GAMBLING IN YOUNG ADULTS:

AN INVESTIGATION OF THE PATHWAYS MODEL USING THE MANITOBA LONGITUDINAL STUDY OF YOUNG ADULTS (MLSYA)

by

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Abstract

A growing body of research indicates that problem gamblers are not a homogeneous group but can instead be subtyped based on differing characteristics proposed in the Pathways Model. This dissertation, composed of two studies, sought to investigate the applicability of this model in understanding young adult gamblers in the province of Manitoba. Study 1 had two aims: (1) to determine if a broad sample of young adult gamblers (N = 566) could be subtyped according to several characteristics described in the Pathways Model (i.e., impulsivity, anxiety, depression, drug use and alcohol dependence) using Latent Class Analysis, and (2) to use multinomial regression to determine if scores on the Problem Gambling Severity Index (PGSI) and demographic variable were predictive of class membership. LCA identified three classes of gamblers: emotionally vulnerable, non-problem and impulsive. The results of the multinomial regression demonstrated that older age, lower income, living independently and PGSI scores were associated with higher odds of being an impulsive gambler. Identifying as European, living independently and PGSI scores were associated with higher odds of being an emotionally vulnerable gambler. Study 2 had two aims: (1) determine if subtypes similar to those in study 1 would be identified in the same sample (N = 566) two years later; and (2) to utilize latent transition analysis (LTA) to examine the stability of class membership over this two-year period. Similar to Wave 2 a three-class model of gamblers was retained at Wave 4 (i.e., emotionally vulnerable, non-problem, and impulsive. LTA revealed that the majority of non-problem gamblers remained in the same class over the two-year period, emotionally vulnerable gamblers were likely to transition into the non-problem gambler class, and impulsive gamblers were equally

likely to transition into the non-problem and emotionally vulnerable classes. Both studies provide evidence for the subtypes of gamblers outlined in the Pathways Model. The results of Study 2 suggest that membership within emotionally vulnerable and impulsive gambling subtypes is unstable during young adulthood.

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Thesis Type

This dissertation was written using the sandwich method; it consists of a collection of published papers (Chapters 2 and 3), bracketed by a General Introduction and General Discussion. This thesis type was approved by my examining committee. Because I have included the published papers in their final forms, there is some redundancy in the literature reviews across Chapters 1—3, in the descriptions of the methods followed in the work described in Chapters 2 and 3, and in the Reference sections.

The thesis largely follows the formatting guidelines set out in the Publication Manual of the American Psychological Association (6th edition). However, before each of the published manuscripts I have inserted a section entitled *My Contribution to the Publication* in which I describe (a) how the paper connects to the overarching theme of the dissertation, and (b) the nature and extent of my contribution. The latter information is important to include as the published papers had several co-authors.

CHAPTER 1: GENERAL INTRODUCTION

Gambling can be defined as "…placing something of value at risk in the hopes of gaining something of greater value" (Potenza, Fiellin, Heninger, Rounsaville, & Mazure, 2002, p.721). Gambling may include activities such as playing the lottery; playing cards or casino games such as blackjack, craps and roulette; wagering on horse and dog racing; sports betting; and playing electronic gambling machines such as video lottery terminals (VLTs).

Gambling is a very common past-time. Indeed, epidemiological studies consistently report adult population prevalence rates for gambling in the vicinity of 60% to 90% (Petry, 2005). Although most people gamble as a social activity and experience few adverse consequences (Ferris & Wynne, 2001), a small number of gamblers develop problems related to the activity (e.g., unsuccessful efforts to control, cut back, or stop gambling) that lead to negative consequences for them and their significant others. Excessive gambling can also lead to negative behaviours that ultimately impact the community both directly (e.g., illegal acts committed to fund gambling activities) and indirectly (e.g., increased health costs related to treatment of disordered gamblers). Gambling is therefore considered a non-drug-related behaviour with addictive potential (Karim & Chaudhri, 2012). Given the large number of people who engage in this behaviour, and the substantial personal, social, and familial harm it can cause, gambling is considered an important public health issue.

Some researchers have advanced a dimensional view of gambling behaviour and suggest that it exists on a continuum from no involvement to excessive involvement (Walker, 1998). According to this view gamblers can be identified as existing at some point along a continuum of behaviour and can be delineated using such terms as: social, at risk, subclinical, problem, pathological, compulsive, or in transition gamblers (Shaffer & Korn, 2002). Despite this, in the

gambling literature, individuals who experience maladaptive gambling behaviour that leads to harmful consequences are generally grouped into two categories: problem gamblers and disordered gamblers. These terms are often used interchangeably, but they have also been used to differentiate gamblers who demonstrate some gambling problems from those who meet diagnostic criteria for gambling disorder.

What today is known as gambling disorder was officially recognized as a psychiatric disorder called pathological gambling in 1980 when it was classified as an *impulse control disorder - not elsewhere classified* in the DSM-III (APA, 1980). Reilly and Smith (2013) indicated that the original seven diagnostic criteria included in the DSM-III were not empirically derived but were largely based on clinical experience and expert consensus. A pathological gambler was described in DSM-III as an individual who had experienced a progressive loss of control of their gambling behaviour that ultimately negatively impacted their family, personal or vocational pursuits, and finances.

Although still classified as an impulse control disorder, the criteria for pathological gambling was updated in DSM-IV (APA, 1994) to include criteria akin to those found in substance use disorders (e.g., repeated unsuccessful attempts to control, cut back, or stop gambling). One major problem with the DSM definition of pathological gambling was that it did not reflect the fact that gambling problems tend to exist on a continuum and that many gamblers who experienced significant problems related to gambling did not meet enough of the criteria to be classified as pathological gamblers (Reilly & Smith, 2013). These individuals were often described in the research literature as “problem”, “at-risk”, “level 2” and “probable pathological” gamblers. Researchers acknowledged that data-driven approaches were needed to better

understand the structure of subsyndromal and syndromal gambling in order to reduce conceptual confusion and make it easier for researchers to compare results across studies (Xian et al., 2008).

Between 1994 and 2013 research accumulated that questioned the validity of classifying pathological gambling as an impulse control disorder. Instead, clinical (Maccallum & Blaszczynski, 2002; Pallanti, 2006; Petry, 2001), neurobiological (Clark & Limbrick-Oldfield, 2013; Holden, 2001; Potenza, 2008; Van Holst, Van Den Brink, Veltman, & Goudriaan, 2010) and genetic (Lobo & Kennedy, 2009; Slutske et al. 2000; True et al., 1999) studies supported the premise that pathological gambling was more similar to a substance use disorder and should therefore be conceptualized as a behavioural addiction. As a result, pathological gambling was reclassified in the DSM-5 (APA, 2013) as a non-substance-related disorder falling within a new section that included other substance related and addictive disorders. In addition, it was renamed *gambling disorder*, as the term "pathological" had become outdated and pejorative (Petry et al., 2014).

