zuckerman	Cloninger
Factors	Extraversion Neuroticism Conscientiousness Agreeableness Openness	Extraversion Neuroticism Psychoticism	Impulsive sensation seeking Neuroticism-Anxiety Aggression-Hostility Sociability Activity	Novelty seeking Harm avoidance Reward dependence Persistence Self-directedness Cooperativeness Self-transcendence
Purpose	To assess the basic dimensions of personality or temperament			
Target	Normal Personality traits			Normal and maladaptive Personality traits
Theory	Biological maturation Lexically based	Psychobiological model of personality		Psychobiological model, Biosocial theories

(Adapted from Ball, 2005; De Fruyt et al., 2000; Kandler, 2012; Zuckerman & Cloninger, 1996: Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993).

In the field of personality structure, it has been agreed that a personality structure is best described in terms of several major factors, and research on alternative dimensional models of personality has been encouraged (Ball, 2005; Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993). Currently, researchers agree that there are a limited number of broad traits of personality (two- to five-factor models) although there is no unanimity with regard to the number, names, or

descriptions of these traits (Ball, 2005). Extraversion (E) and neuroticism (N) are the commonly observed basic factors in factor analyses of personality measures. Extraversion (positive emotionality) is described as "sociable, lively, active, assertive, carefree, dominant, surgent, and venturesome" (G. E. Barnes, Murray, Patton, et al., 2000, p. 11). Neuroticism (negative emotionality) is described as "anxious, depressed, high on guilt feeling, low self-esteem, tense, irrational, shy, moody, and emotional" (G. E. Barnes, Murray, Patton, et al., 2000, p. 11). However, there is less agreement on factors beyond or in addition to extraversion and neuroticism (Zuckerman et al., 1993). Eysenck added only one additional factor, psychoticism (P), which is described as "aggressive, cold, egocentric, impersonal, impulsive, antisocial, unempathic, creative, and tough-minded" (G. E. Barnes, Murray, Patton, et al., 2000, p. 11). Eysenck suggested that factors other than E, N, and P are either components of one of the three factors or else combinations of them. However, Costa and McCrae (1992) suggested that P is a combination of agreeableness and conscientiousness. Zuckerman and Cloninger have defined novelty or sensation seeking (individual differences in optimal levels of stimulation or arousal; Zuckerman, 1971) as a fundamental dimension of personality. However, in the Big Five model, sensation seeking is regarded as a facet of extraversion, and impulsivity as a facet of neuroticism (Zuckerman & Cloninger, 1996). Despite some differences in theories, and in the compositions of broad traits and factors, many studies found significant overlaps and associations between corresponding or similar factors in each personality battery, such as: (a) NEO extraversion, EPQ extraversion, ZKPQ sociability; (b) TCI harm avoidance, ZKPQ neuroticism-anxiety, NEO neuroticism; and (c) EPQ psychoticism, ZKPQ impulsive sensation seeking, TCI novelty seeking (e.g., De Fruyt et al., 2000; Zuckerman & Cloninger, 1996; Zuckerman et al., 1993). Those associations combine each measure's individual strengths in areas such as biological relevance

and clarity of lexical definition/criterion, and thus deepen our understanding of personality.

The personality batteries developed by Zuckerman (ZKPQ), Cloninger (TPQ, TCI), Eysenck (EPQ), and Costa and McCrae (NEO-FFI) are designed to assess normal personality dimensions by utilizing personality factor models. These batteries are therefore often used to measure personality characteristics of individuals both with and without substance use problems. Numerous studies have found that some of the personality factors measured by these batteries are associated with substance use behaviours (e.g., Ball, 2005; Kotov et al., 2010). G. E. Barnes, Murray and Anderson (2000) tested the capability of EPQ, FFI (short version), and TCI in predicting alcohol use and abuse in a large general population based on longitudinal survey data. Barnes and colleagues employed a technique of whole set correlation analyses. This technique allows one to determine the amount of variance in the set of dependent variables that is explained by the set of independent variables. They found that higher EPQ psychoticism, higher EPQ neuroticism, higher FFI neuroticism, higher TCI novelty seeking, and lower TCI cooperativeness predicted more alcohol problems and abuse. The whole set correlation analyses showed that the overall amount of variance explained by EPQ and TCI was 0.16 for both; and was 0.07 for FFI (G. E. Barnes, Murray, & Anderson, 2000).

Measures of specific personality. Measures are available that are intended to measure specific personality traits directly connected to specific outcomes, such as alcoholism or substance use problems. Two of these measures, the *MacAndrew Alcoholism scale* and the *Addiction-Prone Personality scale*, have proven to be useful not only in assessing current problematic substance use but also in predicting future cases of substance use problems.

The MacAndrew Alcoholism scale (MAC) was designed to assess personality traits frequently associated with alcoholism. It is an indirect measure of alcoholism. In other words, no

items about alcohol use per se are included (Craig, 2005; Gizer et al., 2012). Because individuals with alcohol use problems are frequently reluctant to report or acknowledge them, this is one of the strengths of the MAC compared to other alcohol screening measures (e.g., MAST, CAGE; Miller, Shields, Campfield, Wallace, & Weiss, 2007). Subsequent research has shown that the MAC (MAC-R) assesses substance misuse in general rather than alcoholism specifically, and may be more accurately interpreted as a measure of a predisposition for impulsive drug use and reward seeking (Gizer et al., 2012). Therefore, the MAC (and MAC-R) is now known as a personality based indicator of substance abuse problems (Miller et al., 2007).

The Addiction-Prone Personality (APP) scale is a new measure that has been designed to predict underlying vulnerability to substance use problems, similar to MAC (Anderson et al., 2011; Anderson, Barnes, Patton, & Perkins, 1999; G. E. Barnes, Murray, Patton, et al., 2000). The APP scale was originally developed by utilizing data from a large general population survey (Winnipeg Health and Drinking Survey; G. E. Barnes, Murray, & Anderson, 2000). Personality items that linked to both a family history of alcoholism and a lifetime diagnosis of alcoholism were selected from an extensive battery of personality tests (e.g., EPQ, MAC, etc.; see Appendix A for the APP-21 items). The content of this scale suggests that individuals who score high on this measure are characterized by high novelty seeking and low self-regulation. The details of the APP scale, and earlier studies on this scale, will be discussed in the next section.

Addiction-Prone Personality scale. Earlier studies with the APP scale have found that this test is excellent for discriminating drug addicts from non-addicts, and for predicting the severity of addiction and the likelihood of remission during recovery (G. E. Barnes, Murray, Patton, et al., 2000). The APP scale is also a useful instrument for predicting alcohol and other substance misuses across both gender and age cohorts (Anderson et al., 1999). The APP scale

was found to be significantly ($p < .001$) correlated with three of the Five-Factor Personality Scales — high APP scores are correlated with high neuroticism, low agreeableness, and low conscientiousness (G. E. Barnes, Murray, Patton, et al., 2000).

The associations between parents' and offspring's APPs were examined in one of the early studies of the APP (the VFS; G. E. Barnes, Murray, Patton, et al., 2000). It found that offspring's APP traits were significantly associated with those of their parents in biological families. While these correlations were not statistically significant in the smaller sample of adoptive families, the order of magnitude of the effects observed was roughly the same. Cross-sectional research on the APP scale and substance use patterns (Anderson et al., 1999) has found that:

- The APP scores are significantly correlated with substance use (alcohol, tobacco, marijuana and other illicit drugs) in both parents and offspring.
- Males score higher on the APP scale on average.
- Adopted offspring score higher than biological offspring on average.
- The offspring's APP scores are higher than parents' scores; however, within the offspring sample, the APP scores are not significantly different by age.
- Socioeconomic status variables (parents' education, income, and occupation) are not reliable predictors of offspring's APP scores (G. E. Barnes, Murray, Patton, et al., 2000).

The same study has also shown that a nurturing family environment was significantly associated with lower APP scores in offspring (G. E. Barnes, Murray, Patton, et al., 2000). Results support the possible role of the social environment on the development of APP. More recently, Anderson et al. (2011) reported that the APP scale was the strongest unique predictor of

the alcohol dependent measure among other personality batteries (i.e., EPQ, NEO-FFI, and TCI) in their regression analyses. In the same study, Anderson and colleagues also found that the APP scale was a significant predictor of new alcohol abuse/dependence cases ($p < .001$). For comparison purposes, the MAC and the Eysenck Addiction Scale (EPQ-A) were added to the logistic regression models predicting the incidence of new cases of alcohol abuse or dependence. In the model with the MAC and the EPQ-A, the results for the APP scale were still significant ($p = .001$), in comparison to the MAC ($p = .224$) and the EPQ-A ($p = .049$; Anderson et al., 2011).

Dimensions or traits of personality. Numerous reviews and studies on addictive personality have reached the consensus that there is no single, unitary "addictive personality" (e.g., Anderson, 2003; Ball, 2005; Conway, Kane, Ball, Poling, & Rounsaville, 2003; Koller, Preuss, Lü, Soyka, & Pogarell, 2015). However, results from many studies have shown that several personality traits are consistently associated with substance use behaviours (Conway et al., 2003). It is therefore reasonable to hypothesize that addictive personality (or addiction-prone personality) is a multidimensional entity involving more than one specific personality trait. Several personality traits (e.g., novelty or sensation seeking, impulsivity, constraint, proneness to social deviance, and hostility/disagreeableness) have been found among individuals who have substance use problems (Ball, 2005; Conway et al., 2003). Cross-sectional and longitudinal research implicates specific personality traits in the initiation of substance use, the development of abuse, and the maintenance of dependence, as well as symptom severity, psychosocial functioning during abstinence, and the possibility of relapse (Ball, 2005; G. E. Barnes, Murray, Patton, et al., 2000). Moreover, studies utilizing different personality profile scales have found that each personality trait can have a different trajectory of development over time (Hicks et al., 2013; Quinn & Harden, 2013). In other words, specific personality traits may uniquely act as risk

factors, mediators, moderators, and consequences of the development, progression, and outcome of substance use behaviours throughout an individual's lifespan (Ball, 2005). Anderson's 2003 study examined whether the APP is unidimensional or multidimensional, finding that APP is not unidimensional, and that the APP scale could consist of multiple subscales. Anderson derived three subscales of the APP from dimensionality analyses of the 21-item APP scale, based on four clinical samples and general population data. The three subscales represent *Impulsivity/Recklessness, Sensation Seeking,* and *Negative View of Self.* Items that did not load differently on any of the three subscales were categorized as non-loading.

However, I believe that non-loading items describe how individuals relate and respond to social norms. Some of those items are; "Did you play hooky from school quite often as a youngster?"; "Have you ever been in trouble with the law?"; "Do you give money to charities? (Reverse coded)"; and "Do you go to church almost every week? (Reverse coded)". Those items directly match the description of the personality system presented in Jessor's *Problem Behaviour Theory*, particularly the aspects of social criticism, attitudinal tolerance of deviance, and religiosity (Donovan, 2005). Those items also appear to fit well with the description of social deviance proneness — lack of concern for social norms and laws, and antisocial or under-socialized behaviour, including aggression and low self-regulation (e.g., Finn, Sharkansky, Brandt, & Turcotte, 2000). In the current project, therefore, I use the term *Social Deviance Proneness* to describe a fourth possible subscale of the APP, and examine to what extent this subscale is also a reliable and valid component of the APP.

The three subscales noted above were initially described by Anderson (2003) as follows: (a) *impulsivity/recklessness* is related to the impulsivity and disinhibition that is part of the psychoticism factor; (b) *sensation seeking* corresponds closely with the stimulus-reducing factor;

and (c) *negative view of self* is conceptually related to some of the cognitive and affective components of neuroticism (negative emotionality) factor. In addition, I hypothesize and tentatively define the (d) *social deviance proneness* subscale in this project. Social deviance proneness is related to social conformity, traditionalism, religiousness, social deviance, and lower acceptance of conventional rules or moral and ethical values. Since Anderson's dimensionality study (2003), there has been no published research on these APP subscales as independent factors. To this point, there is no investigation of these four subscales of APP-21 over time (by comparing data collected from the same participants on separate occasions), nor any research on the reliability and validity of these subscales. Existing studies of the APP scale have used the cross-sectional data alone, the total scores on 21 items of the APP, or the latent factor of APP (the four subscales' scores are loaded). Therefore, this thesis project will be a valuable opportunity to examine the quality of each subscale and the potential multidimensionality of the APP. However, there were two more crucial aspects I needed to take into account to conduct this project: the life-long trajectory of personality, and the relationship between personality traits and choice of substance.

Change and stability of personality. Contemporary research in personality has shown that "personality development is a lifelong individual process" (Kandler, 2012, p. 291), and that essentially all aspects of personality change across the lifespan (Caspi, Roberts, & Shiner, 2005). Longitudinal studies examining the mean-level change of personality yield estimates of normative change (Blonigen, Carlson, Hicks, Krueger, & Iacono, 2008). Those studies suggest that there are normative patterns of development in personality throughout adolescence and adulthood, even in old age (e.g., Kandler, 2012; Quinn, & Harden, 2013). Based on numerous studies, a normative trend of personality change is commonly identified as an increase of "self-

control, risk avoidance and emotional stability over the life-course" (Hicks et al., 2011, p. 541). At the same time, numerous reviews and studies on the personality change over life-span and during young adulthood have reported moderate to strong rank-order stability for personality traits (e.g., Anderson et al., 2011; Blonigen et al., 2008). Rank-order stability, which is commonly examined by using test-retest correlation, refers to consistency in the relative orders of individuals in a population (Blonigen et al., 2008). Anderson et al. (2011) reported the test-retest correlation of the APP for tests 7 years apart as .74, and Blonigen et al. (2008) reported correlations for multiple personality traits ranging between .50 and .60 (again, for tests 7 years apart). In summary, personality traits may change over time yet stay more or less the same in relation to those of peers. On the one hand, the trajectories of personality change can be due to endogenous processes. That is to say that the degree of stability of most personality traits is driven predominantly by genetic (or, at least, biological) influences. On the other hand, such changes may also occur because of environmental factors and contextual conditions (e.g. social roles), as well as individuals' conscious efforts to adapt to such factors (Hopwood et al., 2011; Kandler, 2012). By integrating both perspectives, the more recent studies of personality development often examine the impacts of genes, environment, and gene–environment interaction by utilizing twin or adoption research designs.

Personality traits and choice of substance. As summarized above, a large number of studies have found significant associations between personality and substance use behaviours (e.g., G. E. Barnes, Murray, Patton, et al., 2000; Hicks et al., 2012; Lackner et al., 2013; Malmberg et al., 2012; Martinotti et al., 2009; Nees et al., 2012; Turiano et al., 2012; Woicik et al., 2009). Research on personality characteristics of individuals who are addicted to various substances has a more than century-long history. By the early 1900s, numerous researchers had

recognized that certain types of individuals are more prone than others to become addicts (Stillé & Maisch, 1894 as cited in Felix, 1944). Their studies indicated that certain personalities are attracted by narcotics (e.g., Claude, 1923, & Kolb, 1925 as cited in Felix, 1944). Based on their personality studies on individuals with addiction, Claude formulated three categories, and Kolb developed six groups, for a general classification of addicts (Felix, 1944). Felix (1944) reviewed both classifications and incorporated them into his 4-group classification of addiction (normal, psychoneurotic, psychopathic, and with psychosis). The earlier studies referred mostly to opioid (more specifically, opium) addiction; therefore, it is not clear whether these categories applied to individuals who were addicted to other substances.

More recently, several researchers have suggested that there is more than one way to approach and examine associations between personality characteristics and substance use (e.g., Elkins, King, McGue, & Iacono, 2006; Gerra et al., 2008; Hopwood, Baker, & Morey, 2008; Milivojevic et al., 2012). On the one hand, certain personality characteristics may be a general risk factor for substance use problems. One or more personality characteristics may be related to a propensity to engage in substance use; in other words, there may be common personality profiles for substance users that differ from those of non-users. In personality and substance use studies, several broad traits of personality (e.g., constraint, neuroticism, extraversion, and characteristics related to behavioural disinhibition) have shown differences between individuals with various substance use problems and those without such problems (e.g., Conway, Swendsen, Rounsaville, & Merikangas, 2002; Gerra et al., 2008; Le Bon et al., 2004; Milivojevic et al., 2012; Patton, Barnes, & Murray, 1993). There has been substantial evidence for an association between these personality traits and substance use behaviours, and, in a general sense, for personality differences between individuals with and without substance use problems. On the

other hand, certain personality features may be a specific risk factor for specific substance use problems. In other words, there may be specific personality/temperament profiles associated with the choice of a specific substance (Elkins et al., 2006).

Theories of substance use vulnerability propose that certain personality traits reflect individual differences in susceptibility to substance-reinforcement (Krank et al., 2011; Pihl & Peterson, 1995; Woicik et al., 2009). For instance, the motivational model of personality risk for substance use hypothesizes personality vulnerability to reinforcement-specific substance patterns through either a positive reinforcement (e.g., enhancement) or a negative reinforcement (e.g., coping) process (Hopley & Brunelle, 2012; Khantzian, 1997; Woicik et al., 2009). Positive reinforcement for substance use is linked to the positive hedonic effects of substances. Negative reinforcement is linked to the ability of substances to relieve negative states (physical or psychological suffering). The motivational model theorizes that there are four motivational personality profiles for substance use — impulsivity, sensation seeking, hopelessness, and anxiety sensitivity; these form the basis for the Substance Use Risk Profile Scale (SURPS; Hopley & Brunelle, 2012; Krank et al., 2011; Woicik et al., 2009). The results of Woicik et al.'s 2009 study indicate that personality may account for differential motivation for substance use, and differential sensitivity to drug reinforcement. With a sample of university and college students, Woicik and her colleagues found associations between (a) impulsivity and more frequent stimulant drug use; (b) sensation seeking and PSU and more frequent alcohol, cannabis, and hallucinogenic drug use; and (c) hopelessness, anxiety sensitivity, and sedative drug use (Woicik et al., 2009).

There are other studies that also found differences in personality characteristics between individuals who are addicted to different substances. For instance, Lackner et al. (2013) utilized

the Five Factor model and compared two addiction groups — alcoholics, and polysubstance dependent. In this study, the polysubstance dependent group showed lower conscientiousness and lower agreeableness than the alcohol abusers (Lackner et al., 2013). Gerra et al. (2008) reported that cocaine-addicted adult patients were found to be more psychopathic and aggressive than heroin addicts. Hopwood et al. (2008) found that individuals who use heroin or cocaine tend to have higher levels of internalizing and externalizing than controls or alcohol/marijuana users. They also found that crack users had the highest levels of internalizing, and heroin users the highest levels of externalizing. Studies conducted by Milivojevic et al. (2012) and Le Bon et al. (2004) utilized the Temperament Character Inventory (TCI) to examine personality differences in different types of substance users. Both Le Bon et al. (2004) and Milivojevic et al. (2012) reported that heroin/opiate patients scored significantly higher in novelty seeking than alcohol patients. Higher self-directedness (Le Bon et al., 2004), and higher proneness to boredom and self-transcendence (Milivojevic et al., 2012) were also reported in the heroin/opiate group.

Furthermore, several studies have found that certain personality characteristics could distinguish and differentiate users of different substances by degrees (highest to lowest) of scores on certain characteristics: constraint (Conway et al., 2002), externalizing (Hopwood et al., 2008), and novelty seeking (Le Bon et al., 2004). Conway et al. (2002) compared five substance use groups (polysubstance, opioid, cocaine, marijuana, and alcohol) with a non-user group regarding their positive and negative emotionality and constraint as measured by the Multidimensional Personality Questionnaire (MPQ). The constraint dimension is most closely associated with the control, harm avoidance, and traditionalism dimensions. Conway et al. (2002) found that individuals who scored high on this factor tended to adhere to traditional values and respond to their environment with caution, deliberation, and restraint. Therefore, low constraint resembles

behavioural disinhibition, impulsivity, and sensation seeking (Conway et al., 2002). Their findings demonstrated that individuals who differ in both a substance of abuse/dependence and a substance of choice vary in terms of constraint scores (highest in the alcohol and lower in the opioid group). Hopwood et al. (2008) included four substance use groups — heroin, cocaine, alcohol, and marijuana — similar to those used in the Conway et al. (2002) study. The results of both of these studies suggest that externalizing might distinguish heroin users from alcohol, marijuana, and cocaine users.

What is more, the associations between personality and choice of substance may be affected by the social acceptability of a substance. Individuals who use illicit drugs can be expected to be more prone to ignore societal rules, cultural mores, and laws — to have a more antisocial profile — than those who use legal substances such as alcohol and tobacco (Le Bon et al., 2004). Several studies have found that individuals who use substances considered to be more socially-deviant (such as heroin and cocaine vs. alcohol, tobacco or marijuana) showed more extreme scores in specific personality characteristics such as constraint, novelty seeking, and externalizing, characteristics that are associated with a social deviance/antisocial profile (Conway et al., 2002; Gerra et al., 2008; Hopwood et al., 2008; Le Bon et al., 2004).