In the DSM-5, the syndrome of gambling disorder is defined as a persistent and recurrent problematic gambling behavior leading to clinically significant impairment or distress, as indicated by the individual exhibiting four (or more) diagnostic criteria in a 12-month period, the presence of which is not better accounted for by a manic episode (see Table 1.1). The diagnostic criterion "has committed illegal acts such as forgery, fraud, theft or embezzlement to finance gambling" was excluded in the DSM-5 because its inclusion was found to contribute little to diagnostic accuracy (Petry et al., 2014). The wording of the criteria was also changed to stipulate that symptoms must occur concurrently, within the past 12-months. Although often included in research studies, time frames were lacking in previous editions of the DSM. Lastly, the threshold for meeting a diagnosis of gambling disorder was reduced from five to four criteria as research

suggested that doing so, especially when the illegal acts criterion was removed, resulted in better diagnostic consistency, when compared to the DSM-IV classification system (Petry et al., 2014).

Table 1.1
DSM-5 Diagnostic Criteria for Gambling Disorder

1	Needs to gamble with increasing amounts of money in order to achieve the desired excitement.
2	Is restless or irritable when attempting to cut down or stop gambling.
3	Has made repeated unsuccessful efforts to control, cut back, or stop gambling.
4	Is often preoccupied with gambling (e.g., having persistent thoughts of reliving past gambling experiences, handicapping or planning the next venture, thinking of ways to get money with which to gamble).
5	Often gambles when feeling distressed (e.g., helpless, guilty, anxious, depressed).
6	After losing money gambling, often returns another day to get even ("chasing" one's losses).
7	Lies to conceal the extent of involvement with gambling.
8	Has jeopardized or lost a significant relationship, job, or educational or career opportunity because of gambling.
9	Relies on others to provide money to relieve a desperate financial situation caused by gambling.

Changes in Access to Gambling in Canada and Their Impact on Gambling Behaviour

Legalized gambling dramatically increased in Canada during the 1990s mainly due to government efforts to increase revenues (Korn, 2000). Government involvement and promotion of gambling has increased the social acceptability of this activity. As a result, access to legal gambling opportunities—including internet gambling—has increased over the last several decades in Canada. Various stakeholders and social policy groups have voiced concerns that increased access to gambling opportunities may impact rates of gambling behaviour and therefore the risk that individuals will develop gambling problems (Korn, 2000). Several studies have been published over the last two decades examining if there is empirical support for this concern.

Room, Turner and Ialomiteanu (1999) used a pre/post design to study the societal impact of the December 1996 opening of a casino in the community of Niagara Falls, Ontario. The

researchers contacted adults from Niagara Falls in 1996 using random digit dialing and conducted phone interviews which included 18 items on disordered gambling. This process was repeated one year later. A statistically significant increase in the prevalence of gambling-related problems was found for five of the 18 items measured over the study period. However, all 18 items saw a rate increase from 1996 to 1997 in the Niagara Falls region. This study provides evidence that the rates of disordered gambling increased in the community one year after the casino was opened.

Jacques, Ladouceur and Ferland (2000) conducted a study similar to that of Room et al. (1999) but involving a random-digit-dial sample of adults from Hull, Quebec. Participants were interviewed before a casino was opened in this community (in 1996) and one year after the opening (in 1997). Jacques et al. found an increase in gambling activities over the timeframe of the study but, in contrast to the findings of Room et al., prevalence of disordered gambling did not increase over the one-year period. Nonetheless, relatives and neighbors of gamblers perceived an increase in the negative effects of gambling one year after the casino opened. The researchers speculated that relatives and neighbors of gamblers were able to recognize problems before the disordered gamblers were able to admit these problems to themselves.

Analyzing data from the Canadian Community Health Survey Cycle 1.2 (CCHS 1.2; Statistics Canada, 2003), a large nationally representative epidemiologic survey, Cox, Yu, Afifi, and Ladoucer (2005) found the 12-month prevalence of gambling problems were highest in Manitoba and Saskatchewan (both 2.9%)—the two provinces that had the highest population densities of VLTs and permanent casinos in the community. This study provided strong support for the theory that availability or access to gambling opportunities is associated with higher rates of disordered gambling. In addition, it highlighted the potential public health implications of

allowing VLTs in venues outside of casinos (e.g., bars and restaurant lounges), as the data suggested that this practice may lead to higher rates of disordered gambling.

Rush, Veldhuizen and Adlaf (2007) used tests of regional variation and a spatial cluster scan technique to analyze data from the CCHS 1.2 to test whether proximity to a gambling venue was associated with higher rates of problem gambling in the province of Ontario. They found disordered gambling to be modestly but significantly associated with proximity to casinos and racetracks with slot facilities. Similar to Cox et al. (2005), this study provided modest evidence that prevalence of disordered gambling is connected to the availability of gambling venues.

Further support for a "proximity effect" came from a 2011 report on gambling behaviour in the Canadian province of Alberta published by Williams, Belanger and Arthur. This group found that most casino revenue comes from people who live in close proximity to the venue. In fact, 46.4% of casino revenue was derived from patrons living within 5 km of the venue. They also found that residential proximity was positively associated with expenditure on gambling and problem gambling prevalence.

A study conducted by Sévigny, Ladouceur, Jaques and Cantinotti (2008) examined casino proximity and its relationship to gambling participation, gambling expenditure, and disordered gambling. They found a positive association between casino proximity and both gambling participation and expenditure of money on gambling. However, a significant relationship between casino proximity and probable or disordered gambling was not found. The researchers suggested that this result may reflect an adaptation occurring in gamblers who live close to casinos, but noted that only longitudinal studies could examine the validity of this theory.

Of greatest relevance to the current research is a study that examined changes in *young adults'* gambling behaviour in response to increased access to gambling opportunities in Canada.

Adams et al. (2007) conducted a study of 1579 Canadian university students in Ontario and found that students enrolled in universities that were close to a large casino had significantly higher rates of disordered gambling than students enrolled in universities located far from casinos. These authors concluded that positioning gambling venues such as casinos close to universities may produce an ecological condition where the school and casino are seen as "combined." They argued that, in such a situation, gambling behavior may inadvertently be encouraged, leading to higher rates of disordered gambling.

The vast majority of studies cited above support the theory that increased access to legal, land-based gambling opportunities over the last few decades has led to an increase in gambling problems in Canada. It is important to note, however, that opportunities to gamble online have also increased since the mid-1990s, giving rise to concerns that making gambling more accessible to anyone with an internet connection might contribute uniquely to increased rates of disordered gambling. A major difficulty facing researchers who are interested in this question is that internet gamblers typically engage in both land-based and online gambling activities; that is, online gambling is just another form of gambling they add to their usual selection of land-based forms of gambling. As a result, internet gamblers appear to be more heavily involved in gambling compared to non-internet gamblers (Wood & Williams, 2011). This is concerning because *gambling involvement* has been shown to impact gambling problems independently of the specific gambling formats individuals engage in (Afifi, LePlante, Taillieu, Dowd, & Shaffer, 2013). Wood and Williams (2011) found that 16.4% of internet gamblers met criteria for either moderate or severe disordered gambling compared to 5.7% of non-internet gamblers.

While increased accessibility to and engagement in gambling may play an important role in the development of disordered gambling, it is important to consider a range of other factors

(e.g., psychological, environmental, biological) that may put an individual at risk. The focus of my dissertation was to explore several of these other factors and, in particular, how they may relate to patterns of gambling behaviour that are seen in young adults. To provide some context for this work, I turn now to a discussion of some of the literature examining factors that contribute to risk-taking behaviour in general, and how/why engagement in this kind of behaviour changes over the course of development. From there I move on to describe work focusing specifically on gambling in young people.

Young Adulthood and Risky Behaviour

Young adulthood (18-25 years old) is a unique developmental stage. It is a time associated with identity development, increased independence and self-sufficiency, and—for many—the pursuit of academics to explore and establish future potential career options (Arnett, 2000). Young adulthood often involves exploration of and participation in various occupations, intimate relationships, and worldviews. In general, it can be understood as a rich and dynamic transitional period between adolescence and adulthood, especially defined by its heterogeneity and non-normative quality. However, it is also a time characterized by increases in risk-taking behaviours (Reyna & Rivers, 2008). Indeed, it is largely acknowledged that many risk-taking behaviours emerge, increase, and eventually peak in young adulthood (Centers for Disease Control & Prevention, 2004; Steinberg et al., 2008). Learning to identify potentially risky situations and to avoid taking excessive risks are considered to be among the most important skills people develop during their lifetime (Byrnes & McClenny, 1994; Garon & Moore, 2004; Steinberg & Scott, 2003).

Risk-taking has been defined in the developmental literature as engagement in behaviours that are associated with some probability of undesirable results (Beyth-Marom & Fischhoff,

1997). Some examples of risky behaviour include: tobacco use, unsafe sexual activity, dangerous driving, interpersonal aggression, delinquent and criminal behaviours, attempted suicide, alcohol or illicit drug consumption, and gambling. Young people may engage in more than one of these forms of risky behaviour, and some evidence suggests that doing so may make them more vulnerable to the development of gambling problems (Reyna & Rivers, 2008). For example, Hing, Russell and Browne (2017) recently reported that, compared to non-problem online gamblers, disordered gamblers who attributed their problems exclusively to online gambling were more likely to be younger and male, and were also more likely to use alcohol and illicit drugs while gambling. The possibility that engaging in risky behaviours such as drinking and drug use can put young adults who gamble online at heightened risk for developing gambling problems is of concern given the high rates at which these behaviours occur during this developmental period. As such, it is important to learn more about factors that drive risk-taking.

Social and environmental factors play a role in the expression of risky behaviour. An example of this is parental monitoring. As adolescents move into young adulthood, parental monitoring tends to decrease. This allows for the increased expression of *sensation seeking*, defined as the desire to pursue experiences and activities that are novel and intense. Sensation seeking is often conflated with impulsivity, which is also associated with risk-taking behavior in adolescence and young adulthood. For example, Bloom et al. (2014) demonstrated that self-reported impulsivity pre-dated the commencement of smoking behaviour in youths, and other researchers have reported an association between scores of sensation-seeking and susceptibility towards increased alcohol use in adolescent and young adult populations (Quinn & Harden, 2013).

As individuals enter their late 20s and early 30s, they often take on new roles and responsibilities. This is purported to limit their sensation seeking and, therefore, lower their propensity to engage in risky behaviours. This idea lies at the heart of a phenomenon referred to in the alcohol use literature as *maturing out*. Researchers who study problem drinking have used this construct to explain why problematic alcohol use decreases as people age (O'Malley, 2005). Generally, heavy drinking and drinking that leads to unpleasant outcomes increase through young adulthood and reach their peaks in the early 20s (Bachman, Johnston, O'Malley, & Schulenberg, 1996). After this time, problem drinking steadily declines through adulthood. Maturing out is hypothesized to occur in response to the new social roles and responsibilities adults take on as they transition out of young adulthood. As adults establish full-time careers, become financially independent, and start families, risky behaviours such as heavy alcohol use usually decline. This occurs to a large degree because the time and financial resources individuals once dedicated to recreational activities associated with sensation seeking such as drinking alcohol, using drugs, and gambling, are shifted to the responsibilities of marriage and childrearing. Although marriage plays a role in the maturing out process, parenthood has been demonstrated as the key factor attributed to reduction in the consumption of alcohol, especially in men who engage in heavy drinking (Bachman et al., 1996).

Another factor connected to the maturing out process is attitudinal change. Longitudinal research has indicated that drinking behaviour is strongly linked to the attitudes one holds toward alcohol. Young adults in college are more likely to approve of heavy drinking and see it as less risky than they did in their adolescent years, whereas those who are married and have children typically view heavy drinking with disapproval and see it as risky (Bachman et al., 2002). These findings suggest that role socialization is a driving factor in the maturing out process.

Biological factors also likely play a role in the maturing out process. Developmental neuroscientists have proposed a dual processing theory that attempts to explain risk-taking behavior in adolescence and young adulthood (Somerville, Jones, & Casey, 2010). According to this model, subcortical and cortical brain development becomes unbalanced during adolescence; specifically, the subcortical *ventral striatum* and *amygdala* are hypothesized to develop prior to the *prefrontal cortex*. Early development of the amygdala and the ventral striatum results in an emotionally-determined approach to rewards and risks and, therefore, to risky, reward-driven behaviour during adolescence and young adulthood. As the inhibitory circuitry of the frontal cortex matures, however, it can moderate ventral striatal activity, reducing the tendency towards risky behaviour. Although many mature out of their tendency to engage in risky behaviours as a result, some likely continue to demonstrate a functional imbalance between subcortical structures involved in reward and cortical regions involved in cognitive control. This could, hypothetically, lead them to continue to engage in risky behaviours such as gambling that could eventually lead to personal, interpersonal, financial, and social problems.

Disordered Gambling in Young Adulthood

Gambling is a risky behaviour that many young adults engage in, and research indicates that gambling problems tend to emerge during this developmental period (Burge, Pietrzak & Petry, 2006). Several studies in the gambling literature have demonstrated that gambling problems are even more prevalent in adolescent and young adult populations than in the general adult population. For example, Gupta and Derevensky (1998) found that 4.7% of adolescents in their study demonstrated problem gambling behaviours. In a meta-analysis of 146 prevalence studies, Shaffer and Hall (2001) found that an even higher percentage of adolescents (approximately 8%) met criteria for lifetime problem gambling. Furthermore, almost 10% of

college students in this study met criteria for problem gambling, and 6% met criteria for disordered gambling. In their study, LaBrie, Shaffer, LaPlante, and Wechsler (2003) estimated the prevalence rate of lifetime disordered gambling in undergraduates to be 5.6%, which is three times the adult rate. These statistics are concerning, in part because problem and disordered gambling in young adults is correlated with a number of other psychological disorders and problem behaviours that also tend to peak during this period including, addictive behaviours, depression, anxiety and substance use problems (Feigelman et al., 2006; LaBrie et al., 2003; Lynch, Maciejewski, & Potenza, 2004; Ste-Marie, Gupta & Derevensky, 2006).

The aforementioned studies are cross-sectional in nature and so are unable to determine if the higher prevalence rates of gambling problems in young adults are due to developmental factors or reflect a cohort effect. This question can only be addressed with longitudinal studies. Two longitudinal studies examining problem gambling prevalence rates in adolescents and young adults exist in the extant literature.