In summary, cross-sectional studies of addicted individuals have revealed differences in personality traits that correlate with the particular substance or combination of substances to which an individual is addicted. The results of these studies indicate that multiple personality traits, taken together, could predict which substance or substances an individual will tend to use. At the same time, some studies with adolescent samples have found that certain personality traits are associated with an increased overall risk of substance use, but not so clearly with the choice of substance (e.g., Elkins et al., 2006; Woicik et al., 2009). By comparing associations between

personality traits and three specific substance use disorders (nicotine, alcohol, and illicit drugs), Elkins and her colleagues (2006) found that some personality traits measured by the MPQ (i.e., constraint and negative emotionality) were significantly associated with all three substance uses. One of the studies reported by Woicik et al. (2009) also showed that three out of four personality profiles measured by the SURPS (impulsivity, sensation seeking, and hopelessness) were all associated with various drinking behaviours, substance use, and reckless behaviour in the sample of high school students. Krank et al. (2011) conducted a longitudinal study with adolescents (grades 8–10) to examine whether the SURPS has concurrent and predictive validity for use of various substances (alcohol, marijuana, tobacco, hallucinogens, and stimulants). The same three personality profiles of the SURPS (i.e., impulsivity, sensation seeking, and hopelessness) were found to be positively related to current and future use of all measured substances. These findings indicate that some personality traits relate to generalized risks for developing a substance use disorder in adolescence (Elkins et al., 2006). However, no study has yet investigated the association between specific substance use and personality characteristics as measured by the APP subscales. In this thesis project, therefore, I examine whether the subscales of the APP associate with different substance use and could predict which substance will likely be used, or whether some of the four subscales of APP are risks for substance use of alcohol, tobacco, marijuana, and other illicit drugs in adolescent and young adult samples.

Biological, Genetic Factors: Behavioural Genetic Approach (Adoption Design)

The behavioural genetic approach examines the inheritance of behavioural traits and individual differences through twin studies or adoption design studies (Plomin et al., 2013). The adoption design methodology originates in the field of quantitative genetics, which was introduced by R. A. Fisher in 1918 and by Sewall Wright in 1921 (Plomin et al., 2013). Their

multiple-gene model (an extension of Mendel's single-gene model) explains the resemblance of relatives. "If genetic factors affect a quantitative trait, phenotypic resemblance of relatives should increase with increasing degree of genetic relatedness" (Plomin et al., 2013, p.34). In other words, offspring should be more similar to a parent than to an aunt or uncle. Behavioural geneticists have developed methods based on family resemblance for inferring the importance of genetic and environmental influences on a broad range of human traits. Two experiments of nature are utilized to disentangle the genetic from the environmental sources of family resemblance: both the twin study and the adoption study separate genetic and environmental influences (Plomin et al., 2013).

The study of transgenerational alcoholism is one of the oldest examples of this type of investigation in practice. As Goodwin, Schulsinger, Hermansen, Guze and Winokur (1973) summarized, empirical studies have indicated for years that alcoholism is a "familial" disorder. More than with other substances, individuals who abuse alcohol are very likely to have one or more close relatives who are alcoholic. However, *familial* is not synonymous here with *genetic*. Usually, biological parents play an important role in their offspring's environment as well as their heredity. To investigate what familial really means in this context, Goodwin et al. (1973) conducted adoption design studies.

Adoption design studies are based on a comparison of the concordance or correlation between offspring behaviour and that of both or either of the biological and the adoptive parents. Similarity in a behaviour between offspring and biological parents is suggestive of genetic influences on that behaviour (due to shared genes and a lack of shared rearing environment), while similarity between offspring and adoptive parents is suggestive — due to the shared rearing environment, and in view of the lack of shared genes — of environment influences

(Agrawal & Lynskey, 2008; Beaver, Rowland, Schwartz, & Nedelec, 2011; Leve et al., 2013). The adoption design is a powerful method because adoption is a natural experiment in which children are reared in families where they are genetically unrelated to their family members. It is regarded as the most direct way to disentangle genetic and environmental sources of family resemblance (Plomin et al., 2013; Tully, Iacono, & McGue, 2008). It can also be used to explore interactions between genes and the environment. It yields evidence about the relative importance for behavioural development of the rearing environment, the genetic background, and their potential interactions (GxE) (Rhea, Bricker, Corley, DeFries, & Wadsworth, 2013).

In the field of substance use studies, it is now widely accepted that both genes and the environment play an important role in predicting substance use and dependence; however, their influences are likely to combine in complex ways (Plomin et al., 2013). The behavioural genetic approach through the adoption design therefore provides a helpful methodology for disentangling the potential complex mingling of genetic and environmental impacts. In the current project, genetic influences on outcomes and pathways between factors are controlled by including both biological and adoptive families. In the biological sample, all direct associations between factors include both biological and family socialization components. In the adoptive sample, associations include only a socialization component.

In adoption design studies, parents in conventional biological families are *genetic-plus-environmental* parents. When an adoption occurs, it creates two types of parents; *genetic* parents (biological parents who do not raise offspring) and *environmental* parents (adoptive parents) (Plomin et al., 2013). Studies utilizing this paradigm typically compare risk bestowed by biological parents who were not involved in rearing their offspring with risk provided by adoptive, rearing parents (Tully et al., 2008). This conceptualization can also be applied to

siblings. Biological siblings reared in the same household are genetic-plus-environmental siblings. In adoption design research, genetic siblings are full siblings adopted apart early in life and reared in different homes, whereas environmental siblings are pairs of genetically unrelated offspring reared in the same home (Plomin et al., 2013).

Adoption design studies undoubtedly contribute to the deepening of our knowledge of the roles of genetic and environmental factors in a wide variety of outcomes. Since the early publications of adoption design studies on alcoholism, investigators have recognized and acknowledged the heterogeneity of alcoholism and the possibility of multiple routes to this disorder (i.e. M. Bohman, R. J. Cadoret, C. R. Cloninger, R. Plomin, and S. Sigvardsson). Adoption studies indicate that both genetic and environmental factors play important roles in the development of alcohol use disorder, and of substance use in general (Plomin et al., 2013). The existence of gene–environment correlations (*r*GE) and interactions (GxE) indicates that genetic and environmental factors coexist and function together in a complex manner (Plomin et al., 2013). The following paragraphs are brief summaries of notable adoption design studies' findings on substance use.

Alcohol use. The early studies conducted by Goodwin, Schulsinger and their colleagues in Denmark (Goodwin et al., 1973; Goodwin, Schulsinger, Knop, Mednick, & Guze, 1977; Goodwin et al., 1974) showed a significantly higher rate of alcoholism among adopted-out sons of alcoholic biological fathers than among sons of non-alcoholic biological fathers, but not a higher rate of alcoholism among adopted-out daughters of alcoholic biological fathers. These findings suggested a genetic component for the manifestation of alcoholism and alcohol abuse (Agrawal & Lynskey, 2008; Bohman, 1981). The Swedish studies conducted by Cloninger, Bohman, and Sigvardsson (Bohman, Sigvardsson, & Cloninger, 1981 as cited in Cloninger,

1983; Cloninger, Bohman, & Sigvardsson, 1981 as cited in Cloninger, 1983) also investigated the heritability and environmental impact on alcohol use by means of the adoption design, and introduced two types of alcoholism. Type I susceptibility is identified as an adult-onset alcoholism that affects both men and women. Based on their Swedish studies, the researchers concluded that Type I alcoholism is strongly dependent on non-genetic influences (Cloninger, 1983). Type II susceptibility; on the other hand, is developed during the teenage years. It is associated with anti-social behaviour and primarily affects men. Type II alcoholism is found to be more strongly heritable than Type I alcoholism (Cloninger, 1983). All participants of both the Danish and the Swedish studies were adult adoptees (approximately 20 to 40 years old). Grove et al. (1990) conducted a monozygotic-twins-reared-apart (MZA) study (twins 16 to 68 years old) and found results that contradicted those from earlier studies. Significant heritability was found in the drug use scale; however, in the alcohol use scale, zero heritability was found (Grove et al., 1990).

Samek, Keyes, Iacono, and McGue (2013) analyzed data from the Minnesota Sibling Interaction and Behaviour Study (SIBS), a longitudinal, genetically informed study including families with at least two adolescent children within five years of age. The data were collected from families consisting of (a) two parents and two adopted children with no genetic connection among them, (b) two parents and two biological children, and (c) two parents and one biological and one adopted child not genetically related to either parent. Samek and her colleagues (2013) examined shared and non-shared environmental effects on adolescent alcohol use (consumption and frequency). They concluded that the heritability of adolescent alcohol use was not significantly different from zero (Samek et al., 2013). In other words, the environment has the dominant impact on alcohol use.

Tobacco use. Only a few adoption design studies have investigated tobacco use as their specific research outcome. In Sweden, Kendler, Thornton, and Pedersen (2000) conducted an MZA study. They found that both genetic and shared rearing environmental effects were significant. From their analysis of the Minnesota SIBS, Keyes, Legrand, Iacono, and McGue (2008), stated that their study provides evidence that exposure to parental smoking (an environmental risk factor) increased the risk for substance use in adolescent offspring; at the same time, the data are consistent with genetic risk transmission from non-adoptive parents who smoke of a non-specific genetic risk to their biological offspring (Keyes et al., 2008).

Other substance use. The earliest adoption design studies of substance use were the often-cited Iowa adoption studies conducted by Cadoret and his colleagues between 1986 and 1996 (Agrawal & Lynskey, 2008; Cadoret, Troughton, O'Gorman, & Heywood, 1986; Cadoret, Yates, Troughton, Woodworth, & Stewart, 1995). They presented early evidence of the importance of genetic effects and two genetic risk-transmission pathways for the development of substance abuse or dependence. The first mechanism is a direct pathway from a biological parent's alcoholism to a biological offspring's substance abuse or dependence. The second mechanism is an indirect path: antisocial personality disorder in the biological parent increases the risk of aggressivity, conduct disorder, and antisocial personality disorder in adopted-away offspring, and may lead to substance abuse or dependence (Cadoret et al., 1995). The series of studies conducted by Cadoret and his colleagues suggest that there is no significant gender difference in genetic and environmental risk mechanisms. They also highlighted the influence of the environment on the development of offspring's substance use (e.g., parental divorce and parental psychiatric disorder in adoptive families; Cadoret et al., 1995).

Two relevant studies were conducted more recently as part of the Minnesota SIBS. The

findings of Marmorstein, Iacono, and McGue (2012) and King et al. (2009) suggest that the association between parental substance use disorder and offspring's substance use is determined more by genetic than environmental risk transmission. Marmorstein et al. (2012) found that risk transmission of substance use disorder had a significant genetic component and was similar across substances — nicotine dependence, alcohol use disorder, and cannabis use disorder. King et al. (2009) found that parental alcohol dependence was associated significantly, in non-adopted adolescents only, with increased risk for tobacco and alcohol use, and for a larger number of substances used. At the same time, exposure to parental alcohol misuse (a shared environmental risk factor) was associated with a substantially increased likelihood of having used alcohol in adopted adolescents: their odds of having ever used alcohol were approximately four times more than for non-exposure offspring (King et al., 2009). In Sweden, Kendler et al. (2012) conducted a full adoption design study that included information about adoptees, their biological and adoptive parents, and their biological full, half, and adoptive siblings. The researchers found strong evidence of genetic risk transmission from both parents and siblings to offspring. They also found that a range of environmental features of the adoptive family (e.g., death, divorce, alcohol problems in the adoptive parents or siblings, criminal behaviour, medical hospitalization) predicted increased risk for substance abuse in adoptees (Kendler et al., 2012), which is consistent with the findings of the Iowa adoption studies (Cadoret et al., 1995). Moreover, evidence of gene–environment interaction in the etiology of substance abuse was found. Adoptees at high genetic risk were more sensitive to both the beneficial and the detrimental effects of family environments than those at low genetic risk (Kendler et al., 2012).

Statement of Problem

As summarized above, research in developmental and personality psychology, and in

substance use studies, suggests that personality is one of the important determinants of various substance use behaviours (Hicks et al., 2011; Turiano et al., 2012). Other studies have shown that personality traits play an important role in the development, duration, and prognosis of problematic substance use (G. E. Barnes, Murray, Patton, et al., 2000; Lackner et al., 2013). At the same time, many studies show that the environment can affect personality development (Schofield et al., 2012) and substance use behaviour (Becoña et al., 2012). Hence, it is commonly hypothesized that substance use is a complex phenotype resulting from the interplay of multiple individual, contextual, and genetic risk factors (Quinn & Harden, 2013; Scarr & McCartney, 1983). Despite the existence of an extensive literature indicating the importance of multiple factors and multilevel causality for the development of substance use behaviours, there is not yet enough empirical evidence to support this hypothesis.

There is an urgent need for more longitudinal studies. Longitudinal analysis is a crucial method of examining the directionality of the relationships between factors. Cross-sectional studies cannot produce substantial evidence of the direction of impact or cause-effect relations. Identifying predisposing factors (antecedents) and predictive factors of substance use behaviours is essential for the development of prevention strategies, and it can be done only by longitudinal studies. It is also important to consider the trajectories of both factors and outcomes. Individuals are not static, and their perspectives, behaviours, environments, and relationships all continuously change. A longitudinal study that examines those changes will therefore offer the most meaningful approach to studying the etiology, development, and prognosis of young people's substance use. Moreover, it is now well recognized that any aspects or factors that cause or are associated with substance use problems and the relationships among them may be affected by one's genes (biology), by one's environment, and by gene–environment correlations (*r*GE) —

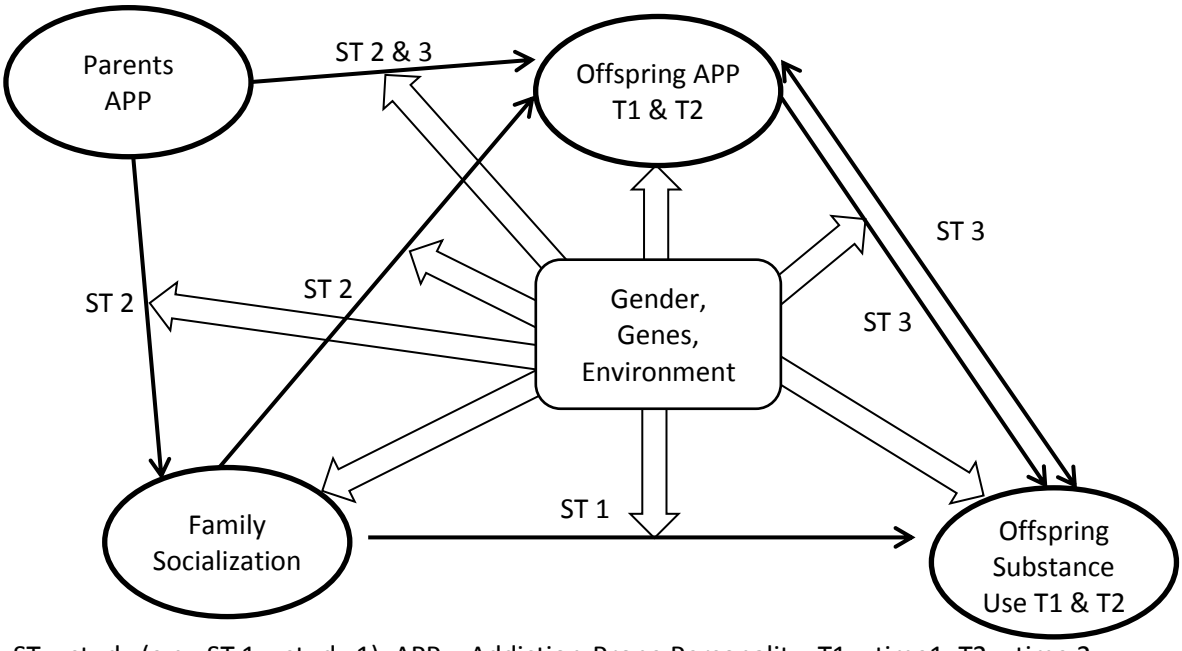
the likelihood of exposure to an environment based on one's own genetic predisposition — (Agrawal & Lynskey, 2014; Plomin et al., 2013; Scarr & McCartney, 1983) and gene–environment interactions (GxE) — the activation or suppression of genetic vulnerability in a particular environmental context (Agrawal & Lynskey, 2014). Therefore, more genetically-informed studies using a twin or adoption design that can control or take into account genes, environment, and GxE, and that can investigate both individual and contextual factors, as well as substance use behaviours, are urgently needed.

Much remains to be learned about the APP, substance use behaviours, and their associations and interplays with family socialization. First, it is unclear whether family socialization has direct long-term impacts on young adults' substance use, and whether controlling heritability (biological vs. adoptive families) changes these impacts. Second, it is also not known whether the development of the APP is affected by family socialization, or is determined more by genes and gene–environment interaction. Third, the characteristics and development of the four subscales of APP are unknown, including their transgenerational associations (parent–offspring) and impacts from genes, environment, and gene–environment interaction. Lastly, it is not known whether the four subscales are indicators or predictors of an individual's use of a specific substance or of his or her use of any substance.

Objectives

The overall objective of this project was to examine associations between family socialization, addiction-prone personality characteristics, and substance use over time. Its central hypothesis was that family socialization factors (contextual factors) influence offspring's personalities (individual factors) and substance use behaviours, both directly and indirectly, and cross-sectionally as well as longitudinally. The current project comprised secondary data

analyses of the VFS longitudinal data set. Specifically, I investigated associations between the family socialization factors (parental socialization and family system), APP characteristics, substance use (PSU and uses of four substances separately), as well as demographic factors. I also utilized the behavioural genetic approach — specifically, the adoption design — to investigate the environmental impact on personality and substance use when controlling for genetic influences. In keeping with the main objective, and by considering the complexity of the conceptual structure, the project was divided into three studies. The proposed structure of the current project is presented in Figure 2.



ST = study (e.g., ST 1 = study 1); APP = Addiction-Prone Personality; T1 = time1; T2 = time 2.

Figure 2. Proposed structure of the current project.

Study 1: Associations between family socialization factors and offspring's polysubstance use.[3] This study examined the associations between offspring's perceptions of fathers' and mothers' parental socialization (parenting styles) and PSU by youths and young adults in biological and adoptive families. The long-term influences of fathers' and mothers'

[3] The report of study 1 has been published (see Franco Cea & Barnes, 2014)

socialization styles were also investigated by using longitudinal data on offspring's PSU. The primary objective of this study was to examine how socialization styles in the first 15 years of offspring's lives were related to offspring's PSU. Based on the findings of one of the early studies of the VFS time 1 data (G. E. Barnes, Patton, & Marshall, 1997) and other studies in family socialization and substance use (e.g., G. M. Barnes et al., 2006; Creemers et al., 2011; Jiménez-Iglesias et al., 2012; Latendresse et al., 2010), I anticipated significant associations between parental socialization factors and offspring's time 1 PSU. Highly nurturing parental socialization factors may associate with low PSU. As several studies have suggested (e.g., Hair et al., 2008; Padilla-Walker et al., 2011), mothers and fathers might influence socialization in distinct ways. In the 1997 study, G. E. Barnes and his colleagues reported somewhat stronger associations between parental socialization factors and several substance use variables in the adoptive group than in the biological group. Therefore, I expected to see some differences in association patterns between biological and adoptive groups in this study. These association patterns might be expected to change (i.e., become weaker) when offspring are older (time 2), in accordance with the hypothesis developed in several behavioural genetic studies (e.g., Derringer, Krueger, McGue, & Iacono, 2008) that adolescents may be more influenced by environmental factors than adults are.

The conceptual model of study 1 is presented in Figure 3, showing how factors might be hypothetically related. Due to the large number of variables simultaneously analyzed and because more than one model was used in this study, not every hypothesized pathway is shown in this figure. The following were the research questions to be considered in study 1:

1. Are fathers' and mothers' socialization styles associated with offspring's PSU in distinct ways?

2. Do socialization factors influence biological offspring and adopted offspring differently?
3. Do socialization factors have similar influences on offspring PSU in adolescence (time 1) and young adulthood (time 2)?