Winters, Stinchfied, Botzet and Anderson (2002) conducted a longitudinal study of 532 gamblers (aged 15-18 years at Wave 1 and 16-20 years at Wave 2) to examine possible changes in prevalence rates for problem gambling over time. The results of this study indicated that overall prevalences of past year problem gambling did not differ across the two timepoints. Moreover, when 305 of the original participants were recalled five years later (i.e., once they had reached young adulthood) the prevalence of problem gambling in the recalled sample was similar to that seen in the two previous waves. Despite this, the rate of at-risk gambling and gambling involvement in gambling machine, lottery, and scratch tabs significantly increased over time. This study did not report data on individual trajectories of gamblers, so it was impossible to determine if the gamblers reporting problems in adolescence were the same

individuals who reported problems later in young adulthood, or if new cases contributed to the prevalence seen in young adulthood. Therefore, the stability and persistence of problem gambling at the individual level could not be determined.

Slutske, Jackson, and Sher (2003) conducted an 11-year, four wave longitudinal study that examined past year and lifetime problem gambling prevalences in college students from the age of 18 to 29. Similar to Winters et al. (2002), past year prevalences were relatively stable across time. Sluske et al. (2003) noted, however, that an analysis at the individual level revealed that different participants contributed to the prevalences at each wave and that the general trend was for individual participants to experience problems at only one of the four time points.

A more recent review by LePlante, Nelson, LaBrie and Shaffer (2008) analyzed five prospective longitudinal studies; these included the studies conducted by Winters et al. (2002) and Slutske et al. (2003) referred to above, along with three additional studies that included samples of older adult gamblers. LePlante et al. found that in all five studies reviewed the course of disordered gambling was unstable and multidirectional. Taken together, these findings contradict the "downward spiral" conception of problem gambling development and challenge the view that the course of disordered gambling is consistent, stable and unremitting. Instead they suggest that gambling problems may often—although not always—be transient and episodic; in short, they suggest that some individuals mature out of their gambling problems.

Given the impact disordered gambling can have on young adults, and the unique vulnerability of this population, more longitudinal research examining the course of disordered gambling through adolescence and young adulthood is needed. Such research will help us to refine theories regarding factors that put certain young people at heightened risk for developing serious gambling problems at early or later stages of their adult lives. This is especially important

in Manitoba where (as noted earlier) prevalence rates for problem gambling are particularly high (Cox et al., 2000). Such research will assist care providers and industry stakeholders to customize their initiatives to help maintain positive trends in gambling behaviour while preventing the onset and worsening of gambling problems. A developmental model that seeks to explain susceptibility to gambling in young people is likely to be informed by and lead to refinements in existing theories that attempt to account for problem and pathological gambling in adults. For this reason, in the next section I outline several of the most important existing theories.

Theoretical Models of Problem and Pathological Gambling

Several early models were proposed to explain how gambling problems develop over time (e.g., Anderson & Brown, 1984; Blum et al., 2000; Ladouceur & Walker, 1996). These different theories posited that specific factors such as learning history, cognition, and genetic vulnerabilities were implicated in the development of gambling problems. Many of these theories focused specifically on one of these factors without considering how it might interact with other factors. More recent theories on problem and pathological gambling hypothesize that psychological, environmental, and biological factors interact to initiate and perpetuate gambling-related problems (e.g., Korn & Shaffer, 1999; Blaszczynski & Nower, 2002). Several comprehensive models that integrate these factors have been forwarded to explain the etiology of problem and pathological gambling. I will briefly discuss three of these models: the *Public Health Model* (Korn & Shaffer, 1999), the *General Theory of Addictions Model* (Jacobs, 1986), and finally the *Pathways Model* (Blaszczynski & Nower, 2002).

Public Health Model. Korn and Shaffer (1999) advanced a public health perspective on gambling by employing the epidemiological communicable disease model similarly used for

alcohol, tobacco and other drugs. This paradigm attempts to explain the complex interrelationship between the host, the agent, the environment, and the vector. When applying this model to gambling, the "host" is the gambler; the "agent" denotes the gambling activities the gambler engages in; the "environment" includes the gambling venue and the familial, socio-economic, political and cultural arena the gambling occurs in; and the "vector" is the money gambled (Korn & Shaffer, 1999).

The authors point out that a public health model incorporates a wide range of factors including the biological, behavioural, social, and economic dimensions of gambling behavior, and that it addresses prevention, treatment and rehabilitation. From the public health perspective, gambling behaviour exists along a spectrum that can range from non-problematic to pathological, with problem gambling existing somewhere in-between these two poles. However, the gambler is understood as existing within a social milieu in which his or her behaviour is influenced by culture, family, and community values. Therefore, instead of viewing gambling behaviour as an isolated phenomenon, Korn and Shaffer (1999) suggest one use a "systems" view that goes beyond the individual and takes into account important external factors impacting that individual's behaviour. In addition to the above, in the Public Health Model an effort is made to understand the risk, resiliency, and protective factors that can impact gambling behaviour.

The major strengths of the Public Health Model are that it is comprehensive and addresses prevention and treatment issues at the individual and social level, but also focuses on factors usually not considered in more traditional clinical models of gambling such as public policy, politics and organizational behaviour. However, because the Public Health Model is so comprehensive in scope, it is difficult to design studies that test all of the factors it outlines. It

might, therefore, be best conceptualized as a meta-theory that provides an overarching framework for other less comprehensive theories to fit into.

General Theory of Addictions. To account for both physiological and psychological factors in the etiology of addictive behaviours, Jacobs (1986) proposed the General Theory of Addictions. He argues that, regardless of the substance they use, persons with an addiction share similarities and that, as such, differentiating them into groups based on the substances they use is erroneous. Jacobs noted the similarities among different kinds of addictive behaviours and suggested that two sets of predisposing factors underlie a person's risk for developing and maintaining an addictive pattern of behaviour: (1) a unipolar physiological resting state that is chronically and excessively either depressed or excited; and (2) a psychological nature that develops during childhood and early adolescence and is marked by feelings of inferiority, inadequacy, rejection, and a tendency to escape from negative experiences via wish-fulfilling fantasies. According to Jacobs, these factors are necessary but insufficient for the development an addictive pattern of behaviour. In addition to exhibiting these underlying factors, the person must also encounter a triggering event with a substance or experience, such as gambling, that reduces their chronic state of tension, and allows them to fulfill grandiose wish-fulfilling fantasies of personal success and social acceptance. Once the effect of this stimulus wears off, however, the person returns to their original state of tension, and attempts to re-establish the positive experience again. Through a gradual process, the person with an addiction continues this pattern of addictive behaviour in seeking pleasure and relief from tension. From a developmental perspective, he noted that persons who are prone to these physiological and psychological factors experience fewer opportunities to interact with the environment and learn coping strategies that help them to manage their anxiety, feelings of inferiority, and social isolation.

A strength of Jacobs' model is that it postulates both physiological and psychological risk factors shared by those who develop addictions. His theory also marked the first attempt to create a model of addiction based on shared characteristics across different classes of addicts. According to this theory only a limited segment of the population would have the two predisposing factors described above and, therefore, be at risk for developing an addiction. Jacobs used the compulsive gambler as the prototype of a person with an addictive personality syndrome. The theory does well to explain gambling problems developing as a result of a gambler's successive attempts to enhance positive moods or reduce negative moods—factors empirically shown to be related to the development of gambling problems (Goldstein, Stewart, Hoaken, & Flett, 2014).