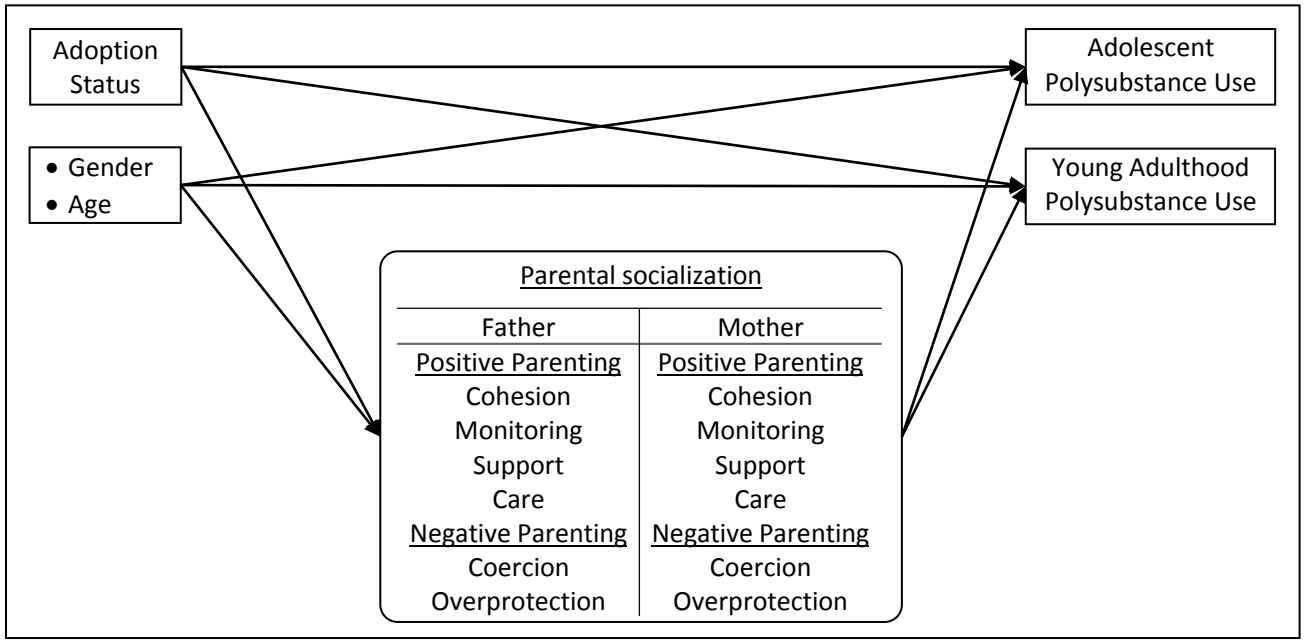


Figure 3. Study 1 conceptual model.

Study 2: Development of addiction-prone personality characteristics (associations between family socialization indicators and APP scores).[4] The objective of this study was to investigate whether or not the parents' APP scores and family socialization factors could predict the development of offspring's APP traits over time. The development of offspring's APP traits was examined from three perspectives: (a) patterns in biological and adoptive families, (b) offspring's vs. parent's perceptions of family socialization, and (c) different points in the lifespan.

Since G. E. Barnes, Murray, Patton, et al.'s (2000) study of the associations between parents' and offspring's time 1 APP scores showed significant but moderate correlations, I

[4] The report of study 2 has been published (see Franco Cea & Barnes, 2015)

anticipated that the direct pathway from parents' APP to offspring's APP scores would be significant also in the time 2 model. I also expected to find a difference in this pathway between biological and adoptive groups. Due to a possible genetic influence on the development of APP and the hypothesis that adults might be more influenced by genes than adolescents are (e.g., Derringer et al., 2008), the biological group were expected to show stronger association with parents' APP scores than the adoptive group does in the time 2 model.

The above-mentioned study (G. E. Barnes, Murray, Patton, et al., 2000) has also shown that a nurturing family environment was significantly associated with lower APP scores in adolescent offspring. Therefore, I anticipated seeing connections between family socialization factors and APP at both time 1 and time 2; however, the pattern of these connections might be different depending on whether offspring's or parents' perceived socialization factors were being analyzed, and associations might be weakening over time. Moreover, based on the findings of the cross-sectional study on the APP scale (i.e., male and adoptive group may score higher than female and biological group; Anderson et al., 1999), I expected to see predictive pathways from adoption status and gender to offspring's APP scores at both times.

The conceptual model of study 2 is presented in Figure 4. This figure shows all factors examined in this study and their hypothetical connections, but it is not a mathematical model for analysis (i.e., structural equation modelling). In this study, multiple models were developed to examine the following research questions:

1. Do the parents' APP scores and family socialization factors predict the offspring's APP scores; and do the association patterns differ between the biological and adoptive samples?
2. Do offspring's and parents' perceived family socialization indicators show different

association patterns with offspring's APP scores?

3. Do the parents' APP scores and family socialization indicators have similar association patterns with offspring's APP scores in both time 1 and time 2?

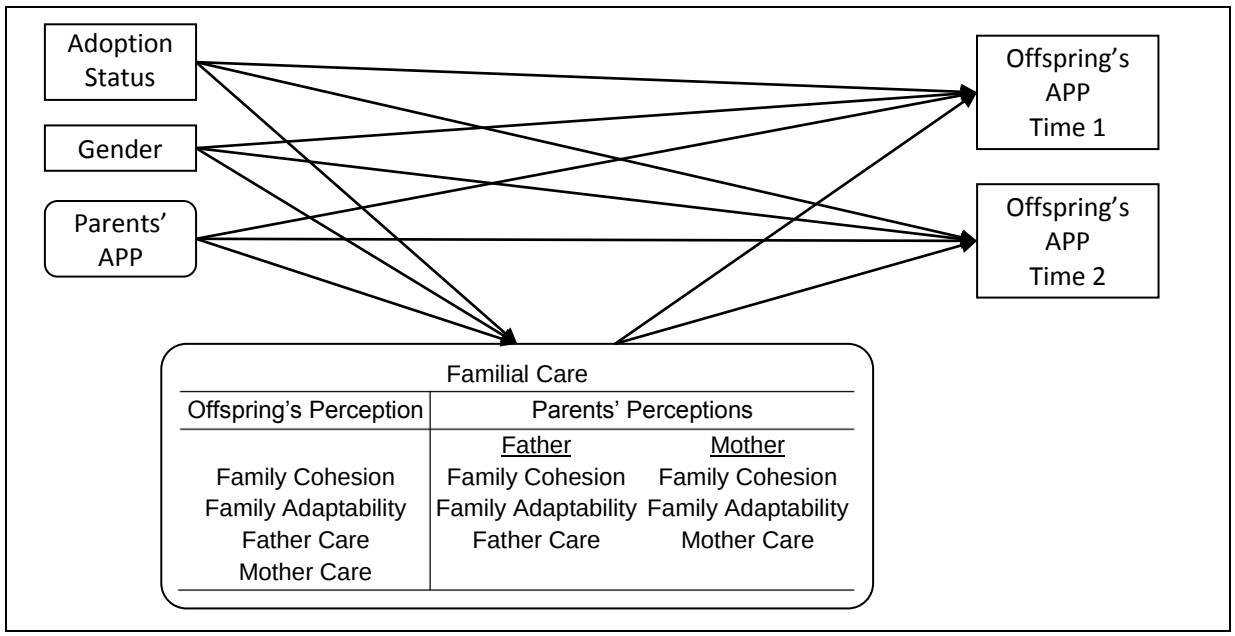


Figure 4. Study 2 conceptual model.

Study 3: Characteristics and trajectories of four subscales of the addiction-prone personality. The goal of this study was to examine more closely the four subscales of the APP (personality traits) and their associations with substance use. Although the test-retest correlation of the total scores of the APP scale (r = .74) was reported by Anderson et al. (2011), the test-retest reliability (i.e., rank-order stability) of the subscales had not yet been tested. In this study, test-retest correlation coefficients were computed by utilizing two waves of offspring's subscales data (7 years apart). For validity testing, the subscales' scores were compared with the personality scores obtained from the NEO-FFI to examine the construct validity of the subscales of the APP. Based on Anderson's (2003) hypothetical description of three subscales, and my hypothesized description of the social deviance proneness subscale, I anticipated significant correlations between each subscale and one or more facets of the NEO-FFI (Costa & McCrae,

1992) to establish satisfactory convergent validity:

- *impulsivity/recklessness*: neuroticism (the impulsivity facet), agreeableness, and conscientiousness (the self-discipline facet);
- *sensation seeking:* extraversion;
- *negative view of self*: neuroticism (the self-conscious and depression facets), conscientiousness, and extraversion; and
- *social deviance proneness*: agreeableness (the compliance and altruism facets) and conscientiousness (the dutifulness, self-discipline, and order facets).

The reviewed studies using the APP total score (e.g., Anderson et al., 1999) found gender difference (males scored higher) and difference by adoption status (adopted offspring scored higher); I therefore anticipated that some subscales might show different scores by gender and adoption status. Also, several studies in personality change indicate that each personality trait may have a different trajectory of development over time (e.g., Hicks et al., 2013; Quinn & Harden, 2013). The four subscales of APP might also show distinct patterns of change over time. Moreover, based on the findings of earlier studies of the associations of total scores of APP with substance use (Anderson et al., 1999) and with parents' APP scores (G. E. Barnes, Murray, Patton, et al., 2000), I expected to see significant associations between parents' and offspring's subscale scores and between offspring's subscales and substance use variables. I hoped to find out whether each subscale shows a unique association pattern or not, and whether these association patterns change when offspring get older. In short, I hypothesized that each of the four subscales of the APP may have (a) different associations with offspring's demographic variables (gender and adoption status), (b) a distinctive trajectory, (c) a unique association between parents and offspring, and (d) a unique association with specific substances. The

research questions in this study were:

1. Are the subscales of the APP reliable and valid?
2. Does each subscale of the APP have unique characteristics and a unique trajectory pattern (i.e., changes from T1 to T2), and do these patterns differ by gender and the adoption status of offspring?
3. Does each subscale of the APP have a significant connection between parents' and offspring's scores, and do the association patterns differ by gender and the adoption status of the offspring?
4. Is each subscale of the offspring's APP connected with substance use, do those connections differ by substance, and do the association patterns remain the same when gender and adoption status of offspring are controlled for?

Chapter 2: Methods

The data for the current study are taken from the Vancouver Family Survey (VFS; G. E. Barnes, Anderson, & Jansson, 2008; G. E. Barnes et al., 1997). The VFS was conducted as a two-wave longitudinal survey in Vancouver, British Columbia, Canada. The primary objective of the VFS was to examine the associations between the family environment and the risk for substance use in biological and adoptive families in a general population sample (G. E. Barnes, Murray, Patton, et al., 2000).

Procedure for Data Collection and Description of Samples

In the original design for the VFS, Gordon E. Barnes, David Patton, and Sheila Marshall proposed screening over 100,000 families to identify a sample of intact families with children in the 14 to 25 age range living at home (G. E. Barnes et al., 1997). The sample for the data collection was identified through a directory of telephone listings in the Greater Vancouver area. The data collection was restricted to intact families to allow an examination of the influence of both parents on the development of offspring. Children in the adoptive families had to be adopted before the age of 5, and in fact most had been adopted early in the first year of life. The sample excluded adoptive families where there existed any biological relationship with one of the parents. The participants were also restricted to respondents who were fluent enough in English to answer the questionnaires.

In the end, this process yielded a large (n = 5,120) sample of biological families eligible for participation, but only 177 adoptive families. Biological families were then selected at random for recruitment into the study, along with all of the identified adoptive families (G. E. Barnes et al., 1997). Families were contacted by telephone and an attempt was made to arrange a visit to each family to administer questionnaires to both parents and the youngest child in the 14

to 25 age range. Families were only included if all three family members were willing to participate. This procedure yielded data on a sample of 477 biological families and 75 adoptive families (participation rate of 53%). Because the screening process was very costly, the recruitment strategy was expanded to include recruitment through newspaper advertisements and referrals. This process produced an additional 57 adoptive families. Demographic comparisons were made between the randomly and non-randomly selected adoptive families. There were no differences between these groups except for mothers' education (15 years of education vs. 14 years in the random sample; G. E. Barnes et al., 1997). In the process of data cleaning, three randomly selected adoptive families, one non-randomly selected adoptive family, and one biological family were dropped for not meeting the inclusion criteria. The final sample consisted of 601 families at wave 1. Participating families each received $50.00.

Beginning in 2003, follow-up data at wave 2 were collected for the young adult sample of participants in the VFS (then aged 21 to 33). Potential participants were offered $25.00 as an incentive to participate. A total of 215 females and 190 males (n = 405) were re-interviewed, either in person or by the mail-out method. This represented 67% of the participants originally tested at time 1. The refusal rate for this project was 18%, and the remaining 15% of the sample were lost because participants could no longer be located, or had died (G. E. Barnes et al., 2008). The final sample comprised 328 offspring from biological families and 77 offspring from adoptive families. Data for time 1 participants who did not participate at time 2 were excluded from this project.

Measures

Substance use (study 1 and 3). Daily average smoking was computed using the number of cigarettes smoked each day during the last seven days. Daily average alcohol consumption

was computed using estimates of the number of drinks consumed each day during the most recent one-week period. In this survey, one "drink" meant one bottle of beer or glass of draft, one glass of wine or a wine cooler, or one straight or mixed drink with about one and a half ounces of hard liquor. Marijuana and other illicit drug use (cocaine or crack, LSD, speed, heroin) were assessed by items regarding the frequency of use of these substances in the past twelve months (0 = never; 1 = less than once a month; 2 = 1-3 times a month; 3 = once a week; 4 = more than once a week). Marijuana was treated as a separate drug use item, and the other drugs were combined to form an "other illicit drugs" variable. For both the first and the second wave of data collection, the same items were administered, and scores were calculated by the same procedure (see Appendix B for the items of substance use measures in the VFS).

Personality (study 2 and 3). The APP-21 measure was used to assess personality vulnerability to substance use. Each family member completed the APP-21 measure at time 1. Seven years later, 405 offspring completed the same APP measure at time 2 (see Appendix A for the APP-21 items). A recent study (Anderson et al., 2011) has shown that the APP-21 scale is a reliable measure, both regarding internal consistency, test-retest reliability, and predictive validity for predicting new cases of substance dependence. This scale also showed good discriminant validity in relation to several of the major personality inventories (Anderson et al., 2011). In the VFS, internal consistencies for the APP-21 scale were .67 (time 1) and .71 (time 2) for offspring, .64 for mothers, and .67 for fathers. Each family member also completed a self-report form of the NEO Five-Factor Inventory, Form S (NEO-FFI; Costa & McCrae, 1992) at time 1. The NEO-FFI was used to measure the personality dimensions of neuroticism, extraversion, openness, agreeableness, and conscientiousness.

Family socialization (study 1 and 2). Perceptions of family socialization were assessed

by three different instruments for measuring family systems and parental socialization (parenting) at time 1. The family system was assessed by asking each family member to complete the Family Adaptability and Cohesion Evaluation Scales II (FACES II; Olson & Tiesel, 1991). Faces II contains two scales designed to measure adaptability and cohesion in each family. Test-retest reliabilities for these scales over a four-week period are r = .80 for adaptability and r = .83 for cohesion (Olson & Tiesel, 1991). In the VFS, internal consistencies for the adaptability scale were .79 for offspring, .74 for mothers, and .72 for fathers. For the cohesion scale, Cronbach's alphas were .88 for offspring, .86 for mothers, and .86 for fathers (G. E. Barnes et al., 1997).

The Parker Parental Bonding Instrument (PBI; Parker, Tupling, & Brown, 1979) was utilized for assessing parental socialization. The PBI contains 13 items measuring parental overprotection and 12 items assessing parental care. High care is defined by affection, emotional warmth, empathy, and closeness. High overprotection has been defined as control, intrusion, excessive contact, and prevention of independent behaviour. Test-retest reliability of the care and overprotection scales over a three-week interval are r= .74 and r= .69 respectively (Parker et al., 1979). In the VFS, offspring filled the instrument out twice, once for each parent. In the offspring's report, internal consistencies of the care and overprotection scales were as follows; maternal care .90; paternal care .91; maternal overprotection .85; paternal overprotection .80. In each of the parent's self-reports, Cronbach's alphas were mother care .73; father care .78; mother overprotection .75; father overprotection .70 (G. E. Barnes et al., 1997).

Additional items for parental support, monitoring, and coercion were taken from the Grace Barnes research (G. M. Barnes & Farrell, 1992) and completed by offspring only (see Appendix C for the items used in the VFS). Mother and father support were separately measured,

each consisting of four items. Mother and father coercion were also measured separately with three items each (Cronbach's alpha = .52 for mother coercion and .58 for father coercion). Monitoring consists of two items about "parents' monitoring" instead of father and mother separated items (Cronbach's alpha = .71): "how often did you tell your parents where you're going to be after school?" and "how often did you tell your parents where you're really going when you went out evenings and weekends?" (G. E. Barnes et al., 1997).

Demographic domain. Demographic questions that were selected as being important in the current investigation as control variables were offspring's gender (0 = female and 1 = male), age (14–25 at time 1 and 21–33 at time 2), and adoption status (0 = biological and 1 = adopted).

Study-specific descriptions of measures: Study 1.

Substance use: PSU 1 and PSU 2. Based on use data for each of four substances (alcohol, tobacco, marijuana, and other illicit drugs), the standardized PSU variables for each wave were created by researchers who were also analysing VFS data (M. Jansson, personal communication, November 28, 2011). These variables were developed by using the following strategies: (a) compute standardized individual scores for alcohol use, smoking, marijuana, and other drugs; (b) calculate an average overall score based on these four individual standardized scores; and (c) standardize this overall score.

Family socialization: Offspring's reports of cohesion, care, overprotection, support, monitoring, and coercion. All data on family socialization were based on the offspring's perspectives on their parents' socialization styles in the first 15 years of their lives. In this study, only the offspring's perspectives of socialization styles were analysed because several socialization style variables were only available from the offspring's perspectives in the VFS data set. Potentially significant variables, such as monitoring and coercion, were not included in

the parents' questionnaire.

Demographic domain. The demographic domain variables employed in this study were gender, age, and adoption status**.**

Study-specific descriptions of measures: Study 2.

Personality: Father's APP, mother's APP, parents' midpoint APP, offspring's APP time 1 and 2. In addition to father's and mother's APP scores, the parents' midpoint APP scores were also computed and correlated with the offspring's scores. The parents' midpoint scores were used in earlier adoption studies and found to be slightly better predictors of the offspring's personality scores than were the individual parent scores (e.g., Scarr, Webber, Weinberg, & Wittig, 1981).

Family socialization: Parents' and offspring's reports of cohesion, adaptability, and care. As one of the analytical objectives is to compare parents' and offspring's perceptions, variables based on the items completed only by offspring are excluded from the analyses in study 2.

Demographic domain. The demographic domain variables employed in this study were gender, age, and adoption status.

Study-specific descriptions of measures: Study 3.

Personality: Four subscales of parents' midpoint APP, offspring's APP time 1 and 2, and offspring's FFI scores. Based on the dimensionality study of APP-21 conducted by Anderson (2003), the scores of each subscale were calculated. The *impulsivity/recklessness* subscale consists of five items (e.g., Have people said that you sometimes act too rashly?). The *sensation seeking* subscale consists of five items (e.g., Do you prefer loud music over quiet music?). The *negative view of self* subscale also consists of five items (e.g., Do you wish you

could have more respect for yourself?). And the newly named *social deviance proneness* subscale contains six items (e.g., Have you ever been in trouble with the law?) All items of the APP subscales are shown in Appendix A. For each subscale, parents' midpoint scores (average of father's and mother's scores) were computed. To test the concurrent validity of each subscale, offspring's FFI scores (neuroticism, extraversion, openness, agreeableness, and conscientiousness) were used in this study.

Substance use: Alcohol, smoking, marijuana, other illicit drugs (time 1 and time2). Four substance use variables for each time were used for this project instead of aggregated PSU variables.

Demographic domain. The demographic domain variables employed in this study were gender and adoption status.

Data Analysis

Study 1: Associations between family socialization factors and offspring's polysubstance use. In this study, I conducted a series of analyses to examine and answer the three research questions established in the previous chapter. As a preliminary analysis, I examined whether there was any potential difference in offspring's perceived father's and mother's parental socialization, and in substance use by demographic factors (i.e., gender and adoption status). These patterns were examined with multivariate analysis of variance (MANOVA). The between-subject independent variables were offspring's gender, adoption status (biological vs. adopted), and their interactions. For all variables, I reported effect sizes using a partial eta-squared; η^2. The bivariate associations between predictors, parental socialization style, and the substance use dependent variables were also calculated to determine which variables were correlated with each other and whether there was any difference in

correlation patterns between biological and adopted groups. These preliminary steps were necessary to establish the relevance of the proposed research questions.

Research question 1: Are fathers' and mothers' socialization styles associated with offspring's polysubstance use differently? To examine the influences of fathers' and mothers' socialization on their offspring, I chose the structural equation modelling method for analyses, and built models with EQS 6.1 (Bentler, 2004) using the maximum likelihood solution. First, I looked at the measurement structures in each of the domains. I executed confirmatory factor analysis for parental socialization styles and substance use. The substance use measures seemed to fit together on a PSU latent factor; however, since the standardized composite PSU variable showed better overall fits in the later analysis, this variable was selected instead of the latent factor. In the proposed conceptual model (see Figure 3), the parental socialization style variables fit onto four latent factor variables: positive parenting (cohesion, monitoring, support, and care) by a father; positive parenting by a mother; negative parenting (coercion and overprotection) by a father; and negative parenting by a mother. However, the potentially most significant variables (monitoring and cohesion) were assessed only as joint measures in the original VFS, and are not available separately for father and mother; at the same time, I particularly wanted to test whether these variables fit onto both father and mother latent variables. Moreover, to answer research question 1, it was crucial to examine and compare the father's and mother's association patterns with the offspring's substance use. Therefore, I chose to develop the father's and mother's models separately. Monitoring and cohesion were loaded on the latent factor — positive parenting in both models. Coercion and overprotection variables, each available for fathers and mothers separately, were considered to be potentially negative parenting variables; however, these two variables did not fit well into a joint latent factor and so were examined as independent

predictors in each model.

Research question 2: Do socialization factors influence biological offspring and adopted offspring differently? In order to examine and compare biological and adoptive groups' association patterns, I chose to utilize multiple group constraint analyses. The multiple group constrained model strategy in structural equation modelling allows users to analyze more than one group simultaneously. It is possible to investigate whether a specific model fits equally well in both groups by placing equality constraints on parameters across groups. Placing an equality constraint on a parameter means that the researcher commands the software to estimate one parameter that is equal in both groups (Hox & Bechger, 1998).

During the process of determining constraint paths, some equality constraints on parameters may be rejected. This occurs when these parameters are not equal in either the direction (positive or negative) or the sizes of path coefficients between groups. When these constraints are removed, the coefficients of the unconstrained paths reveal unique path coefficients in each group.

For this study, if I can place equality constraints on all parameters (intercepts, loadings, error variances, and factor covariance), this model will work for both biological and adoptive groups. In other words, the parameters including measurement pathways and structural pathways are equivalent for both groups. In this study, the difference between the biological group (genetic-plus-environmental impacts) and the adoptive group (environmental impacts) may suggest possible genetic effects on associations between factors. If similar models work for both groups, the results of the structural equation modelling may indicate stronger supports for environmental effects.

Research Question 3: Do socialization factors have similar influences on offspring

polysubstance use in both adolescence (time 1) and young adulthood (time 2)? I chose to address this question by comparing two association patterns: socialization and time 1 PSU, and socialization and time 2 PSU, to see if there are similarities or differences in the patterns of influence of predictors. To compare the patterns of those associations, I first needed to obtain an association pattern model for each outcome variable (time 1 or time 2 PSU). Therefore, I developed time 1 and time 2 models separately for the comparison. I particularly focused on the direct association between family socialization and PSU because the analysis of direct-effect patterns might show a long-term influence of internalized family socialization on the time 2 outcome. Moreover, congruent with the family socialization framework, I hypothesized family socialization as a mediator between individual factors (i.e., age and gender) and outcomes (PSU). After consideration, I decided that testing and reporting the mediated effect (by time 1 PSU) of a mediator's effect (family socialization) on time 2 PSU would be too complex to be done in one study. In order to be able to straightforwardly and clearly address research question 3 in this study, the analyses of indirect influence of family socialization (mediated by time 1 PSU scores) were moved to a future project.

During the stage of building the structural equation model, the structural pathways were based on the rationales and decisions mentioned above. A pairwise covariance matrix was employed to handle missing data. The Lagrange Multiplier test and Wald test as well as the Comparative Fit Index (CFI) and the Root Mean Square Error of Approximation (RMSEA) guided me to add and subtract covariance paths between factors in the models until the model reached a satisfactory fit level and estimated effect size (Kelley & Preacher, 2012). This structural pathway model was used for both time 1 and time 2 models, and for both mother and father models for comparison. In the final stage of model building, I employed the multiple

group constrained model strategy for all four models. Criteria used to judge the fit of a final solution included reaching a χ^2 to degrees of freedom ratio of less than 2 to 1, a CFI of over .90, and RMSEA of less than .10 (Byrne, 2012).

Study 2: Development of addiction-prone personality characteristics (associations between family socialization indicators and APP scores). One of the main differences between this study and the earlier APP study (Barnes, Murray, Patton et al., 2000) was the availability of two waves of APP data. The previous study used only time 1 data to examine associations between parents' APP, family socialization factors, and offspring's APP. Therefore, I conducted two preliminary analyses of time 2 APP scores. I first needed to test whether offspring's APP scores changed significantly, which entailed examining the mean differences of the APP scores between time 1 and time 2 by conducting a dependent t-test. Next, correlations were computed between the parents' APP scores and the offspring's APP scores in both the biological and the adoptive samples. The parents' midpoint APP scores were also calculated and correlated with the offspring scores. The parents' midpoint scores were used in earlier adoption studies and found to be slightly better predictors of offspring's personality scores than individual parent's scores (e.g., Scarr et al., 1981).

Research question 1: Do the parents' APP scores and family socialization factors predict the offspring's APP scores; and do the association patterns differ between the biological and adoptive samples? The first part of research question 1 is an overarching question throughout this study. To address this question, the structural equation modelling method was employed. Overall structural equation models were developed by utilizing EQS 6.1 (Bentler, 2004) to examine the association between the parents' APP, the offspring's APP, and familial care factors as shown in Figure 4. Latent factors for familial care were developed using three

variables (family cohesion, family adaptability, and parental care). The Lagrange Multiplier test and Wald test as well as the CFI and the RMSEA were used to guide modifications of covariance paths in the models until an acceptable level of fit and estimated effect size was achieved (i.e., a χ^2 to degrees of freedom ratio of less than 2 to 1, a CFI of over .90, and RMSEA of less than .10; Byrne, 2012; Kelley & Preacher, 2012).

To examine the second part of research question 1, I chose to use the multiple group constrained model to compare association patterns between the biological and adoptive sample groups.

Research question 2: Do offspring's and parents' perceived family socialization indicators show different association patterns with offspring's APP scores? Comparisons of association patterns between factors of parents' and offspring's perceived socialization were made by developing parents' and offspring's perception models separately. The latent factor of familial care in the parents' model consisted of the father's and mother's perceived family cohesion and family adaptability, and self-reports of own care of the offspring. In the offspring's model, offspring's perceived family cohesion, family adaptability, father's care, and mother's care variables were loaded onto the same latent factor.

Research question 3: Do the parents' APP scores and family socialization indicators have similar association patterns with offspring's APP scores in both time 1 and time 2? To address this question, I chose to compare two association patterns: predictive factors (the parents' APP scores and socialization indicators) and time 1 APP scores, and the same predictive factors and time 2 APP scores, to see any different pattern emerged. Since this is the first study to examine the longitudinal association between predictive factors and time 2 APP scores, it was important to establish the direct association pattern of time 2 APP scores first. Therefore, I

developed time 1 and time 2 models separately for the comparison.

Study 3: Characteristics and trajectories of four subscales of the addiction-prone personality.

Research question 1: Are subscales of APP reliable and valid measures to use? I tested the reliability of subscales of the APP by computing test-retest correlation coefficients. Two waves of offspring's subscales data (7 years apart) were utilized. For validity testing, convergent validity of subscales of APP was examined by utilizing the scores of five facets of the NEO-FFI. I computed correlation coefficients to see whether the scores of APP subscale (time 1) were significantly correlated with theoretically related facets of the NEO-FFI.

Research question 2: Does each subscale of the APP have unique characteristics and a unique trajectory pattern (i.e., changes from T1 to T2), and do these patterns differ by gender and the adoption status of offspring? To answer research question 2, a repeated measures MANOVA was conducted using the four APP subscales as dependent variables. The between-subject independent variables were offspring's gender, adoption status (biological vs. adopted), and their interactions. The within-subject variables were time, time x gender, time x age group, and time x adoption status.

Research question 3: Does each subscale of the APP have a significant connection between parents' and offspring's scores, and do the association patterns differ by gender and the adoption status of the offspring? To address this research question, associations between parents' and offspring's time 1 and time 2 scores on the APP subscales were examined by utilizing the structural equation modelling method with EQS 6.1 (Bentler, 2004). In order to examine the second part of the above research question, two multiple group constrained models, one by adoption status group (biological vs. adoptive) and another by gender (males vs. females),

were tested. In these models, I controlled for gender (in the adoption status group constraint model), and adoption status (in the gender group constraint model). I expected to see direct pathways from parents' subscales to offspring's time 1 subscales, and from offspring's time 1 subscales to time 2 subscales. In study 2, I found that time 2 overall APP scores and parents' overall APP scores were moderately correlated. Therefore, I expected to see some of the four APP subscales show significant associations between parents' and offspring's time 2 scores even when time 1 subscales were controlled.

Research question 4: Is each subscale of the offspring's APP connected with substance use, do those connections differ by substance, and do the association patterns remain the same when gender and the adoption status of offspring are controlled? I chose to address this research question by examining direct and indirect associations between the four subscales of the APP and the four substance variables by utilizing the structural equation modelling method with EQS 6.1 (Bentler, 2004). For this final step, only offspring's time 1 and time 2 scores (for both APP subscales and substance use) were used for the analysis. Based on the previous studies 1 and 2, I expected to see significant associations between time 1 and time 2 APP subscales and between time 1 and time 2 substance use variables, although both previous studies used overall APP scores and standardized PSU variables. First, effects of demographic factors on four substance use variables were tested by conducting a repeated measures MANOVA. The between-subject independent variables were offspring's gender, adoption status (biological vs. adopted), and their interactions. Pathways of cross-sectional associations (time 1 APP subscales – time 1 substance use; and time 2 APP subscales – time 2 substance use) and longitudinal associations (time 1 APP subscales – time 2 substance use) were examined simultaneously in the structural equation model. The gender and adoption status variables were included as control

variables in these analyses.

Chapter 3: Results

Study 1: Associations between Family Socialization Factors and Offspring's Polysubstance Use.

A series of analyses to examine the three research questions in this study began with two steps of preliminary analysis. As the first preliminary analysis, differences in offspring's perceived father's and mother's parental socialization, and in substance use by demographic factors (adoption status and gender), were examined with MANOVA.

Table 2

Multivariate Effects for Adoption Status and Gender on Parenting Styles and Polysubstance Use Patterns

	F	*df*	Error *df*	*p*	η_p^2
Parenting styles					
Adoption status	2.299	10	380	.013	.057
Gender	2.443	10	380	.008	.060
Adoption * Gender	1.383	10	380	.186	.035
Polysubstance use					
Adoption status	13.466	2	395	.000	.064
Gender	3.835	2	395	.022	.019
Adoption * Gender	1.885	2	395	.153	.009

Adoption status was entered into a MANOVA with the dependent variables of family socialization and substance use. The results of the MANOVA (see Table 2) revealed significant multivariate main effects for adoption status on both parental socialization, F (10, 380) = 2.299, p = .013, *partial* η^2 = .057; and substance use, F (2, 395) = 13.466, p < .001, *partial* η^2 = .064. Partial eta squared was used as an indicator of effect size in this analysis (small – *partial* η^2 >.01, medium – *partial* η^2 >.06, large – *partial* η^2 >.14; Gray & Kinnear, 2012). Based on this guideline, I interpreted both main effects for adoption status as having medium effect sizes. The main effects for gender were found to be significant on parental socialization, F (10, 380) = 2.443, p = .008, *partial* η^2 = .060 (medium); and substance use, F (2, 395) = 3.835, p = .022,

partial η^2 = .019 (small). The effect for the adoption status x gender interaction was not statistically significant. Given the significance of the overall test, the univariate effects were examined.

Table 3a

Significant Univariate Effects for Adoption status (at p < .05 level)

	Means (S.D.)						
	Biological	Adopted	*df*	Error *df*	F	*p*	η_p^2
Parenting styles							
Cohesion	3.89 (1.60)	3.37 (1.70)	1	389	7.24	.007	.018
Monitoring	7.93 (1.75)	7.19 (2.13)	1	389	10.17	.002	.025
Mother Coercion	5.13 (1.36)	5.52 (1.43)	1	389	4.93	.027	.013
Father Coercion	4.88 (1.43)	5.29 (1.68)	1	389	4.90	.027	.012
Substance use							
PSU Time 1	-.10 (.86)	.42 (1.36)	1	396	18.88	.000	.045
PSU Time 2	-.11 (.81)	.47 (1.52)	1	396	22.03	.000	.053

Table 3b

Significant Univariate Effects for Gender (at p < .05 level)

	Means (S.D.)						
	Female	Male	*df*	Error *df*	F	*p*	η_p^2
Parenting styles							
Cohesion	3.83 (1.70)	3.76 (1.56)	1	389	4.34	.038	.011
Monitoring	8.10 (1.78)	7.45 (1.87)	1	389	8.66	.003	.022
Mother Coercion	5.01 (1.35)	5.41 (1.38)	1	389	4.57	.033	.012
Father Coercion	4.77 (1.41)	5.15 (1.54)	1	389	5.55	.019	.014
Father Care	24.76 (7.95)	23.81 (7.06)	1	389	6.38	.012	.016
Substance use							
PSU Time 2	-.11 (.72)	.13 (1.24)	1	396	7.36	.007	.018

Significant univariate effects ($p < .05$) were found on four socialization variables (small effect sizes; Gray & Kinnear, 2012) and both substance use variables (medium effect sizes; see Table 3a). The results of the univariate effect test showed that adopted offspring scored lower than biological offspring on cohesion and monitoring, but higher on mother coercion, father coercion, time 1 PSU, and time 2 PSU. Significant univariate effects for gender were also

obtained on five family socialization variables and the time 2 PSU variable (small effect sizes; see Table 3b). The results showed that males scored lower on cohesion, monitoring, and father care, but higher on mother coercion, father coercion, and time 2 PSU. Both between-subjects independent variables (adoption status and gender) consist of two groups, and all comparisons were made between two groups. Therefore, there was no need to conduct any post hoc test, (e.g., Bonferroni).

The multivariate tests did not reveal a significant effect for the adoption status x gender interaction; however, three significant univariate interactions were found between adoption status and gender on cohesion ($F(1,389) = 7.860$, $p=.005$, *partial* $\eta^2= .020$), father support ($F(1,389) = 9.437$, $p=.002$, *partial* $\eta^2=.024$), and father care variables ($F(1,389) = 6.078$, $p=.014$, *partial* $\eta^2=.015$). To examine the interaction, the data was split by adoption status and a MANOVA was run for gender. It was found that males scored lower than females on cohesion, father support, and father care only for the adopted offspring group. The gender effect was not found for the biological group. The data was then split by gender and a MANOVA was performed to investigate the effects for adoption status. It was found that male adopted offspring scored significantly lower than male biological offspring on these three variables, whereas females did not show a significant effect by adoption status. In short, the interaction between adoption status (being adopted) and gender (being male) showed effects on the presumably protective factors of cohesion, father support, and father care. The adopted male offspring reported significantly lower scores on these variables.

The second part of the preliminary analyses involved an examination of bivariate associations between predictors — including parental socialization style measures — and the substance use dependent variables. The correlations between demographics, parental

socialization variables and PSU measures are shown in Table 4. In both biological and adopted samples, high scores in cohesion, monitoring, father care, and mother care showed significant associations with low scores in PSU time 1. In addition, high mother support, low father coercion, and low mother coercion were significantly associated with low PSU in biological offspring; whereas, in adopted offspring, neither coercion score was significant, but high father support was significantly associated with low PSU. The correlation patterns showed more noticeable differences between biological and adopted offspring at time 2 than at time 1. For biological offspring, the only significant correlation was between monitoring and PSU (high monitoring with low PSU), whereas for adopted offspring four parental socialization variables had significant negative correlations with PSU: cohesion, father support, father care, and mother care.

Moreover, adopted offspring data showed PSU to be significantly associated with lower father support at both time 1 and time 2, but not with mother support at either time. Biological offspring data showed a significant negative correlation between mother support and PSU, but not between father support and PSU at time 1. These correlations suggest that there might be different patterns of association between parental socialization and PSU for mothers and fathers.

Table 4

Correlations between Demographic, Parenting and Polysubstance Use Variables

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Gender	-	.07	.04	-.17**	.09	.02	.12*	.14*	-.01	.04	-.10	.04	-.00	.12*
2	Age	-.14	-	.04	-.03	-.04	.02	.03	.05	-.07	.09	-.07	-.07	.04	-.11*
3	Cohesion	-.26*	.11	-	.32***	.55***	.50***	-.14*	-.18**	.58***	.48***	-.20***	-.23***	-.17**	-.06
4	Monitoring	-.16	-.13	.35**	-	.20***	.37***	-.16**	-.22***	.17**	.24***	-.05	-.04	-.27***	-.13*
5	Father Support	-.29*	-.05	.53***	.42***	-	.50***	-.10	-.06	.75***	.30***	-.17**	-.10	-.08	-.02
6	Mother Support	-.17	-.03	.47***	.36*	.52***	-	-.14*	-.30***	.37***	.70***	-.16**	-.27***	-.18**	-.04
7	Father Coercion	.18	-.12	-.18	-.17	-.23*	-.27*	-	.47***	-.27***	-.14*	.39***	.12*	.14*	.08
8	Mother Coercion	.14	-.15	-.30**	-.09	.21	-.41***	.50***	-	-.14*	-.42***	.24***	.40***	.23***	.11
9	Father Care	-.30**	.05	.63***	.34**	.83***	.45***	-.27*	-.27*	-	.43***	-.30***	-.21***	-.18**	-.03
10	Mother Care	-.16	.17	.59***	.34**	.44***	.78***	-.33**	-.50***	.60***	-	-.35***	-.50***	-.21***	-.08
11	Father Overprotection	.04	-.14	-.29*	-.28*	-.28*	-.36**	.39***	.38**	-.39**	-.54***	-	.55***	-.04	-.03
12	Mother Overprotection	.08	-.09	-.31**	-.30**	-.26*	-.42***	.11	.49***	-.34**	-.54***	.55***	-	.05	.09
13	PSU T1	.19	.05	-.40***	-.46***	-.23*	-.22	.06	.08	-.27*	-.28*	.07	.14	-	.55***
14	PSU T2	.16	-.15	-.33**	-.11	-.26*	-.13	.09	-.19	-.33**	-.26*	.09	.09	.49***	-

Note. PSU: Standardized polysubstance use. Correlation coefficients for adopted offspring are below the diagonal; for biological offspring are above the diagonal.

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

Multiple group constraints model analyses. This study consisted of three research questions. Research question 1 was about comparing the influence of fathers' and mothers' socialization on offspring. Research question 2 was about comparing association patterns between biological and adoptive groups. Research question 3 was about comparing association patterns between time 1 and time 2. To examine the three research questions simultaneously, four multiple group constraints model analyses were conducted. Once all four overall models — (a) time 1 father parenting, (b) time 1 mother parenting, (c) time 2 father parenting, and (d) time 2 mother parenting — were found to fit the data reasonably and showed similar estimated effect sizes (i.e., RMSEAs) — (a) CFI = 0.95 RMSEA = 0.08; (b) CFI = 0.93 RMSEA = 0.10; (c) CFI = 0.95 RMSEA = 0.08; and (d) CFI = 0.93 RMSEA = 0.10 — these models were tested as two-group (adoptive versus biological) constrained models. Results of the final structural equation models are presented in Figures 5a, 5b, 5c, and 5d.

In the four models, the tested paths are the same even though the respective coefficients may differ. The constrained paths are presented as solid lines, while unconstrained paths are displayed as dotted lines and show path coefficients for both the adoptive group (A) and the biological group (B). In the figures, only significant path coefficients are shown. If a path is constrained and not significant for both groups, a thin line is shown.

Time 1 father parenting model. The fit indices for the solution of time 1 father parenting model were considered to be a "good fit" based on recommended criteria (Byrne, 2012): χ^2 = 84.005; df = 44; CFI = 0.95; RMSEA = 0.07; R^2 = 0.18 (see Figure 5a). This model showed that gender was significantly associated with monitoring (low for male) and coercion (high for male) for both biological and adopted youth. For the adoptive group, gender was also significantly associated with all three positive parenting variables, whereas, for the biological group, it was

only associated with overprotection (low in male). As expected, the monitoring independent variable and the father positive parenting factor were both found to be directly associated with PSU as protective factors for both biological and adopted offspring. The cohesion independent variable was a significant direct predictor for the adoptive group only. Father coercion was found to be a risk factor for PSU for the biological group only. One unexpected result was that father overprotection turned out to be a significant protective factor for both biological and adopted offspring. All five covariance paths (shown as curved arrows in the models) were significant for both groups.

Time 1 mother parenting model. The fit indices for the time 1 mother parenting model suggested a moderate fit: $\chi^2 = 98.783$; $df = 45$; CFI = 0.93; RMSEA = 0.08; $R^2 = 0.15$ (see Figure 5b). This model showed that the predictor patterns were relatively similar to those found in the father model. However, the mother parenting model yielded several differences from the time 1 father model. In particular, the association between gender and mother overprotection was constrained and not significant overall in the mother parenting model. Moreover, mother overprotection was not a significant direct predictor of PSU in either biological or adopted offspring in the mother model. The covariance path between support and care was not significant in this model.

Time 2 father parenting model. The fit indices for the time 2 father parenting model showed a good fit: $\chi^2 = 77.103$; $df = 45$; CFI = 0.96; RMSEA = 0.06; $R^2 = 0.07$ (see Figure 5c). In this time 2 model, offspring's gender and age became significant direct predictors of PSU. Higher time 2 PSU scores were associated with male gender and younger age in both biological and adoptive samples. Monitoring, father positive parenting, father coercion, and father overprotection were no longer significant direct predictors for either group; however, cohesion

was still a significant protective factor for the adoptive group.