One major limitation of the General Theory of Addictions is that is does not explain how individuals without such predisposing risk factors become addicted to substances or behaviours. For example, regarding gambling, this theory does not account for individuals who are characterized by an absence of pre-existing psychopathology yet still go on to develop gambling behaviour as a result of the classical and operant reinforcement contingencies inherent in gambling tasks. Another limitation of this theory is that it does not account for impulsivity, which is a risk factor strongly associated with the development of disordered gambling (Blanco et al., 2009; Shenassa, Paradis, Dolan, Wilhelm, & Buka, 2012).

Pathways Model. Blaszczynski and Nower (2002) proposed their Pathways Model to integrate biological, personality, developmental, cognitive, learning theory, and environmental factors that have been discussed within the gambling literature to explain problem and pathological gambling. According to Blaszczynski and Nower, pathological and problem gambling emerge in response to a common, core set of ecological factors (e.g., increased

availability and access to gambling opportunities) and cognitive and learning factors (behavioral contingencies of reinforcement, cognitive distortions, and poor decision making). With repeated exposure to gambling activities, these common factors lead some individuals to lose control over their gambling behaviour, which leads to mounting financial deficits. Attempts to recover financially through continued gambling (i.e., chasing) further entrenches the person in a destructive cycle that leads to other problems in their life that arise from their inability to sustain this pattern indefinitely. Blaszczynski and Nower argue that models proposed prior to the Pathways Model acknowledge these shared factors but erroneously assume that disordered gamblers are a homogeneous population. They suggest, instead, that it may be more productive to differentiate gamblers into subgroups based on the roles that other biopsychosocial factors play in the development of their gambling problems. Within their model they propose that distinctly different vulnerability factors contribute to the establishment of three different gambling subtypes.

Behaviorally conditioned problem gamblers are preoccupied with gambling, engage in chasing losses, abuse alcohol, and report depression and anxiety because of their problem gambling behaviour (Blaszczynski & Nower, 2002). Individuals belonging to this subtype experience the least severe types of gambling problems and, most importantly, do not present with premorbid psychopathology, substance abuse, or impulsivity. Behaviourally conditioned gamblers are said to fluctuate between heavy and problematic gambling, but once difficulties begin to emerge in their lives they typically are motivated to seek out and benefit from treatment and can regain control of their gambling behaviour (Blaszczynski & Nower, 2002).

The next subgroup defined within the model is the *emotionally vulnerable* problem gambler. These individuals share all the features of the behaviourally conditioned subtype

however they are motivated to gamble to relieve or escape negative affective states. These gamblers are distinguished from the behaviourally conditioned subtype by the presence of premorbid biological and emotional vulnerabilities manifesting as depression and anxiety; poor coping/problem-solving skills; a history of negative childhood experiences of inadequacy, inferiority and low self-esteem; and alcohol dependence. This subtype resembles the disordered gambler described in Jacobs' (1986) General Theory of Addiction, which was discussed above. In addition to providing education directed at combatting cognitive distortions about gambling, treatment of individuals in this pathway must also address the factors that lead to the establishment of their emotional vulnerability. Individuals in this subtype are more difficult to treat because they lack effective coping mechanisms that could help them to regulate their emotions and control their gambling behaviour (Blaszczynski & Nower, 2002).

Blaszczynski and Nower's third subtype is known as the *antisocial impulsivist* problem gambler. These individuals are distinguished from behaviourally conditioned and emotionally vulnerable gamblers in that they show signs of trait impulsivity, attention deficit, and antisocial personality disorder. The presence of these characteristics increases the likelihood that antisocial/impulsivist gamblers will also report a number of other behavioural problems, including substance abuse, suicidality, irritability, low tolerance for boredom, criminal behaviour, poor interpersonal relationships, excessive alcohol and polydrug experimentation, and a family history of antisocial behaviour and alcohol problems. These individuals are believed to start gambling at an early age and experience rapid and intense escalations in their gambling behaviour that result in more pathological gambling problems as they age. Antisocial impulsivist gamblers are more likely than other types of gamblers to engage in gambling-related criminal activities to maintain their gambling behaviour.

For characterological reasons, individuals who belong to this subtype typically do not seek out treatment and those who do often exhibit poor compliance. This subtype therefore seems best suited to conform to the traditional pattern of chronic and enduring gambling problems described in the literature.

Other Research Aimed at Subtyping Gamblers

The publication of the Pathways Model (Blaszczynski & Nower, 2002) was important as it suggested that there may be utility in classifying gamblers into subtypes based on a range of etiological risk factors in that it may (a) provide us with a more nuanced understanding of the etiology and development of gambling problems; and (b) help clinicians design prevention and treatment strategies tailored to the individual. But Blaszczynski and Nower were not the first researchers to propose that there may be different subtypes of disordered gamblers. An important early contributor in this area was Moran (1970). Through conducting interviews with treatment-seeking pathological gamblers, Moran derived five distinctive subtypes of pathological gamblers that could be differentiated on the basis of social factors and individual characteristics. This seminal paper encouraged other researchers to investigate if and how disordered gamblers could be subtyped based on their shared characteristics.

A total of 17 subtyping studies published over the four decades following the publication of Moran's paper in 1970 were reviewed by Milosevic and Ledgerwood in 2010. These authors concluded that the findings from these studies provided good support for three subtypes of gamblers that closely resemble those proposed in the Pathways Model. On these grounds, they recommended that the Pathways Model be adopted as the primary conceptual framework for further theoretical and empirical research into gambling subtypes. I have followed this recommendation in research described in the chapters that follow.

To provide some background for the work described in Chapters 2 and 3, in this section I review several studies published between 2007 and 2013 that utilized a statistical technique referred to as latent class analysis (LCA) (or a similar technique called latent profile analysis) to derive subtypes of gamblers in detail. Most of these studies focused on subtyping gamblers based on risk factors or diagnostic criteria for gambling disorder; as such, fit with the Pathways Model could not be comprehensively tested. In addition, only three focused on adolescent or young adult samples, which were the focus of my own research.

LCA studies using adult samples. Cunningham-Williams and Hong (2007) completed a study of 312 lifetime gamblers that investigated if they could be classified into different subgroups based on the following factors: diagnostic gambling symptoms, reasons for gambling, gambling "withdrawal-like" symptoms, problem gambling perceptions, gambling venues, financial sources for gambling, gambling treatment/help-seeking, and religiosity/spirituality. LCA revealed that a 6-class model fit the data best. Class 1 (57%) was classified as a nonproblem gambler subtype characterized by non-endorsement of the majority of indicators. Gamblers in Class 2 (3.5%) did not endorse treatment/help-seeking but had low level endorsement of all other indicators except different reasons to gamble, which fell in the moderate range. Class 3 (12.2%) was distinguished by a moderate number of "withdraw-like symptoms" and individuals in this class were defined as mild risk gamblers. Moderate risk gamblers (Class 4) made up 8.7% of the sample. Participants in this class endorsed a moderate number of DSM/ICD symptoms, higher numbers of different perceptions of problem gambling, and financial sources of gambling. Individuals in Class 5 (12.2%) were distinguished from the other classes mainly by a high endorsement of the majority of indicators, with the exception being the number of treatment/help-seeking sources they sought for gambling problems. Finally, members

of Class 6 (6.4%) were classified as severe-risk gamblers due to having the highest rates of indicators in comparison to those in the other classes. The results of this study support the premise that gamblers can be subtyped based on severity of disordered gambling symptoms. This study did include a measure of withdrawal-like symptoms as an indicator, however other co-occurring psychiatric disorders were not included, which meant that the classes derived could not be compared to those proposed in the Pathways Model.