***Time 2 mother parenting model*.** The fit indices for the time 2 mother parenting model showed a moderate fit: $\chi^2 = 94.950$; $df = 45$; CFI = 0.94; RMSEA = 0.07; $R^2 = 0.06$ (see Figure 5d). By comparing this model with the time 1 mother model and the father models, there are several clear differences. In the same manner as described above for the time 2 father model, monitoring and positive parenting are no longer significant for either biological or adopted offspring; however, not only did cohesion remain significant, but mother coercion (risk factor as indicated by a positive path) and overprotection (protective factor as indicated by a negative path) also became significant, though only for the adoptive group.

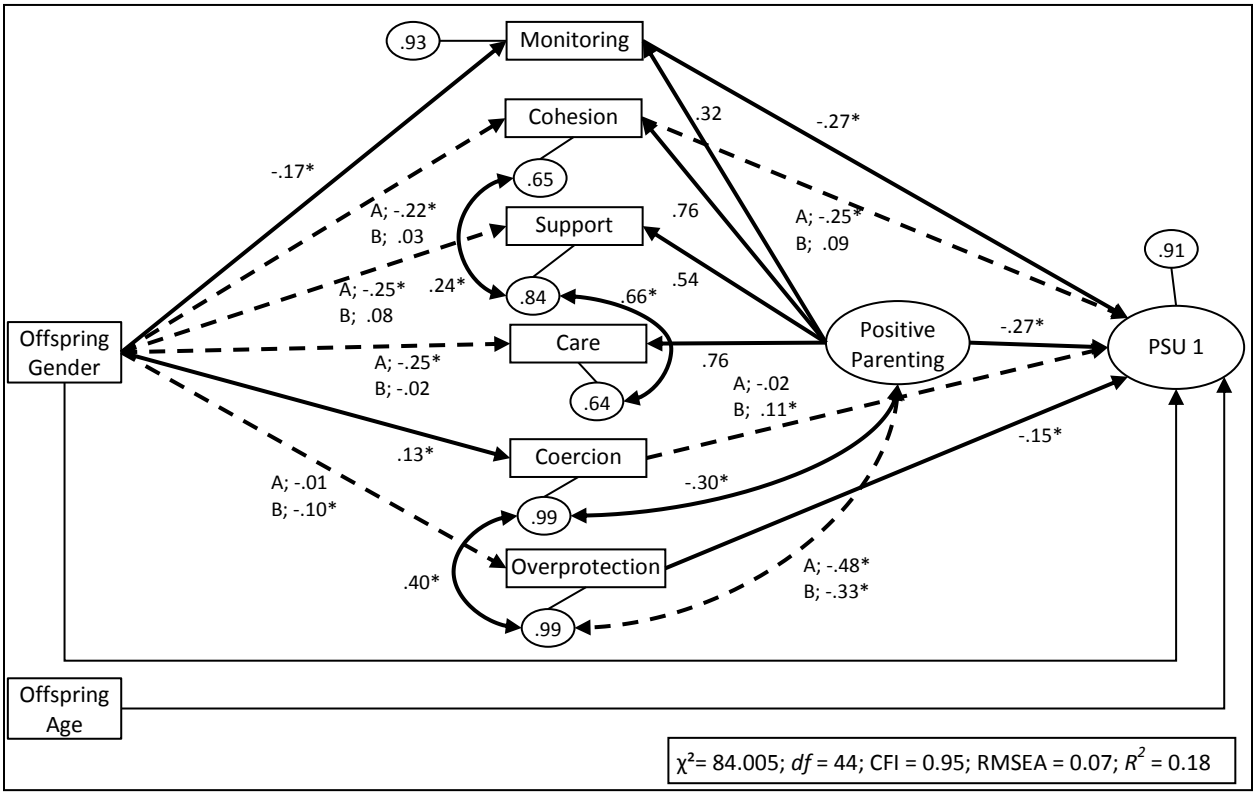


Figure 5a. Structural equation model – Parental socialization and PSU: Time 1 Father parenting.

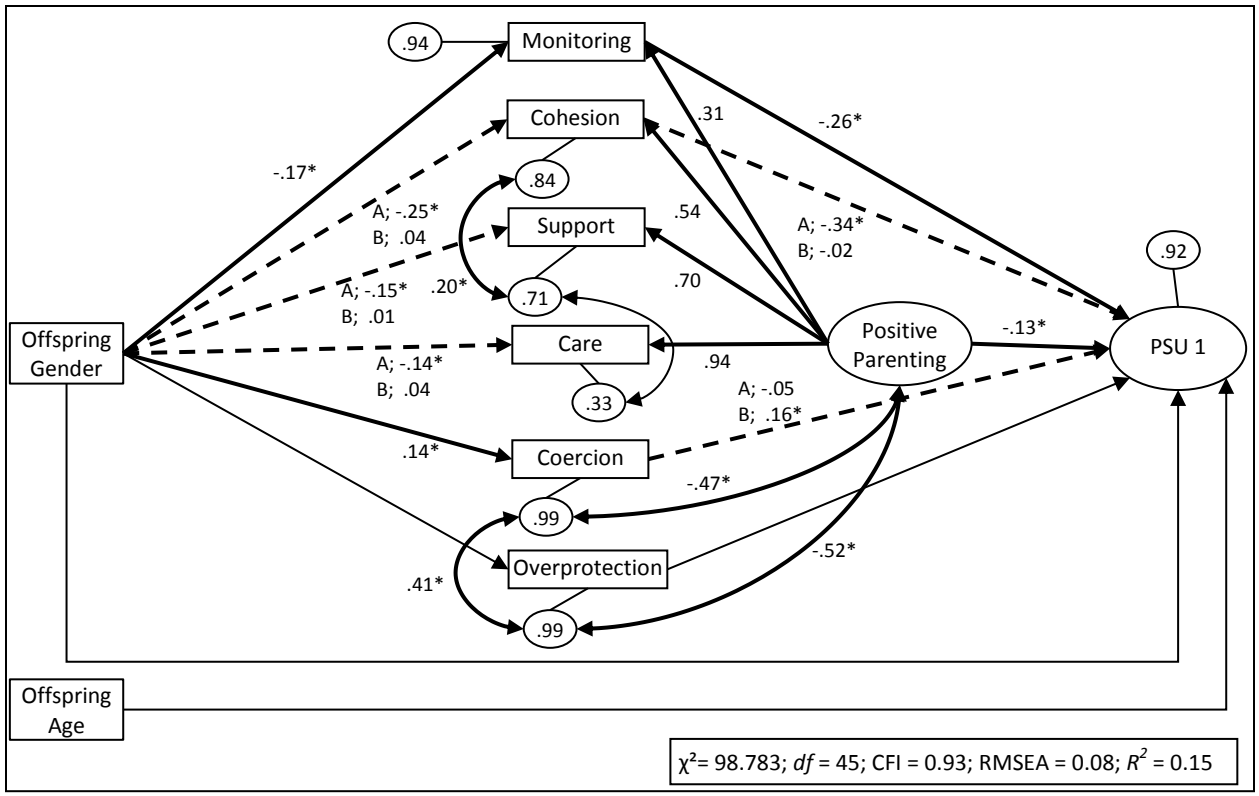


Figure 5b. Structural equation model – Parental socialization and PSU: Time 1 Mother parenting.

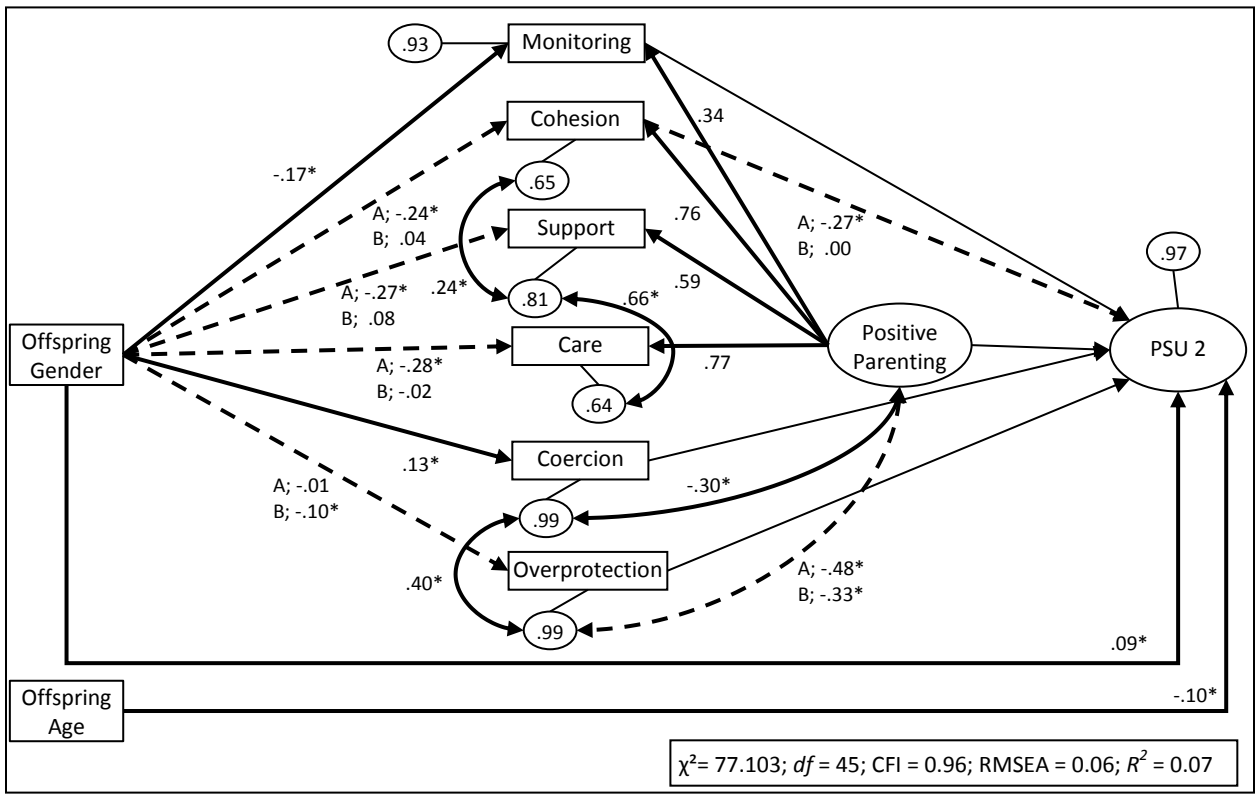


Figure 5c. Structural equation model – Parental socialization and PSU: Time 2 Father parenting.

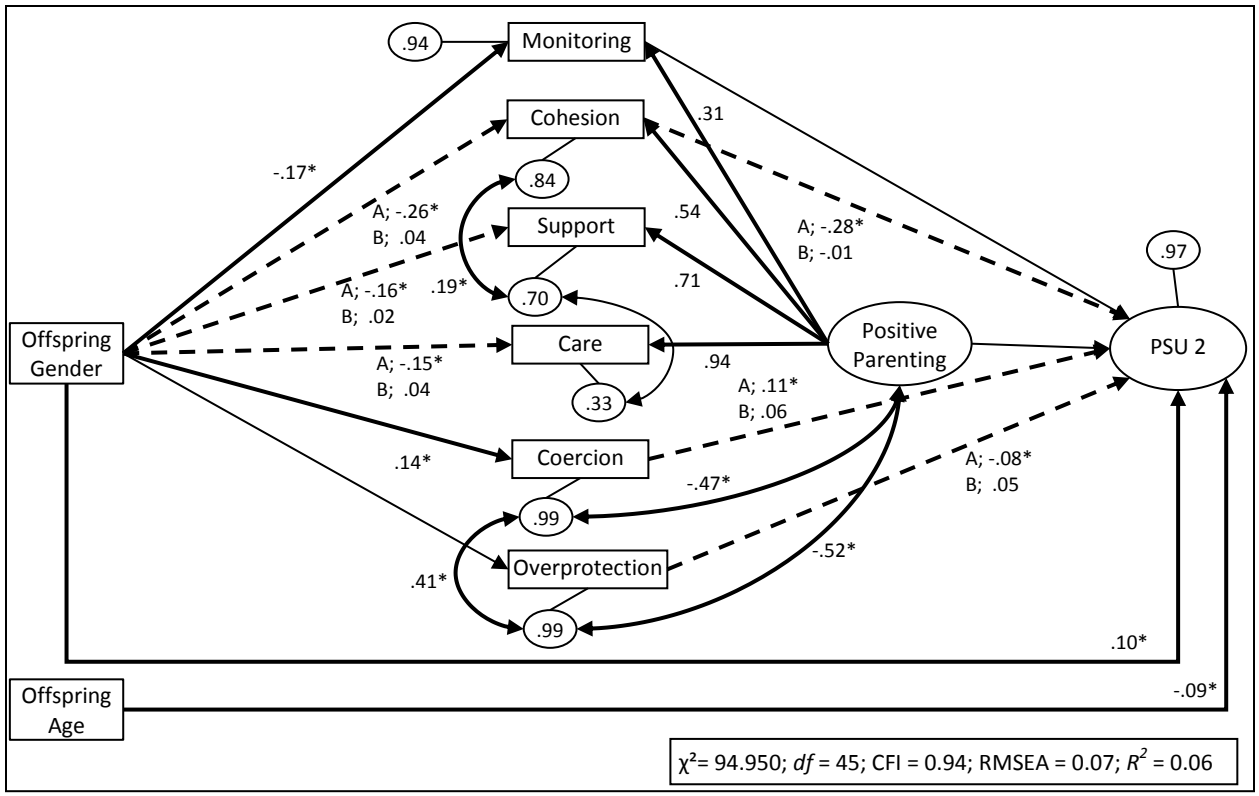


Figure 5d. Structural equation model – Parental socialization and PSU: Time 2 Mother parenting.

Summary of results.

Research question 1: Are fathers' and mothers' socialization styles associated with offspring's polysubstance use differently? The final structural equation models showed that offspring's perceptions of both fathers' and mothers' parental socializations directly affect offspring's PSU, a result that is consistent with existing studies. Our results also indicate the possibility that fathers' and mothers' parental socialization influences offspring's substance use behaviours in some different ways. Both fathers' and mothers' models showed similarly good fits and similar estimated effect sizes; however, mothers' parental socialization showed more unconstrained paths (equality constraints were rejected) between groups than fathers' models showed.

Research question 2: Do socialization factors influence biological offspring and adopted offspring differently? Both preliminary analysis (MANOVA) and structural equation

modelling analyses (rejected equality constraints) showed differences in parental socialization variables by adoption status. However, the overall structure of models and association patterns of positive family socialization indicators with PSU were found to be similar between biological and adopted groups.

Research Question 3: Do socialization factors have similar influences on offspring polysubstance use in both adolescence (time 1) and young adulthood (time 2)? Results of analyses of biological offspring's data also revealed that although various parental socialization factors showed significant impacts at time 1, reports on earlier socialization patterns did not show strong direct associations with offspring's substance use behaviours at time 2. However, adopted offspring's PSU showed continuous significant connections with family socialization factors over time.

Study 2: Development of addiction-prone personality characteristics (associations between family socialization indicators and APP scores).

The analyses of this study started with two preliminary analysis steps to examine changes of APP scores from time 1 to time 2 and their association with parents' scores. The result of the dependent t-test was t (404) = 8.171, $p < .001$ (Cohen's d = .39). From the means of the two APP scores and the direction of the t-value it can be concluded that there was a statistically significant decline of offspring's APP scores over time from 10.15 ± 3.57 to 8.74 ± 3.77 ($p < .001$); a decrease of 1.42 ± 3.49.

Correlations between the parents' and offspring's APP scores at time 1 and time 2 are presented in Table 5. The trend of correlations is very similar to the one found in the study done by G. E. Barnes, Murray, Patton, and colleagues (2000). Offspring's time 1 and time 2 APP correlations with parents-mid scores showed Cohen's ds = .31 and .50 and effect size rs = .15

and .24, respectively. In terms of the effect size of correlations, correlation coefficients are considered as effect sizes. All the correlations shown in Table 5 fell in the small to medium range (Cohen, 1992). I also computed the significant difference in comparisons of correlations from biological and adoptive groups by calculating the Z scores of differences. First, each correlation coefficient was converted into a *z*-score using Fisher's *r*-to-*z* transformation. Then, these *z*-scores were compared. None of the correlations shown in Table 5 were significantly different (range of z scores = .00–.82; range of probability = .42–1.00) between biological and adoptive groups.

Table 5

APP Correlations between Parents and Offspring in Biological and Adoptive Families

	Offspring's APP			
	Biological Sample (*n* = 328)		Adoptive Sample (*n* = 77)	
	Time 1	Time 2	Time 1	Time 2
Mother's APP	.18**	.16**	.28*	.19
Father's APP	.19**	.16**	.19	.11
Parents Midpoint APP	.24***	.20***	.30**	.20

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

Structural equation models. The results of the final structural equation models (constrained models) are shown in Figures 6a to 6d. In these final models, the constrained paths are presented as solid lines, while dotted lines represent paths that are required to reject equality constraints. In the final offspring's perception models (see Figures 6a and 6b), the models fit the data well with CFI of .96 (RMSEA = .06) for time 1 and .99 (RMSEA = .04) for time 2. The parents' perception models (see Figures 6c and 6d) also fit well with both the time 1 and the time 2 data (CFI = .97 and .97; RMSEA = .04 and .04 respectively). The estimated effect sizes of these four models are similar (RMSEAs = .04–.06). The variable characteristics for all variables used in these models are summarized in Table 6.

Table 6

Characteristics of Variables Used in the Final Models

	Mean	Range	SD
Time 1			
Offspring's age	17.86	14-25	2.54
Parents' Mid APP	4.93	0-13.50	2.30
Offspring's APP	10.15	0-19.89	3.57
Father's perspective			
Cohesion	4.68	1-8	1.54
Adaptability	5.10	2-8	1.41
Care	27.73	11-36	5.29
Mother's perspective			
Cohesion	4.95	2-8	1.51
Adaptability	5.24	1-8	1.38
Care	31.22	16-36	4.23
Offspring's perspective			
Cohesion	3.82	1-8	1.63
Adaptability	4.19	1-8	1.75
Paternal care	24.42	0-36	7.54
Maternal care	28.26	6-36	6.62
Time 2			
Offspring's age	25.84	21-33	2.59
Offspring's APP	8.74	0-18.00	3.77

Research question 1: Do the parents' APP scores and family socialization factors predict the offspring's APP scores; and do the association patterns differ between biological and adoptive samples? The results of structural equation model analyses showed that both the APP scores of the parents and family socialization factors directly predicted the offspring's APP scores. In the constrained models, all measurement paths and many structural paths were constrained to be equal, but among the latter there were several exceptions. The structural path from the familial care factor to the offspring's APP scores showed a clear difference between the biological and the adoptive samples. It was the significant predictive path in all four models for adoptive samples; however, for biological samples, this path was significant only in the offspring

models. Male gender directly predicts offspring's higher APP scores in the biological samples, whereas, it affects APP scores through the lower familial care latent variable in the adoptive samples. Lastly, the parents' APP scores predict family cohesion only in the biological offspring samples.

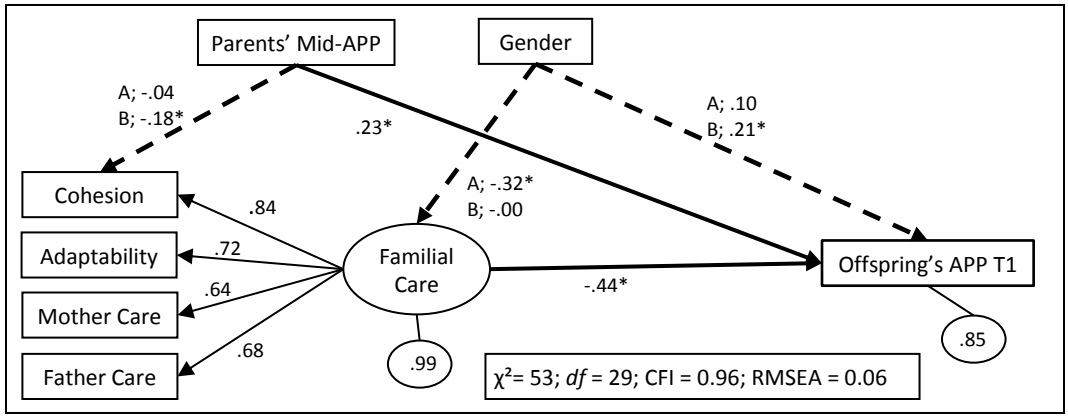


Figure 6a. Structural equation model of APP development: Offspring's perception Time 1.

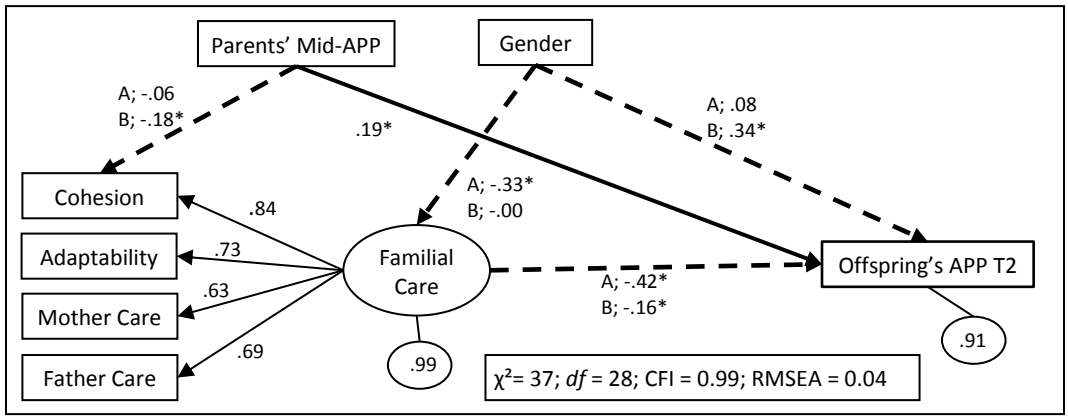


Figure 6b. Structural equation model of APP development: Offspring's perception Time 2.

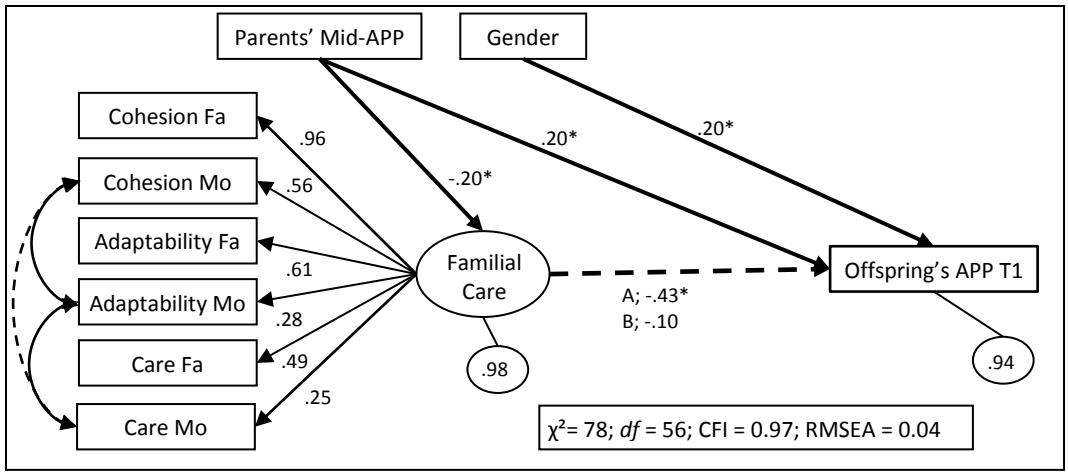


Figure 6c. Structural equation model of APP development: Parents' perception Time 1.

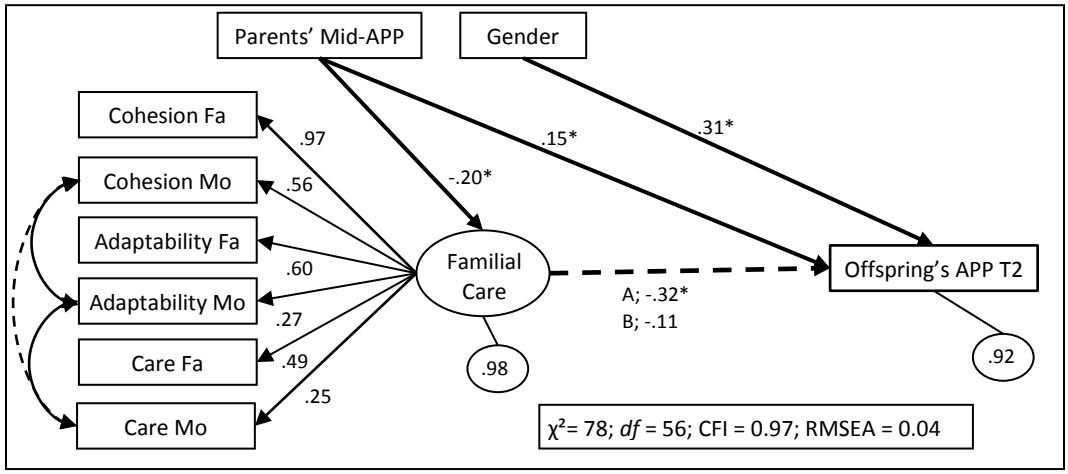


Figure 6d. Structural equation model of APP development: Parents' perception Time 2.

Research question 2: Do offspring's and parents' perceived family socialization indicators show different association patterns with offspring's APP scores? Both offspring's and parents' perceptions of familial care fit well within the models and show similar structural paths. One difference is that the parents' APP scores did not predict the offspring's perceived familial care factor, whereas it was a significant, consistent predictor in the parents' perception models. In the offspring models, male gender strongly predicted lower scores on the familial care factor in the adoptive samples; however, gender did not predict the familial care factor in the parents' models even for the adoptive samples.

Research question 3: Do the parents' APP scores and family socialization indicators

have similar association patterns with offspring's APP scores in both time 1 and time 2?

Despite the significant difference between time 1 and time 2 APP scores found by the dependent t-test, the models did not show much difference in the association patterns between the two times in both the offspring's and the parents' perception models. One difference is the path from the familial care factor to the offspring's APP. The coefficient of this path declined over time in the biological samples, though it was still statistically significant (see Figures 5a & b). However, this effect remained high in the adoptive samples. At time 2, the difference in the sizes of coefficients of this path between groups was large enough to require the removal of the equality constraint. For the biological samples, gender was the consistent significant predictor of offspring's APP scores in both the offspring's and the parents' perception models.

In summary, this study found that family socialization could predict offspring's APP scores regardless of the source of information (parents' or offspring's perceived family socialization) at time 1. In both biological and adoptive families, parents' and offspring's APP scores were moderately correlated. This indicates that offspring's APP development may be influenced more by environment. As in study 1, different patterns of parent–offspring relationships were found between biological and adoptive families by comparing time 1 and time 2 models. In adoptive families, family socialization factors characteristic of a caring family continuously predicted offspring's APP scores at time 2 as protective factors. This indicates three things: (a) development of an APP might be influenced by family socialization more than by genes; (b) support for the differential susceptibility hypothesis (individuals who might carry genetic risk factors will benefit more from positive environment and experience than those who do not have such genetic risk); and (c) adoption itself might have an impact on adoptees, and cause different development patterns than are seen in non-adoptees.

Study 3: Characteristics and Trajectories of Four Subscales of the Addiction-Prone Personality

In this study, a series of analyses to examine and answer the four research questions established in the previous chapter was conducted.

Research question 1: Are subscales of APP reliable and valid measures to use?

Pearson correlations were used to estimate the 7 year test-retest reliability (stability) coefficients of four subscales of APP. Test-retest correlation coefficients of subscales were all found to be moderate and statistically significant ($p < .001$); impulsivity/recklessness = .49, sensation seeking = .49, negative view of self = .38, and social deviance proneness = .48. These results indicate that the subscales of APP showed moderate reliability, and at a rank-order level, these subscales are fairly stable.

Construct validity, more specifically convergent validity, was tested by examining associations between the four subscales of the APP scale and the NEO-FFI scores. All correlations reported in this section were statistically significant ($ps < .001$); however, the correlation coefficients ranged from small to large, from -.17 to -.66. The results were almost consistent with Anderson's (2003) conceptualization of subscales and my hypothesized description. High impulsivity/recklessness was moderately associated with high neuroticism, low agreeableness, and low conscientiousness, as I anticipated. High negative view of self was strongly correlated with high neuroticism ($r > .50$), and moderately correlated with low extraversion, low agreeableness, and low conscientiousness ($r > .30$). Although low agreeableness was not included in my hypothetical description of this subscale, the negative view of self subscale showed moderate-to-strong connections to the anticipated facets of NEO-FFI. Social deviance proneness was correlated with low agreeableness and low conscientiousness,

with small to medium effect sizes. These correlations were also consistent with the hypothesized construct of this subscale. The sensation seeking subscale showed an unexpectedly significant correlation with agreeableness, instead of extraversion. Anderson (2003) conceptualized this subscale as correspond with the stimulus-reducing factor that is often described as being related to Zuckerman's sensation seeking and Eysenck's extraversion. Also, the NEO-FFI contains sensation seeking as one facet of extraversion. This result may indicate that the sensation seeking subscale of APP is measuring the stimulus-reducing factor as Anderson (2003) expected. However, it is not closely related to what the NEO-FFI measures as excitement seeking. Instead, it might be closer to Zuckerman and Cloninger's novelty or sensation seeking which refers to individual differences in optimal levels of stimulation or arousal. In short, correlations between subscales of the APP and domains of the NEO-FFI indicate that subscales of the APP could be valid tools to measure their intended constructs.

Research question 2: Does each subscale of the APP have unique characteristics and a unique trajectory pattern (i.e., changes from T1 to T2), and do these patterns differ by gender and the adoption status of offspring? To answer this research question, the repeated measures MANOVA was conducted to test the effects of adoption status and gender on APP subscales and measure these effects over time. Between-subjects factors are gender and adoption status. Within-subjects factors are time and its interactions with gender and adoption status.

The multivariate test revealed that both between-subjects factors, adoption status and gender, showed significant main effects on APP subscales, but the gender x adoption status interaction did not (see Table 7). The same test also showed that subscales were affected by time; in other words, these scores changed over time and their changes were statistically significant. However, the results of multivariate tests showed there was no difference between biological

versus adoptive groups and female versus male groups on APP subscales over time, F (4, 374) = 1.37, p = .25, *partial* η^2 = .01, and F (4, 374) = .82, p = .51, *partial* η^2 = .01, respectively.

Table 7

Multivariate Effects on Addiction-Prone Personality Subscales

	F	*df*	Error *df*	Sig.	η_p^2
Between-subjects					
Adoption status	5.176	4	374	.000	.052
Gender	14.308	4	374	.000	.133
Adoption * Gender	1.037	4	374	.388	.011
Within-subjects					
Time	12.246	4	374	.000	.116
Time * Adoption status	1.365	4	374	.246	.014
Time * Gender	.820	4	374	.513	.009
Time * Adoption * Gender	.084	4	374	.987	.001

Significant univariate effects ($p < .05$) for adoption status were found on three subscale scores (see Table 8). The results of univariate effect tests showed that adopted offspring scored higher than biological offspring on impulsivity/recklessness, negative view of self, and social deviance proneness. Significant univariate effects for gender were obtained on sensation seeking and social deviance proneness, with males scoring significantly higher than females on both subscales. The tests of univariate effects for time revealed that there were two potentially unique trajectory patterns among the four subscales. The results of univariate effect tests showed that scores of impulsivity/recklessness, sensation seeking, and negative view of self significantly declined over time (pattern one), but social deviance proneness did not (pattern two).

The multivariate tests did not reveal significant effects for interaction between time and between-subjects factors; however, one significant univariate interaction was found between time and adoption status on negative view of self. Adopted offspring's scores for negative view of self did not decline and remained higher than biological offspring's scores. This result indicated that adoption status might affect changes over time in the negative view of self

subscale; however, it might not have a significant impact on changes for other subscales.

Table 8

Significant Univariate Effects on Addiction-Prone Personality Subscales (at p < .05 level)

	Mean estimates (Standard error)		*df*	Error *df*	F	*p*	η_p^2
For Adoption status	Biological	Adopted					
Impulsivity/recklessness	2.28 (.07)	2.75 (.15)	1	377	8.01	.005	.021
Negative view of self	1.70 (.06)	2.07 (.13)	1	377	6.72	.010	.017
Social deviance proneness	2.40 (.06)	2.99 (.13)	1	377	17.15	.000	.044
For Gender	Female	Male					
Sensation seeking	2.36 (.11)	3.46 (.12)	1	377	49.40	.000	.116
Social deviance proneness	2.42 (.10)	2.97 (.10)	1	377	15.41	.000	.039
For Time	Time 1	Time 2					
Impulsivity/recklessness	2.68 (.09)	2.35 (.10)	1	377	11.84	.001	.030
Sensation seeking	3.23 (.09)	2.60 (.10)	1	377	38.11	.000	.092
Negative view of self	2.00 (.08)	1.77 (.09)	1	377	6.40	.012	.017
For Time * Adoption status	Biological	Adopted					
Negative view of self	T1: 1.92 (.07) T2: 1.49 (.07)	T1: 2.09 (.15) T2: 2.05 (.15)	1	377	4.55	.034	.012

Research question 3: Does each subscale of the APP have a significant connection between parents' and offspring's scores, and do the association patterns differ by gender and the adoption status of the offspring? To examine the association patterns between parents' and offspring's APP subscales, a structural equation model was developed utilizing EQS 6.1 (Bentler, 2004). The multiple group constrained model is shown in Figure 7. In this model, the constrained paths are presented as solid lines, while a dotted line represents a path where the equality constraint is not placed and shows path coefficients for both the adoptive group (A) and the biological group (B). This figure shows only significant path coefficients. If a path is constrained and not significant for both groups, a thin line is shown. The fit indices for this model were considered to be a moderately "good fit" based on recommended criteria (Byrne, 2012): χ^2= 195.48; *df* = 134; CFI = 0.93; RMSEA = 0.05. The results of multiple group

constrained analysis showed that subscales of parents' midpoint APP directly associated with the offspring's subscales (see Figure 7). All subscales except the impulsivity/recklessness subscale showed direct predictive paths from parents' midpoint scores to offspring's time 2 scores even when time 1 scores were controlled. On all the pathways except the direct path from the offspring's time 1 negative view of self to time 2 negative view of self, equality constraints were placed. In other words, all these parameters were set equal in the biological and adoptive samples, and the model works for both groups. This result indicates that the development of APP subscales might be affected more by environment than by genes.

The pathway from time 1 negative view of self to time 2 negative view of self was not constrained; however, it was a significant parameter for both groups. As a free parameter, it showed a difference in size of coefficient between groups (adoptive = .58; biological = .31).

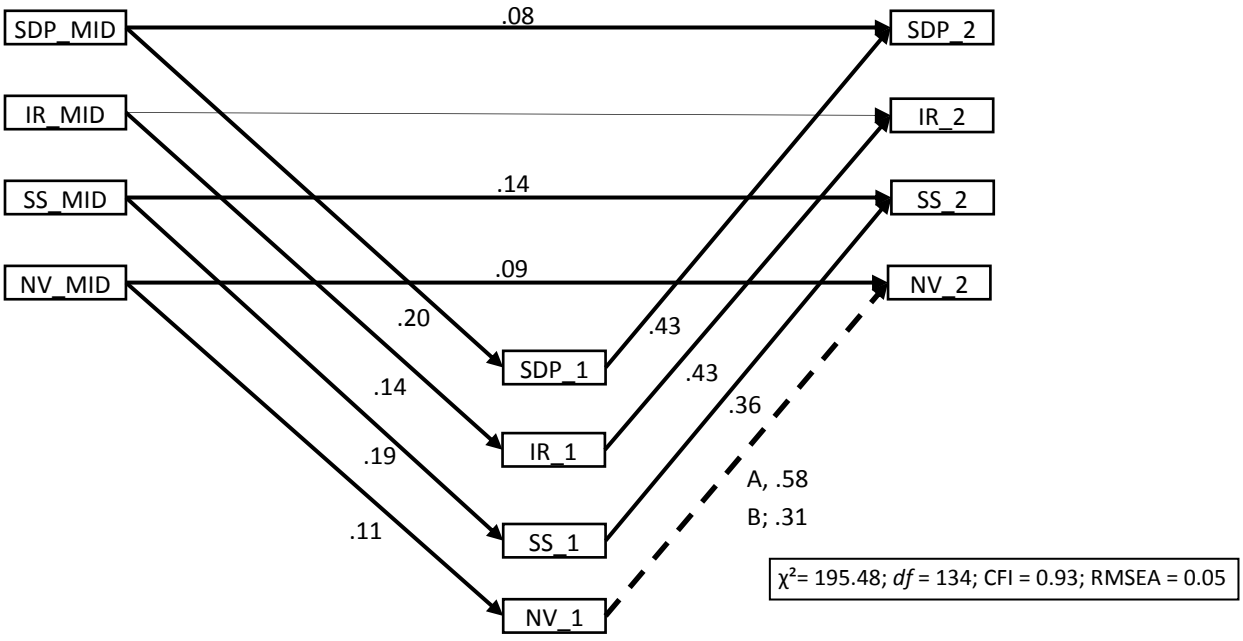


Figure 7. Associations between parents' and offspring's scores on the APP subscales. SDP = Social deviance proneness; IR =Impulsivity/recklessness; SS = Sensation seeking; NV = Negative view of self; MID = Parents' midpoint.

Equality constraints were also placed on the pathways from gender to all APP subscales of offspring (not shown in the figure). All eight constrained pathways, except one to time 2 negative view of self, were found significant ($p < .05$). Six pathways showed positive coefficients, which means being male associated with higher scores in social deviance proneness, impulsivity/recklessness, and sensation seeking at both times (see Table 9). One pathway to time 1 negative view of self showed a negative coefficient — being female associated with a higher negative–view-of-self subscale score. In short, the results suggest that gender is significantly associated with the APP subscales at both times, and those association patterns are similar between biological and adoptive groups.

Table 9

Coefficients of Pathways From Gender to APP Subscales Time 1 & 2

Gender (male = 1; female = 0)	APP subscales			
	SDP	IR	SS	NV
Time 1	.14	.09	.34	-.10
Time 2	.14	.13	.29	NS

Note. SDP = Social deviance proneness; IR =Impulsivity/recklessness; SS = Sensation seeking; NV = Negative view of self.

For the group constrained model by gender (this model is not shown), all subscales except the impulsivity/recklessness subscale showed direct predictive paths from parents' midpoint scores to offspring's time 2 scores even when time 1 scores were controlled. Equality constraints were placed on all the pathways; therefore, all parameters were set to equal between males and females, and the model works for both groups.

Equality constraints were also placed on the pathways from adoption status to all APP subscales of offspring. Four out of eight constrained pathways were found significant ($p < .05$) — from adoption status to time 1 social deviance proneness, time 2 social deviance proneness, time 1 impulsivity/recklessness, and time 2 negative view of self. All those pathways showed

positive coefficients: being adopted was associated with higher scores in these four subscales.

Research question 4: Is each subscale of the offspring's APP connected with substance use, do those connections differ by substance, and do the association patterns remain the same when gender and the adoption status of offspring are controlled? Before examining association patterns, the effects of demographic factors (i.e., adoption status and gender) on the four substance use variables and these effects over time were tested by conducting the repeated measures MANOVA. Between-subjects factors are gender and adoption status. Within-subjects factors are time and its interactions with gender and adoption status.

The multivariate test revealed that only adoption status showed significant main effects on substance use variables; gender and the gender x adoption status interaction did not (see Table 10). The same test also showed that substance use scores were affected by time and these changes over time were statistically significant. However, it showed no difference between biological versus adoptive groups and female versus male groups on APP subscales over time, F (4, 366) = .19, p = .95, *partial* η^2 = .00, and F (4, 366) = 1.27, p = .28, *partial* η^2 = .01, respectively.

Table 10

Multivariate Effects on Substance Use Variables

	F	*df*	Error *df*	Sig.	η_p^2
Between-subjects					
Adoption status	5.038	4	366	.001	.052
Gender	1.501	4	366	.201	.016
Adoption * Gender	1.915	4	366	.107	.021
Within-subjects					
Time	3.294	4	366	.011	.035
Time * Adoption status	.187	4	366	.945	.002
Time * Gender	1.267	4	366	.283	.014
Time * Adoption * Gender	2.586	4	366	.037	.027

Significant univariate effects ($p < .05$) for adoption status were found on all four substance use scores (see Table 11). The results of univariate effect tests showed that adopted offspring scored higher than biological offspring on smoking, drinking, marijuana use, and use of other illicit drugs. A small univariate effect for gender was obtained only on hemp use (males scored higher than females). The tests of univariate effects for time revealed that drinking scores increased over time.

The multivariate tests did not reveal significant effects for interactions between time and between-subjects factors; however, one significant univariate interaction was found between time and gender on hemp use. Females' hemp use scores slightly declined over time, whereas males' scores increased.