Xian et al. (2008) used LCA to empirically derive three subtypes of gamblers based on participants' lifetime endorsement of DSM-III-R criteria. Similar to Cunningham-Williams and Hong (2007), the classes identified in this study were distinguished according to severity of disordered gambling symptoms. The authors found that nicotine dependence, antisocial personality disorder, and conduct disorder were most strongly associated with Class 3, the subtype that also showed the most severe disordered gambling. This finding is consistent with the claim in the Pathways Model that the antisocial impulsivist subtype has the most severe gambling problems.

McBride, Adamson and Shelvin (2010) used LCA to explore the heterogeneity of gamblers in a large sample of British gamblers (N = 5,644), based on their endorsement of DSM-IV gambling disorder criteria. They reported evidence for three latent classes. Members of one class, which included 88.9% of the sample, were characterized as "*non-problematic*" gamblers with a low probability of endorsing any of the criteria. Members of the second class (9.7%) were described as "*preoccupied chasers*" who had a higher probability of endorsing the majority of criteria when compared to the first class, and (especially) of endorsing preoccupation with gambling and chasing losses. Members of the last class, which included the fewest number of gamblers (1.4%), were classified as "*antisocial impulsivist*' gamblers. This subtype demonstrated

the highest probability of endorsing all criteria included in the LCA. Committing illegal acts, gambling to regulate negative affect, and being bailed out of their gambling debts by others were almost exclusively endorsed by this subtype. McBride et al. noted that although there was some evidence that the classes were differentiated with regard to the specific criteria endorsed, the severity of the problems experienced by the gamblers were more indicative of class membership. One limitation of this study was that it did not include measures of personality, mood, and anxiety disorders. These disorders are frequently found to be co-morbid with disordered gambling (Blaszczynski & Nower, 2002) and including them in the LCA could have provided important information about how subtypes differ when co-morbid disorders were considered in tandem with disordered gambling.

Carragher and McWilliams (2011) used LCA to subtype a large sample of gamblers (N = 11,104) according to the 10 DSM-IV pathological gambling criteria. Three classes of gamblers emerged that were differentiated based on their severity of gambling problems. The largest class, comprising 93.3% of the sample, was classified as a "*no gambling problems*" subtype due to their low probability of endorsing any criteria. Members of a second "*moderate gambling problems*" class (6.1%) were characterized by preoccupation with gambling, tolerance, and chasing. The third class (0.6%) was identified as a "*pervasive gambling problems*" subtype as its members demonstrated a high probability of endorsing the majority of the DSM-IV pathological gambling criteria. The results of this study mirrored the findings of McBride et al. (2010) and provided additional support for the utility of differentiating gamblers into subtypes based on the severity of their gambling problems.

A strength of the McBride et al. (2010) and Carragher and McWilliams (2011) studies was that they utilized nationally representative samples from Britain and the United States,

respectively. In addition, Carragher and McWilliams' (2011) study was able to demonstrate that differences existed between the classes regarding psychiatric and substance use disorders. Specifically, gamblers in the moderate and pervasive gambling problems classes were at an increased risk of reporting any alcohol use disorder and a specific phobia. In addition, moderate problem gamblers were more likely to meet diagnostic criteria for hypomania, panic disorder without agoraphobia, and obsessive-compulsive personality disorder. Lastly, gamblers in the pervasive gambling problems class were at higher risk for being diagnosed with mania, social phobia, and antisocial personality disorder. Both of these studies support the Pathways Model prediction of an antisocial impulsivist subtype that is typified by severe gambling problems and antisocial tendencies.

Martins, Ghandour, and Storr (2011) carried out the first subtyping study using LCA to derive classes of gamblers using Canadian population-based data (collected in three provinces). Only participants who reported some risk for gambling problems were included in this study (N = 1,071). Martins et al. included 16 gambling-related indicator variables in their LCA: 15 derived from the Canadian Problem Gambling Index (CPGI) and a single item assessing preference for electronic gambling, which they suggested might be linked to a higher likelihood of developing gambling problems. Their LCA revealed a three-class solution. Class 1 (50%) was composed of gamblers who had a low probability of endorsing all items except the electronic gambling item, which had a moderate probability of endorsement. Class 2 gamblers were differentiated from the other classes of gamblers based on their moderate to high probability of endorsing all items. Finally, Class 3 gamblers were unique in that they had high probabilities of endorsing a family history of alcohol and drug problems in addition to a moderate probability of endorsing an item indicating their memory of a big win when starting gambling. A unique

strength of this study was that it examined a non-clinical sample of gamblers at risk of gambling problems. It also sampled a broader range of characteristics included in Blaszczynski and Nower's (2002) Pathways Model, including information about respondents' family history of alcohol, drug, and/or gambling problems.

Most recently, Nower, Martins, Lin, and Blanco (2013) used LCA to derive three subtypes of disordered gamblers from the National Epidemiological Survey on Alcohol and Related Conditions (NESARC; Grant, Dawson, & Hasin, 2001). These authors limited their sample to 581 gamblers who endorsed three or more DSM-IV criteria for pathological gambling—a group they referred to as "disordered gamblers." They identified 22 variables that they felt represented important clinical indicators outlined in the Pathways Model. LCA revealed a three-class solution resembling the subtypes proposed in the Pathways Model. Class 1 gamblers (who comprised 50.76% of the sample) resembled Blaszczynski and Nower's (2002) behaviourally conditioned subtype. Gamblers in this class demonstrated moderate probabilities of endorsing prior-to-past-year substance use disorders and the death of a parent or family member, but low probabilities of endorsing the remaining indicators. Gamblers in Class 2 (20.06% of the sample) had a high probability of endorsing past year substance abuse disorders, and moderate probabilities of endorsing past-year death of a parent or family member, physical fights due to drinking, parents with alcohol or drug problems, and any personality disorder. Class 3 gamblers (29.18% of the sample), who showed the most severe gambling problems, were differentiated from the other two classes by having high probabilities of endorsing a personality disorder and prior-to-past-year substance use disorder. They also had moderate probabilities of endorsing a history of antisocial personality disorder, past-year substance use disorder, and parents who had alcohol or drug problems and a history of antisocial personality disorder.

LCA studies in adolescents and young adults. The studies described above examined broad samples of adult gamblers. Given the high rates of gambling in young adulthood, it is important to determine if gamblers interviewed at earlier stages of risk pathways can be subtyped as well and, if so, whether the subtypes identified differ from those found in studies focusing mainly on adult populations.