Table 11

Significant Univariate Effects on Substance Use Variables (at p < .05 level)

	Mean estimates (Standard error)		*df*	Error *df*	F	*p*	η_p^2
For Adoption status	Biological	Adopted					
Smoking	1.47 (.23)	3.76 (.51)	1	369	16.41	.000	.043
Drinking	.52 (.05)	.87 (.11)	1	369	8.00	.005	.021
Marijuana	.58 (.06)	1.06 (.12)	1	369	12.25	.001	.032
Drugs	.13 (.03)	.27 (.06)	1	369	4.14	.043	.011
For Gender	Female	Male					
Marijuana	.69 (.10)	.96 (.10)	1	369	4.02	.046	.011
For Time	Time 1	Time 2					
Drinking	.53 (.07)	.86 (.09)	1	369	11.94	.001	.031
For Time * Gender	Female	Male					
Marijuana	T1: .73 (.11)	T1: .85 (.11)	1	369	3.96	.047	.011
	T2: .64 (.12)	T2: 1.07 (.12)					

In sum, there were statistically significant differences in substance use variables between biological and adoptive groups as determined by the repeated measures MANOVA. Effects of gender on substance use scores over time were mostly insignificant; however, since the results

shown in Figure 7 and Table 9 suggest the impact of gender on APP subscales, I decided to include gender in the analysis of associations between APP subscales and substance use variables.

Figure 8 shows the association patterns between APP subscales and four substance use variables. Adoption status and gender were controlled in this structural model; however, parameters from gender and adoption status, and covariance paths are not shown in this figure. Also, this figure shows only significant ($p < .05$) structural paths and their coefficients. The fit indices for this model were considered to be a "good fit" based on recommended criteria (Byrne, 2012): χ^2= 165.407; *df* = 93; CFI = 0.96; RMSEA = 0.04 (see Figure 8).

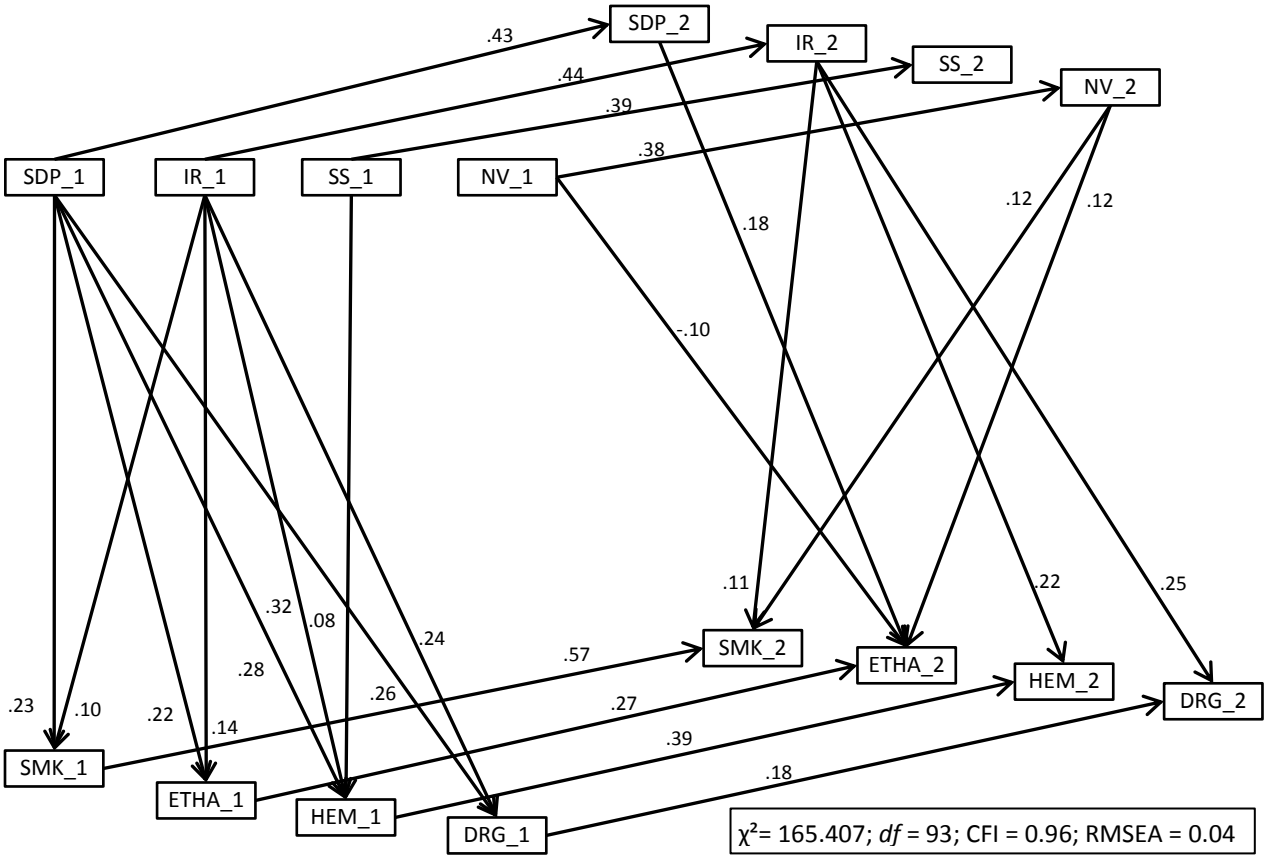


Figure 8. Association patterns between APP subscales and substance use. SDP = Social deviance proneness; IR =Impulsivity/recklessness; SS = Sensation seeking; NV = Negative view of self; SMK = smoking tobacco; ETHA = drinking alcohol; HEM = marijuana use; DRG = other illicit drug use.

The model showed that all four APP subscales at time 1 directly associated and predicted the corresponding subscales' scores at time 2 which was consistent with the result of previous analysis (see Figure 7). All four substance use variables at time 1 also were found to be directly predictive for corresponding time 2 substance use variables.

Table 12

Coefficients of Pathways From Gender and Adoption Status to APP Subscales and Substance Use Variables Time 1 & 2 ($p < .05$)

	Gender (female = 0; male = 1)		Adoption Status (biological = 0; adopted = 1)	
APP	Time 1	Time 2	Time 1	Time 2
APP SDP	.10	.13	.14	
APP IR		.12	.11	
APP SS	.32	.28		
APP NV	-.13			.15
Substance use	Time 1	Time 2	Time 1	Time 2
Smoking			.14	
Drinking		.09		
Drugs	-.10			

Note. SDP = Social deviance proneness; IR =Impulsivity/recklessness; SS = Sensation seeking; NV = Negative view of self.

Time 1 cross-sectional associations between APP subscales and substance use behaviours showed that social deviance proneness and impulsivity/recklessness subscales' scores were significantly associated with all four substance use variables. The sensation seeking subscale was associated only with marijuana use. However, the negative view of self subscale did not show any significant association with substance use variables. Time 2 cross-sectional associations between APP subscales and substance use behaviours showed somewhat different patterns from the time 1 associations. The impulsivity/recklessness subscales were directly associated with three out of four substance use variables; therefore, this subscale could still be functioning as a more general risk factor. Social deviance proneness showed only one path to drinking, whereas sensation seeking did not show any significant path. Unlike time 1 negative view of self, time 2

negative view of self showed significant association with drinking alcohol and smoking tobacco.

In comparison to association patterns between APP subscales and substance use variables at time 1, the time 2 cross-sectional association showed somewhat more specific connections between APP subscales and use of substance (e.g., social deviance proneness to drinking, negative view of self to smoking and drinking). However, it is still not clear whether any specific personality–substance connections are demonstrated in this study.

This model showed that all four time 1 APP subscales had indirect effects on time 2 substance use, and their effects were mediated by either or both of time 1 substance use variables and time 2 APP subscales. The effects of social deviance proneness on the four substance use variables were mediated by all four substance use variables at time 1 variables, and by time 2 social deviance proneness on drinking. The effects of impulsivity/recklessness on four substance use variables were mediated by both time 1 substance use variables and time 2 impulsivity/recklessness, except drinking. The effect of time 1 sensation seeking on marijuana use was mediated only by the time 1 marijuana use variable. The effects of negative view of self on smoking and drinking were mediated only by time 2 negative view of self. There was only one pathway showing longitudinal direct association between time 1 negative view of self and time 2 drinking. This direct path showed an unexpected association pattern (e.g., negative coefficient). This means that a high negative view of self at time 1 directly predicts low drinking at time 2; however, high negative view of self at time 2 predicts high smoking and drinking scores. One possible explanation for this unanticipated result would be that negative view of self has a unique normative developmental pattern in comparison with other subscales. For example, high negative view of self at time 1 may be rather normal in adolescence, and not a risk factor, while low negative view of self at time 1 might be atypical and might predict later drinking. Over

time, however, negative view of self might be expected to decline with normative change (or maturity); therefore if the negative view of self scores remain high, this subscale could indicate higher risk for substance use. Although the difference in comparisons of correlations was not significant ($z = 1.74 – 1.93$, $p > .05$) among the four APP subscales, negative view of self showed the lowest rank-order stability (test-retest correlations, $r = .38$). These results might suggest that negative view of self has a unique trajectory and might be influenced by different demographic factors at different developmental stages (see Table 12). As a result, time 1 and time 2 negative view of self showed unique associations (predictive paths) to substance use variables (see Figure 7).

The model, together with Table 12, suggests that substance use differences between biological and adopted offspring (see Table 11) might be results of multiple impacts from multiple factors including APP subscales, and early substance use behaviours. Time 2 substance use variables did not show any significant direct path from adoption status despite the fact that the repeated measures MANOVA test showed significant group differences (Table 10). Instead, the model showed that adoption status was linked with the APP subscales which directly and indirectly predicted substance use at time 2.

In summary, this study showed that the four subscales of the APP could be reliable and valid tools. Each subscale showed good construct validity in that each was significantly correlated with the theoretically related, anticipated facets of the NEO-FFI. Each subscale also showed modest test-retest reliability (7 years apart). This study also showed that the four subscales of the APP scale differ by offspring's adoption status and gender. Results showed that subscales have unique characteristics: there were two potentially unique trajectory patterns among the four subscales. Consistent with studies in personality and substance use (and other

externalising behaviours), such as Quinn and Harden (2013), this study showed that personality traits related to or underlying disinhibited or undercontrolled behaviour (e.g., impulsivity and sensation seeking) decline over time. The associations between offspring's and parents' corresponding subscale scores showed that parents' midpoint scores of APP subscales directly predicted offspring's time 2 scores even when time 1 scores were controlled. This result indicates that there is a continuous influence of the parents' personality on the offspring's personality development. This parents–offspring association pattern showed no difference between biological and adoptive groups, indicating that the development of APP subscales is affected more by environment than by genes. The associations between APP subscales and substance use variables showed significant cross-sectional and longitudinal connections. Both adoption status, gender, and time 1 APP subscales directly and indirectly associated with and predicted time 2 subscales and substance use variables. However, there was no clear evidence of unique associations between personality traits and particular substances.

Chapter 4: Discussion

Summary of Main Findings

In study 1, I found that both fathers' and mothers' parental socialization patterns might directly influence offspring's PSU, and that fathers and mothers showed slightly different patterns in these associations. Overall results showed that environmental factors (family socialization in the first 15 years of offspring's lives) were significantly associated with PSU in adolescence (time 1), but that these associations were no longer significant in young adulthood (time 2). These findings are consistent with the idea, arising from the behavioural genetic approach, that adolescents are more influenced by environmental factors than adults are (e.g., Derringer et al., 2008). The findings might also be explained by the developmental change in gene effect (Ducci et al., 2011). When individuals grow up and start making their own decisions, their choices and actions are more affected by their genes than in their earlier environment, which was controlled by the adults in their lives, mainly their parents.

In study 2, I found direct associations between parents' and offspring's personality characteristics, and associations between parental socialization patterns and offspring's personality development. Those findings are consistent with other studies (e.g., Schofield et al., 2012). Moreover, I was able to control for genetic influences on APP development by including both biological and adoptive families. In the biological sample, the direct pathway between the parents' APP and the offspring's APP includes both biological and family socialization components. In the adoptive sample, this pathway includes only a socialization component. The finding that these pathways are similar in strength in our biological and adoptive samples suggests that any genetic component contributing to the pathway between the offspring's and the parents' APP scores is not very strong in this sample. Comparisons between parents' and

offspring's perception models showed that all models were similar in association patterns and model fits (CFIs = .96–.99; RMSEAs = .04–.06) at both times. This finding indicates that the links between family socialization patterns and offspring outcomes hold up across different reporting sources.

Both studies 1 and 2 showed the difference between biological and adoptive families in the association patterns of family socialization with both substance use and personality development at time 2. These differences might be explained by the differential susceptibility hypothesis, which claims that their genetic background may make some individuals more susceptible to both positive and negative environmental influences (Belsky et al., 2009; Enoch, 2012).

In study 3, I found that each subscale of the APP had unique characteristics and differed by demographic factors (adoption status and gender). Among the four subscales, there were two trajectory patterns linking time 1 and time 2. The associations between offspring's scores and parents' corresponding subscale scores indicate potential continuous connections between parents' APP subscales and the development of offspring's APP subscales. The finding that almost all pathways in the model were constrained to be equal in strength in our biological and adoptive samples is consistent with studies 1 and 2, and suggests that environmental components might contribute to these pathways more strongly than genetic components. The associations between APP subscales and substance use variables showed significant cross-sectional and longitudinal connections. Both demographic factors and time 1 APP subscales were directly and indirectly associated with time 2 subscales and substance use variables. Clear evidence of a unique association between a single personality trait and a specific substance (e.g., one personality subscale associated with all four substance use variables at time 1) was not found in

this study. This is consistent with the findings of previous studies with adolescents (e.g., Elkins et al., 2006; Woicik et al., 2009), which indicated that some personality traits may be generalized risks for developing any substance disorders in adolescence.

Collectively, this project suggests that the environment, specifically parental socialization, might affect (modify, mediate, exaggerate, etc.) substance use behaviours and APP development over time both directly and indirectly. It also provides support for the family socialization framework (G. M. Barnes, 1990), which hypothesizes that internalized effects of interaction and socialization within the family mediate the impact of individual factors. The findings are also consistent with recent work in family studies and behavioural genetics. For example, in their review of behavioural genetics research in parenting, Horwitz and Neiderhiser (2011) concluded that parental socialization can moderate genetic and other environmental influences on child adjustment. Other studies have found that family socialization can predict the development of personality traits, such as the Five-Factor personality traits (Saucier, Wilson, & Warka, 2007), and the alpha-linked personality traits (Schofield et al., 2012).

The main strength of the present project is its methodology and research design. By using a multi-systemic perspective, the limitations (as identified earlier) of existing substance use research are specifically addressed. By utilizing the VFS dataset, I was able to conduct a project with a large general population sample and a longitudinal design, and to analyse family socialization data from multiple sources (parents and offspring). All the measures used in this project are proven to be reliable and valid. The VFS dataset contains data from biological and adoptive families; this enabled me to control for genetic impact throughout this project. Finally, a number of sophisticated analytic methods were applied in this project. Structural equation modelling proved to be a particularly useful strategy to examine the relationship among

dependent and independent variables, and show the direct effects and indirect effects of predictive factors simultaneously. Altogether, I believe that the methodology of this project was sound, and that its findings can be regarded as meaningful.

Theoretical Implications

The results of the current project are consistent with the family socialization framework (G. M. Barnes, 1990) and suggest that this framework could be an effective and useful theoretical foundation for improving our understanding concerning the development of young people's substance use behaviours. In each of the three studies, association patterns of the environment with substance use behaviours (direct connections) or with the addiction-prone personality (indirect connections) were suggested. Particularly in the first two studies, family socialization factors were found to be directly associated with and predictive of targeted dependent factors.

This finding is very encouraging because socialization is something we can learn, change, teach, practice, and improve.

Perceived family socialization and parental socialization. The results of this project suggest that family socialization may be of vital importance to understanding the nature of substance use in young people, and that it should be a focus of further research. The findings of this project align better with the family socialization framework than with other perspectives that emphasize other social influences outside of the family context. For instance, the group socialization theory (Harris, 1998; 2000) focuses on contextual influences of socialization agents; hypothesized that individuals are influenced by various context-specific agents and that these socialization agents are influential only within their own domain. Therefore, we behave differently based on our context-specific knowledge and experience. For instance, what

individuals have learned with their peers at school affects their values, beliefs, norms, and behaviour at school, but will not affect their internalizations through socialization at home. However, this project indicates that there are direct and indirect associations between family socialization and substance use behaviours that are most likely to happen in different contexts with different agents (parents and family members vs. peers and friends). In keeping with what the family socialization framework suggests, internalization of values, beliefs, and norms through family socialization appears to affect individuals' substance use behaviours in various contexts. Socialization starts and continues within the family as the internalization of the cultural system, societal expectations, and social appropriateness. Through this internalization, individuals integrate values, beliefs, standards, and the opinions of others, incorporating them into their self-concepts or identities. The influences of the values, beliefs, and mores of family/culture/society that we have internalized through family socialization might be the foundations of our socializations with peers, spouses, children, and others (G. M. Barnes, 1990; Flouri & Buchanan, 2002). They might continuously, affect individuals' decisions and actions (e.g., choices of friends and partners, responses to peer pressure, management of various stressors), both directly and indirectly.

We cannot change our biological origin or our genetic structure, and thus our biological and genetic vulnerability and susceptibility to problematic substance use. We cannot directly change our personality. But we can work on our family environment or our perceptions of the social environment. There might not be any single ideal family socialization, especially because our perceived family socialization is in part subjective. Manipulating the environment will not yield a quick fix; however, we now have reasonably good ideas from the current project and other parenting studies of what a hypothetically optimal family socialization would look like in

relation to substance use behaviours. Despite the fact that there is no universal definition and description of parental socialization, numerous studies and reviews have found several common characteristics of positive socialization, such as monitoring, parental knowledge, attachment and relationships, autonomy granting, responsiveness, parental rule-setting, care and support, and low psychological control (e.g., Becoña et al., 2012; Ryan et al., 2010). The current project also indicated that monitoring, family cohesion, care and support, and family adaptability might help prevent or reduce the possibility of substance use in the young population both directly and indirectly by affecting personality development.

Recent work in molecular genetics has been aimed at identifying genes responsible for substance use problems, and investigations of epistasis (specific interactions between genes) will follow. However, molecular genetics may not be able to explain fully why some individuals who carry genes associated with vulnerability to substance use issues nevertheless do not succumb. Likewise, no psychological factor or personality trait can fully explain why not everyone with a substance use-prone personality actually has an issue with substance use. As numerous studies in the past decade have emphasized, there may be no single cause for substance use problems. It might be reasonable for us to hypothesize that there are multiple factors and multilevel causality, and that those factors are interactional. However, that does not mean that remediation efforts need to focus on all factors simultaneously. Because the factors are interacting and interrelated, working on and changing a single factor for the better could bring about a better outcome; theoretically, by making such a change, substance use problems could be treated more effectively or even prevented outright.

I believe, therefore, that family socialization is a key to substance abuse prevention and intervention. I interpret family socialization as a co-creation of parents, offspring, and other

family members. It will interact with — that is, affect, modify, mediate, or exaggerate — an individual's vulnerability, opportunity, and inclination to engage in substance use. For instance, Kendler et al. (2012) conducted a full adoption design study that included information about adoptees, their biological and adoptive parents, and their biological full, half, and adoptive siblings in Sweden. They found that a range of environmental features of the adoptive family (all of which directly affect socialization within a family), such as death, divorce, alcohol problems in the adoptive parents or siblings, criminal behaviour, and medical hospitalization, predicted risk for substance abuse in adoptees (Kendler et al., 2012). Those findings are consistent with the findings of Iowa adoption studies (Cadoret et al., 1995) that also highlighted the significance of the family environment impacting on socialization (e.g., parental divorce and parental psychiatric disorder in adoptive families) in the development of offspring's substance use.

This study's adoption design suggests the potential importance of environmental impacts (socialization) on all associations, but does not provide strong support for genetic influence (heredity) on personality development and substance use behaviours. Genetic susceptibility might take the form of a tendency to engage in risk-taking behaviour (such as substance use), or of a particular psychophysiological response to a particular substance (Rutter et al., 2006). Genes can contribute to the risk, but usually only in the context of co-existing factors in the environment; such an environmental perspective has been suggested by Schuckit (2014). In other words, genes may not be the cause of substance use problems, but may be seen as underlying risks. Grace Barnes' model of family socialization framework illustrates this point very clearly (see Figure 1), with no direct line from genetic factors or psychological factors to substance use behaviours. This does not mean that genes have no influence, or that only the environment is significant. Substance use behaviours and other externalizing behaviours are phenotypes that

may result from interactions between individual (genetic and biological) and environmental factors.

The social environment and the internalized effects of family socialization may furnish opportunities as well as risks. Sensation seekers who find high-arousal sports activities before experimenting with casual substance use might not seek substances to satisfy their needs for excitement. Impulsive individuals who start structured activities (e.g., martial arts) at a young age might learn how to control their impulsivity effectively and experience the benefit of non-impulsive actions. Social deviance-prone individuals might benefit from non-parental role models in their lives (coaches, teachers, etc.) despite a socially deviant family environment and inherited tendencies of deviance. At the same time, such opportunities can depend on parents' active and conscious decisions, their personalities and their socialization patterns, especially when the children are young. Through family socialization, children will be given opportunities to develop personality traits, and to learn and acquire skills and tools for future challenges and socialization.