Faregh and Derevensky (2011) used LCA to classify adolescent gamblers with known psychoactive substance dependence into subtypes based on DSM-IV endorsement criteria. *At-risk gamblers* in the community fell into two subtypes (antisocial and neurological), while *problem gamblers* were not differentiated into subgroups – findings incongruent with the Pathways Model. Another interesting finding from this study was that male and female adolescent gamblers differed in their endorsement profiles and followed different pathways toward the development of gambling behaviors.

Gupta, Nower, Derevensky, Blaszczynski, Faregh and Temcheff (2013) included measures of personality, attention deficit hyperactivity disorder, gambling severity, and reasons for gambling in their LCA to investigate the validity of the Pathways Model with a sample of 109 adolescent problem gamblers. Their analysis revealed five classes, with three resembling those proposed in the Pathways Model, one characterized by depression only, and another that included problem gamblers with both internalizing and externalizing disorders.

A limitation of both of the two studies described above is that they were cross-sectional in nature and, as a result, could not test any temporal aspects of the Pathways Model. Another limitation of many of the studies mentioned thus far is that samples were limited to disordered gamblers and therefore do not address sub-clinical or non-problem gamblers. This highlights an important gap in the subtyping research on disordered gambling. Considering that young

adulthood is a developmental period that is associated with increased risk-taking and emotional lability, longitudinal studies examining a broad cross-section of young adult gamblers, including recreational and subclinical gamblers, could demonstrate if the characteristics differentiating disordered gambling subtypes can also be used for subtyping gamblers in general. From this perspective, the Pathways Model can be conceptualized as a developmental framework for disordered gambling where the pathways represent subtypes of individuals with unique clusters of risk factors for disordered gambling. Only a small proportion of gamblers in each subtype go on to develop gambling problems, but the development can be explained by their unique constellation of risk factors. Examining these pathways in subclinical samples of young adult gamblers might contribute to our knowledge about the structure of subsyndromal gambling and provide important information relevant to early prevention of gambling problems.

To my knowledge, to date there is only one longitudinal study that has investigated the applicability of the Pathways Model to adolescents transitioning into emerging adulthood. Allami, Vitaro, Brendgen, Carbonneau, Lacourse, and Tremblay (2017) identified four subtypes of at-risk 12-year-old adolescent gamblers using latent profile analysis. Three of the subtypes resembled those described in the Pathways model, however a fourth subtype was also identified that shared characteristics of both the emotionally vulnerable and antisocial impulsivist subtypes. Secondary prospective longitudinal investigations revealed that subtype membership at age 12 did not predict age of onset or frequency of gambling behaviour at ages 16 or 23. These findings contradict a prediction in the Pathways Model that antisocial impulsivist gamblers have an earlier age of onset in comparison to the other two subtypes. Another important finding in this study was that by age 23 both the emotionally vulnerable and behaviourally conditioned subtypes experienced a decline in gambling problems, as measured by the South Oaks Gambling

Screen, a finding in line with the maturing out hypothesis. This trend was not found for members of their *biologically vulnerable* (i.e., antisocial impulsivist) subtype, which experienced increases in problematic gambling behaviour. Although the design of this study was able to test some developmental aspects of the Pathways Model, Allami et al. (2017) were unable to determine if the subtypes derived at age 12 remained stable into emerging adulthood or if gamblers were likely to transition between subtypes as they progressed through these stages of development.

The Current Research

The overarching goal of the present research was to address several of the gaps in the literature discussed above by performing secondary data analyses on a subset of the data collected in the Manitoba Longitudinal Study of Young Adults (MLSYA; Manitoba Gaming Control Commission et al. 2011), a longitudinal study that involved four waves of data collection between 2007 and 2011. Participants in the study formed a representative sample of young adult gamblers from Winnipeg, Brandon, and several smaller rural communities in the province of Manitoba, Canada.

The specific aim of the research described in Chapter 2 was to examine if meaningful subtypes could be identified in a sample of young adults reporting a wide range of involvement in gambling behaviors. In order to do this, I applied LCA to the data obtained in Wave 2 of the MLSYA, selecting as my input variables measures from the dataset that captured a range of characteristics included in Blaszczynski and Nower's (2002) Pathways Model.

The specific aims of the research described in Chapter 3 were two-fold. First, I sought to determine if subtypes of gamblers observed at Wave 2 remained stable over time. To do this, I conducted an LCA based on data collected at Wave 4 to determine if a class solution similar to that seen at Wave 2 emerged at this time point. My second aim was to determine whether

particular individuals would continue to be classified in the same manner over time. To test this, I applied a statistical technique called latent transition analysis (LTA) to the data collected at Waves 2 and 4.

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CHAPTER 2: A LATENT CLASS ANALYSIS OF YOUNG ADULT GAMBLERS FROM THE MANITOBA LONGITUDINAL SURVEY OF YOUNG ADULTS

Keywords: gambling, gambler subtypes, pathways, young adult, emerging adulthood, Latent Class Analysis

Except for some minor formatting changes, Chapter 2 is reprinted here with permission as it appears in:

Dowd, D. A., Keough, M. T., Jakobson, L. S., Bolton, J. M., & Edgerton, J. D. (2019). A latent class analysis of young adult gamblers from the Manitoba Longitudinal Survey of Young Adults. *International Gambling Studies*, *19*(1), 148–166. doi: 10.1080/14459795.2018.1520909

My Contribution to the Publication

The goal of the research described in Chapter 2 was to examine if meaningful subtypes of gamblers could be identified in a sample of young adults reporting varied levels of gambling behaviors. Doing this was important because relatively few studies have looked for evidence of subtypes in general samples of young adult gamblers. Doing so might contribute to our understanding of the structure of subsyndromal gambling and provide important information relevant to early prevention of gambling problems.

I conducted the literature review, designed the study, and requested permission to access the MYLSA database. I determined the methods used for data analysis in consultation with Dr. Keough and conducted the analyses for this study. I then drafted and revised the manuscript based on feedback from Drs. Keough and Jakobson, and then revised it further based on feedback from Drs. Bolton and Edgerton. I selected the journal, *International Gambling Studies*, to which we submitted the manuscript after I received approval to proceed from all co-authors. Based on the reviewers' comments that we received, I revised the manuscript in consultation with Drs. Keough and Jakobson and resubmitted the manuscript along with our responses to the reviewers.

Abstract

Informed by the Pathways Model, the current study utilized latent class analysis (LCA) to empirically derive subtypes of gamblers based on measures of impulsivity, anxiety, depression, drug use and alcohol dependence. The sample in this study ($N = 566$) was comprised of young adult gamblers (18-22 years of age) who participated in the Manitoba Longitudinal Survey of Young Adults (MLSYA). Multinomial regression was utilized to examine how demographic variables and participant scores on the Problem Gambling Severity Index (PGSI) predicted membership in gambler classes from the LCA. Results of the LCA revealed three classes of gamblers: *emotionally vulnerable*, *non-problem*, and *impulsive*. Multinomial regression showed that older age (i.e., 20-22 years of age), lower income (< $20,000 per year), living independently and PGSI scores were associated with increased odds of being classified as an impulsive gambler. Identifying as European, living independently, and PGSI scores were associated with increased odds of being grouped in the emotionally vulnerable class of gambler. These results suggest that young adult gamblers are not a homogeneous group but instead are best understood as falling into different subtypes based on shared characteristics outlined in the Pathways Model.