As Kendler (2013) stated, it is possible that parents can affect the expression of genetic influences on their children. This perception might help us understand why the correlations in all four APP subscales are high in both biological and adopted offspring. For instance, in either biological or adoptive families, parents with high impulsivity may affect the offspring's expression of impulsivity-related genes if carried. Even if offspring carry high-impulsivity genes, these genes might not be expressed in offspring raised by low-impulsivity adoptive parents. In other words, there is the possibility that parents could have the capacity to exacerbate or attenuate the effects of genetic variants that predispose their offspring to certain behavioural traits.

On the other hand, we still do not know exactly what makes some individuals decline a substance when offered. It is not yet understood why, for instance, one sibling might abstain from drinking "because my parent (or grandparent) was an alcoholic," while another decides to drink. As the case of the monozygotic twin girls' in Kendler (2013) exemplified, genetically identical individuals can make very different conscious decisions, with completely different outcomes in their lives. To understand such individual differences (i.e., variance), individual factors should be closely examined. A consideration of the roles of environmental and other influences in shaping personality may challenge our view that personality is truly an "individual" and "independent" entity. It might be time to reconsider personality itself as a complex, multilevel, interrelational, and ever-changing matter.

Personality traits and APP. In the current project, I found that personality traits (subscales) declined over time; these changing patterns are consistent with other longitudinal studies examining similar traits (e.g., Harden & Tucker-Drob, 2011; Hicks et al., 2013; Quinn & Harden, 2013; Steinberg, 2010). These consistent findings might indicate that there is an expected normative change (decline) associated with development (maturity) in these subscales of the APP, and that this change continues well into young adulthood. The above-cited studies also found that each personality trait has a distinct age-related mean trend. Harden and Tucker-Drob (2011) found that average impulsivity scores linearly declined from age 12 to the mid-20s, whereas sensation seeking scores initially increased until mid-adolescence (i.e., age 16) and declined more gradually through the mid-20s. Steinberg (2010) found that impulsivity declined steadily from age 10 to 30 by following a linear pattern, whereas reward-seeking follows a curvilinear pattern in which mean scores increased between pre- and mid-adolescence and declined thereafter (up to 30 in the study). The VFS dataset consists of two waves of data;

therefore, we cannot determine the pattern (linear or curvilinear) of change in the four subscales. However, the results of the current project still suggest that each personality trait might have its own rate of lifetime change as found in the studies mentioned above. For instance, the social deviance proneness dimension decreased overall from time 1 to time 2; however, the mean change was statistically insignificant. This could indicate that social deviance proneness might not follow a linear pattern. As a normative mean trend, this trait might be stabilized by mid-adolescence; or it might start declining at a different point in the lifespan (e.g., after young adulthood).

Moreover, several researchers now emphasize the importance of personality change itself. Quinn and Harden (2013) reported that, particularly in late adolescence and early adulthood, the continuation and escalation of substance use coincides with slower declines in specific personality traits (e.g., sensation seeking, impulsivity). In other words, atypical changes in certain personality traits could be important predictors of and risk factors for problematic substance use behaviours. In this project, specifically in Study 3, the repeated measures MANOVA showed that the negative view of self subscale declined over time. This might be the pattern of this subscale's normative change. The subsequent analysis using the structural equation modelling found that this subscale's time 1 scores did not associate with any time 1 substance use variables. However, at time 2, the negative view of self subscale significantly associated with two of the substance use variables. In other words, high (or low) negative view of self scores may not be a risk factor for substance use behaviours in adolescence. Only if the time 2 score is high or if the scores of this subscale remain high over time is this pattern likely to be a risk factor for substance use behaviours in young adulthood. Neither Quinn and Harden's study (2013) nor the current study demonstrate that change (decline) in personality traits, or lack

of change, could be a direct cause of substance use; however, it is apparent that changes of personality traits need to be studied thoroughly. Several studies emphasize that personality traits are not static risk factors, that individuals might differ in their lifelong trajectories of personality change, and that those trajectories of personality traits are important in predicting long-term substance use behaviour (e.g., Hicks et al., 2011; Quinn & Harden, 2013; Turiano et al., 2012). For future studies, therefore, it will be meaningful to examine personality change as a predictor of the initiation of substance use behaviours, not just an influence on their courses of development.

Since this project utilized the adoption design but did not intend to examine the outcome of adoption practice, this may not be the place to speculate as to whether some or all of the differences between biological and adoptive groups could be the result of adoption per se, and its related challenges (attachment disruption, adverse early experiences and traumas, etc.). Nevertheless, the difference between biological (genetic and environmental influence) and adoptive (environmental influence) groups is an indicator of genetic influence. In all three studies in the current project, equality constraints were placed on most of the parameters in the structural equation models, and those models showed acceptable fits. The models worked for both biological and adoptive groups; thus, the results of three studies indicate that the difference between groups may not be large. These results indicate environmental influences on all associations. However, this should not be taken to imply that a genetic influence is not there or is less important. As the differential susceptibility hypothesis holds, genes do not lead unerringly to corresponding outcomes, but individuals vary in their plasticity or susceptibility to environmental influences (Belsky et al., 2009; Enoch, 2012; Horwitz & Neiderhiser, 2011; Kendler et al., 2012). The differences between the biological and the adoptive samples are found

in all factors (personality, perceived family socialization, and substance use), and these factors are associated with each other in multiple ways. This indicates that genes, the environment, and gene–environment interaction may affect these factors in a complex manner including direct, indirect, and interactive effects over an individuals' lifespan.

Implications for Child and Youth Care Practice

The results of this study are consistent in showing that the social environment plays an important role in offspring's substance use behaviours and the development of addiction-prone personality traits. Nurturing family socialization may be protective against the development of substance use behaviours and APP characteristics. Moreover, it could remain protective in adoptive families even when offspring become older. I found that APP traits could be affected by environmental factors and change over the life-course. These findings suggest that parenting programs and family support programs should do more to promote positive family and parental socialization aspects such as monitoring, parental knowledge, care and support, and family cohesion, as well as father involvement. Values and beliefs are internalized through family socialization, along with the development of personality and identity. Such effects of family socialization might affect and continuously impact young people's substance use behaviours, even when they become older and leave the family home. Therefore, parents should be encouraged to be confidently involved in their offspring's development even beyond adolescence. Maintaining a focus on the family environment (socialization) will help make such programs useful for parents as well as for professionals working with children, youth, and families. Building a better environment together with young people and providing them with appropriate support will encourage healthier personality development; young people will be less vulnerable to substance abuse and misuse, and future substance-related problems might be prevented.

Furthermore, based on the findings of the potential sensitivity and susceptibility of adopted offspring towards family socialization and its long-term influence, it is crucial that all personnel who work with or live with adopted or fostered children and youth are aware of the direct and indirect impact of the whole family environment.

Limitations and Future Directions

The current study was not without limitations. First, the project was based on secondary analyses of the VFS longitudinal dataset. This dataset contains a large number of variables and valuable data; however, it imposes certain limitations on the project. Some variables are measured by very few items or do not fit well with recent trends in the field of parental socialization studies. For example, the monitoring variable does not allow us to examine how and why offspring provided the information to their parents that ultimately became "monitoring" in the study. This variable could encompass parent-solicited information as well as voluntary disclosure by offspring, depending on the specifics of the parent–child relationship, but these are different aspects of family socialization (Bohnert, Anthony, & Breslau, 2012; Kerr, Stattin, & Burk, 2010). The small sample size of the adoptive group (n = 77) relative to the biological counterparts (n = 328) made analyses of impacts of the interaction of adoption status and gender very difficult, and significantly affected the statistical significance of all stages of the analyses.

Second, one of the main objectives of this project was to control and examine genetic and environmental impacts on predictors and outcomes. Therefore, the behavioural genetic approach was used, and in particular the adoption design. All three studies suggested that the environment (family socialization) plays an important role in the development of personality and substance use behaviour. However, it is highly possible that these findings exaggerate the impact of environment and minimize the genetic or biological impact on outcomes. Moreover, the reasons

why adoptees showed higher scores in all four subscales of the APP might be that their birth parents had higher tendencies in these traits. Although no study utilizing the APP scale has ever examined individuals who chose to or were forced to choose adopting-away their children, it is possible that this group has high genetic tendencies regarding APP subscales. Unfortunately, in this project, information about birth parents of adoptees — regarding personality or substance use, for example — was not available. There was therefore no way to control the problems that adoption design studies often face, such as (a) selective placement — adoptive parents are chosen based on their similarities to child's biological parents, (b) representativeness — adopting-out parents may constitute a unique group of people with shared characteristics, and (c) adoption openness — family socialization could be affected by both genes and environment in adoptive families by knowing or communicating with the birth family (e.g., Agrawal & Lynskey, 2008; Leve et al., 2013; Plomin et al., 2013). In future studies, complete data from all three parties (biological, adoptive parents, and offspring) will help researchers make a stronger argument about the impacts of genes, environment, and gene–environment interaction on the development of personality and substance use behaviours (Kendler, 2012).

Third, most of the measures in the VFS are self-report; therefore, we need to consider the possibility of biased data due to response distortion and social desirability (Viswesvaran & Ones, 1999). All participants were asked to complete self-report measures to assess APP. The family socialization items for parents and substance use measures for offspring were also self-report. According to Viswesvaran and Ones (1999) and Vecchione, Dentale, Alessandri, and Barbaranelli (2014), self-report personality measures are particularly susceptible to faking. Since the current project utilized a self-report personality scale only, personality data could be biased. On the other hand, both studies concluded that such biased responses (i.e., faking) did not

necessary destroy the validity of the measure. They also pointed out that response distortion and social desirability can be more evident depending on situational demand — in an evaluative context such as a job application, for example — which is not the case in the current study. Regarding family socialization factors, there are items that both parents and offspring reported (i.e., care, overprotection, adaptability, cohesion) and others reported only by offspring (i.e., monitoring, support, coercion). Both parents' self-report models and offspring's perception models were very similar and showed that family socialization affects offspring outcomes. Therefore, in this study, response distortion in the family socialization variables could be small. At the same time, self-report measures can be subjective and heavily biased, especially when the constructs of interest are sensitive in nature (van Hooft & Born, 2012), as with substance use behaviours. Therefore, the findings of this project should be interpreted with caution. For further studies, in addition to family socialization variables, it will be important to collect data from multiple sources for personality and substance use behaviours. For studies about youths and young adults, including only the parents might not be enough when considering the developmental stages of individuals' lives. Peers, siblings, and co-workers may also prove to be valuable sources of information about personality and substance use.

On a related point, the APP scale, and especially its four subscales, are relatively new tools that need to be tested in different general population samples, in various age groups and ethnocultural groups, and by different researchers to establish that they possess satisfactory psychometric properties. An effort should also be made to examine and revise each item in the scale. Since its first establishment, the APP scale has never been revised. Some items may no longer be applicable to or appropriate for current youths' and young adults' interests, activities, and lifestyles. Because some items ask for a retrospective view, while others ask for a current

view, the items as they stand may not be suitable for repeated use (multiple waves). Moreover, it would also be useful to develop parallel versions of the APP scale for parents, peers and friends, siblings, and co-workers and supervisors to assess young people's APPs.

Lastly, it should be acknowledged that there are possible multidirectional impacts and relations between offspring's personality, family environment, and offspring's substance use. Many studies suggest that there is a two-way effect of upbringing between children and parents, since the characteristics of the child can facilitate or complicate the type of parental socialization strategies used by the parents (e.g., G. M. Barnes et al., 2006; Becoña et al., 2012; O'Connor, 2002). For example, a child's prior interest in or use of substances might cause parents to increase their monitoring levels (Bohnert et al., 2012) or their psychological control (Albrecht, Galambos, & Jansson, 2007). Research in developmental and personality psychology over the last several decades has increasingly emphasized the individuals' role in influencing his or her own environment, including the rearing environment, and selection of social environment (Hicks et al., 2013; Oppenheimer, Hankin, Jenness, Young, & Smolen, 2013). The theory of genotype-environment effects hypothesizes that individuals are exposed to, seek out, select, and create their own environments (Scarr & McCartney, 1983). In other words, an offspring's personality traits and behaviours, such as substance use, can affect his or her environment. At the same time, substance use studies suggest that there are possible bidirectional relations between personality development and substance use (Hicks et al., 2012; Malmberg et al., 2012; Quinn & Harden, 2013). While accepting the impact of an offspring's personality on substance use, these authors point to the possibility that the onset and trajectory of substance use will affect the offspring's personality development. By considering such possibilities, future studies should examine changes in the environment (parental socialization), behaviours (substance use), and personality

traits longitudinally by utilizing multiple data entry points (waves) for all these factors, and analyze the interplay among these factors.

Based on this consideration, a logical step would be to conduct analyses of a longitudinal dataset consisting of multiple data entries (more than two waves) of the APP scale, family socialization factors, and substance use. Fortunately, another longitudinal general population survey, the Victoria Healthy Youth Survey, has been conducted since 2003. This six-wave survey project contains four waves of the APP scores, three waves of family socialization factors, and six waves of substance use data. Analyses of these data will be meaningful in examining the trajectories of all factors and the longitudinal interplays between them. Results of those analyses will be helpful in deepening our understanding of substance use and the development of APP, and the influences of socialization on both of them. Moreover, these data will enable us to test the psychometric properties of the APP scale and subscales as personality measures, and to revise them effectively.

To pursue my behavioural genetics-oriented investigation, another logical step would be to conduct a full-adoption design study containing data from biological and adopted offspring, and their biological and adoptive parents. The APP scores of biological parents in particular will be helpful for strengthening the current project's finding of family socialization influences, and for better explaining differences in all factors between biological and adopted offspring. For example, in the case where biological and adoptive parents show similar APP scores, strong correlations between adoptive parents' and adopted offspring's APPs should not be taken as evidence of only environmental influence.

The results of this project suggest that family socialization may play an important role in the development of APP and substance use in youths and young adults. Nurturing family

socialization might be protective against the development of addiction-prone personality characteristics. It could also be protective against the development of substance use behaviours. I believe that this is a very encouraging finding for child, youth, and family-related practice. What we can work on, what we can change or maintain, is socialization, and that could have a positive impact on the prevention of substance use problems.

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Appendix A

APP-21 Items and Four Dimensions

Item #	Sub scale	Original Scale	Question items
1	IR	EGOST	Have you had very strange or peculiar experiences?
2	IR	EPQ-P	Have you often gone against your parent's wishes?
7	IR	MAC	Have your parents often objected to the kind of people you went around with?
9	IR	EPQ-E	Have people said that you sometimes act too rashly?
15	IR	EGOST	Do you have strange or peculiar thoughts?
6	SS	VANDO	Do you prefer rock music over ballads?
10	SS	VANDO	Do you prefer loud music over quiet music?
13	SS	VANDO	Do you prefer sports cars over passenger cars?
16	SS	VANDO	Would you prefer to be a stunt-man/woman over a prop-man/woman?
20	SS	VANDO	Do you prefer electric music over unamplified music?
3	NV	TRAIT	Are you a steady person?*
4	NV	ESTEEM	Do you wish you could have more respect for yourself?
8	NV	MAC	Have you lived the right kind of life?*
14	NV	EPQ-N	Do you often feel ''fed up''?
18	NV	MAC	Did you ever feel that strangers were looking at you critically?
5	SDP	MAC	Have you ever been in trouble with the law?
11	SDP	MAC	Are you unable to keep your mind on one thing?
12	SDP	EGOST	Do you go to church almost every week?*
17	SDP	VANDO	Do you prefer endurance sports over games with rests?
19	SDP	MAC	Did you play hooky from school quite often as a youngster?
21	SDP	EPQ-P	Do you give money to charities?*

Note. Item # = original item numbering in the APP-21 (Anderson et al., 2011).

IR = Impulsivity/recklessness; SS = Sensation seeking; NV = Negative view of self; SDP = Social deviance proneness (initially categorized as non-loading).

EGOST = Barron's Ego Strength scale; EPQ-E = Eysenck's Extraversion scale; EPQ-N = Eysenck's Neuroticism scale; EPQ-P = Eysenck's Psychoticism scale; ESTEEM = Rosenberg's Self-Esteem scale; MAC = MacAndrew scale; TRAIT = Spielberger's Trait Anxiety scale; VANDO = Vando's Reducer-Augmenter scale.

* These items are reversed coded.

Appendix B

Items in Substance Use Measures

Smoking

Thinking back over the last seven days, starting with yesterday, how many cigarettes did you smoke?

None ..... □0

How many cigarettes did you have on each day?

Monday ..... □□
Tuesday ..... □□
Wednesday ..... □□
Thursday ..... □□
Friday ..... □□
Saturday ..... □□
Sunday ..... □□

Alcohol use

The next few questions ask about alcohol. In these questions when we use the word "drink" it means:

One bottle of beer or glass of draft, or
One glass of wine or a wine cooler, or
One straight or mixed drink with about one and a half ounces of hard liquor

Thinking back over the past 7 days, on how many of these days did you have any alcoholic drinks?

None at all ..... □0

How many drinks did you have on each day?

Monday ..... □□
Tuesday ..... □□
Wednesday ..... □□
Thursday ..... □□
Friday ..... □□
Saturday ..... □□
Sunday ..... □□

Hemp & Other illicit drugs

How often have you used any of the following?

a. Marijuana or hash

Never ..... □0
Less than once a month ..... □1
1-3 times a month ..... □2
Once a week ..... □3
More than once a week ..... □4

b. Cocaine or crack

Never ..... □0
Less than once a month ..... □1
1-3 times a month ..... □2
Once a week ..... □3
More than once a week ..... □4

c. LSD (acid)

Never ..... □0
Less than once a month ..... □1
1-3 times a month ..... □2
Once a week ..... □3
More than once a week ..... □4

d. Speed (amphetamines)

Never ..... □0
Less than once a month ..... □1
1-3 times a month ..... □2
Once a week ..... □3
More than once a week ..... □4

e. Heroin

Never ..... □0
Less than once a month ..... □1
1-3 times a month ..... □2
Once a week ..... □3
More than once a week ..... □4

Appendix C

Other Family Socialization Items Used in the VFS

Monitoring

Section in the Vancouver Family Survey: Parents

The questions in this section ask about you and your parents. There are ono right or wrong answers. We are interested only in what **you** feel to be true. Please answer these questions as you recall your home life when you were **15 years old**. Please place a tick mark (✓) in the most appropriate box (□).

How often did you tell your parents where you're going to be after school?

Always ..... □5
Most of the time ..... □4
Sometimes ..... □3
Hardly ever ..... □2
Never ..... □1

How often did you tell your parents where you're really going when you went out evenings and weekends?

Always ..... □5
Most of the time ..... □4
Sometimes ..... □3
Hardly ever ..... □2
Never ..... □1

Support

Please answer the following questions about you and your **MOTHER**. Please answer the questions as you remember your mother when you were 15 years old. Please place a tick mark (✓) in the most appropriate box (□).

When you did something well, how often did your mother give you praise or encouragement for what you did?

Always ..... □5
Frequently ..... □4
Sometimes ..... □3
Hardly ever ..... □2
Never ..... □1

How much did you rely on your mother for advice and guidance?

Not at all ..... □1
A little ..... □2
Quite a bit ..... □3
Very much ..... □4

Completely ..... □5

How often did your mother give you a hug, a kiss, or a pat on the shoulder?

Everyday ..... □6
Several times a week ..... □5
About once or twice a week ..... □4
About once or twice a month ..... □3
Less than once a month ..... □2
Never ..... □1

How often did you and your mother do things together that you both enjoy – things like playing sports or games, going somewhere together, or working on things together?

Several times a week or more often ..... □5
About once or twice a week ..... □4
About once or twice a month ..... □3
Less than once a month ..... □2
Never ..... □1

Please answer the following questions about you and your **FATHER**. Please answer the questions as you remember your father when you were 15 years old. Please place a tick mark (✓) in the most appropriate box (□).

When you did something well, how often did your father give you praise or encouragement for what you did?

Always ..... □5
Frequently ..... □4
Sometimes ..... □3
Hardly ever ..... □2
Never ..... □1

How much did you rely on your father for advice and guidance?

Not at all ..... □1
A little ..... □2
Quite a bit ..... □3
Very much ..... □4
Completely ..... □5

How often did your father give you a hug, a kiss, or a pat on the shoulder?

Everyday ..... □6
Several times a week ..... □5
About once or twice a week ..... □4
About once or twice a month ..... □3

Less than once a month ..... □2
Never ..... □1

How often did you and your father do things together that you both enjoy – things like playing sports or games, going somewhere together, or working on things together?

Several times a week or more often ..... □5
About once or twice a week ..... □4
About once or twice a month ..... □3
Less than once a month ..... □2
Never ..... □1

Coercion

Scoring: Never = 1, Sometimes = 2, Often = 3, All the time = 4

When you were 15 years old:

	Never	Sometimes	Often	All the time
How often did your mother slap or hit you?				
How often did your mother take away your privileges or ground you?				
How often did your mother yell, shout or scream at you after you disobeyed her or had done something she did not approve of?				
How often did your father slap or hit you?				
How often did your father take away your privileges or ground you?				
How often did your father yell, shout or scream at you after you disobeyed him or had done something he did not approve of?				