Introduction

With the widespread expansion of legalized gambling opportunities, gambling problems have increasingly become a significant public health issue (Welte, Wieczorek, Barnes, Tidwell, & Hoffman, 2004). Of particular concern is the growing number of young people and young adults who gamble to excess; indeed, it is now acknowledged that young people are at an even higher risk than adults of developing gambling problems (Calado, Alexandre, & Griffiths, 2017; Huang & Boyer, 2007; Shaffer & Hall, 2001), with prevalence rates estimated at 2-3% in Canada (Cox, Yu, Afifi, & Ladouceur, 2005; Huang & Boyer, 2007). The goal of the present study was to contribute to efforts designed to elucidate factors that may increase risk in this vulnerable population. In particular, our goal was to determine if different subgroups of young adult gamblers can be identified based on different risk profiles.

In the gambling literature, individuals who experience maladaptive gambling behaviour that leads to harmful consequences (e.g., anxiety, depression, financial difficulties, interpersonal conflicts, and work-related problems) are generally grouped into two categories: (1) sub-clinical problem gamblers and, (2) gamblers who meet criteria for gambling disorder. These terms are often used interchangeably, but they typically distinguish those who are at low to high risk for problems from those who exhibit four or more symptoms required for diagnosis of gambling disorder, formerly "pathological gambling," in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5, American Psychiatric Association, 2013).

Numerous studies involving adult samples have suggested links between gambling problems and other mental disorders (e.g., Lesieur & Blume, 1991; Miller & Westermeyer, 1996), including substance abuse disorders (Kessler et al., 2008; Spunt, Dupont, Lesieur, Liberty, & Hunt, 1998), mood and anxiety disorders (el-Guebaly et al., 2006; Petry, Stinson, &

Grant, 2005), Antisocial Personality Disorder, Narcissistic Personality Disorder, and Attention-Deficit Hyperactive Disorder (Carlton & Manowitz, 1992; Pietrzak & Petry, 2005; Rugle & Melamed, 1993; Specker, Carlson, Christenson, & Marcotte, 1995). Problem gambling in adults has also been associated with specific traits such as sensation seeking (Bonnaire, Varescon, & Bungener, 2007), impulsivity (Bagby et al., 2007; Blaszczynski, Steel, & McConaghy, 1997; Clark, 2006; Legerwood, Alessi, Phoenix, & Petry, 2009; Nower & Blaszczynski, 2006; Vitaro, Arseneault, & Tremblay, 1999; Vitaro, Ferland, Jacques, & Ladouceur, 1998), and psychoticism or neuroticism (Bagby et al., 2007; Clark, 2006; Myreseth, Pallensen, Molde, Johnsen, & Lorvik, 2009). Observations such as these have led some to suggest that mental health disorders, personality traits, and behavioural problems play a role in the development of gambling problems.

It has also been argued that problem gamblers are not a homogeneous group (see Milosevic & Ledgerwood, 2010 for a review). The possibility that gamblers can be subtyped based on differing characteristics, such as co-occurring psychopathologies and personality traits, has important clinical relevance. For example, subtyping may allow prevention and treatment efforts to be individualized to address the specific underlying issues and risk factors that distinguish different groups. Indeed, Blaszczynski and Nower (2017) have recently developed and validated a screening instrument based on their model of problem gambling to help clinicians identify subtypes of treatment-seeking gamblers.

Several theoretical models of problem gambling exist. Early theories posited that specific factors such as learning history, cognition, and genetic vulnerabilities were implicated in the development of gambling problems (e.g., Anderson & Brown, 1984; Blum et al., 2000; Ladouceur & Walker, 1996). Many of these theories focused specifically on one of these factors

without taking into account how it might interact with other factors. More recent theories on problem and gambling hypothesize that psychological, environmental, and biological factors interact to initiate and perpetuate gambling-related problems (e.g., Blaszczynski & Nower, 2002; Korn & Shaffer, 1999). Based on their review of the problem gambling subtyping literature, Milosevic and Ledgerwood (2010) suggested that future research investigate the theoretical framework of the Blaszczynski and Nower's Pathways Model.

The Pathways Model

Blaszczynski and Nower (2002) proposed their Pathways Model in an attempt to integrate biological, personality, developmental, cognitive, learning theory, and environmental factors, all of which have been discussed in the gambling literature. According to this model, problem gambling emerges in response to a common, core set of ecological factors (e.g., increased availability and access to gambling opportunities) and cognitive and learning factors (behavioral contingencies of reinforcement, cognitive distortions, and poor decision making). However, according to the model, problem gamblers can be differentiated into subgroups on the basis of the role that biopsychosocial factors play in the development of their gambling problems, as outlined below.

Behaviourally conditioned problem gamblers engage in alcohol abuse and report depression and anxiety as a consequence of their gambling behaviour. These individuals experience the least severe types of gambling problems and, most importantly, do not present with premorbid psychopathology, substance abuse, or impulsivity. In the absence of comorbid psychopathology (including impulsivity), cognitive distortions are pivotal in driving problem gambling behaviour.

Emotionally vulnerable problem gamblers are motivated to gamble in an attempt to relieve or escape aversive affective states. They are distinguished from the behaviourally conditioned subtype by the presence of premorbid biological and emotional vulnerabilities manifesting as depression and anxiety; poor coping/problem-solving skills; a history of negative childhood experiences of inadequacy, inferiority and low self-esteem; and alcohol dependence.

Antisocial impulsivist problem gamblers are differentiated from behaviourally conditioned and emotionally vulnerable gamblers by trait impulsivity and antisocial behaviour. The presence of these characteristics increases the likelihood that they also report other behavioural problems, including substance abuse, suicidality, irritability, low tolerance for boredom, criminal behaviour, poor interpersonal relationships, excessive alcohol and poly-drug experimentation, and a family history of antisocial behaviour and alcohol problems.

Research Examining the Pathways Model

Since the Pathways Model was proposed, several researchers have investigated its empirical validity (see Milosevic & Ledgerwood, 2010 for a review). Nower, Silva, Martins, Lin and Blanco (2013) utilized latent class analysis (LCA) to identify three distinct subtypes of disordered gamblers, roughly corresponding to those outlined in the Pathways Model, in a sample of 581 adults who completed the US National Epidemiologic Survey on Alcohol and Related Conditions (NESARC; Grant, Dawson, & Hasin, 2001). Applying cluster analysis to variables of coping motives for gambling, childhood trauma, boredom proneness, risk-taking, impulsivity, attention-deficit/hyperactivity disorder (ADHD), and antisocial personality disorder, Moon, Lister, Milosevic and Legerwood (2016) also identified three distinct subgroups of gamblers consistent with the Pathways Model in a combined community/undergraduate sample

of non-treatment seeking problem gamblers ($N = 150$). Both of these studies examined adults (18 and over) who met criteria for problem or gambling disorder.

Gaps in Research and Aims of Study

To date, little research has specifically examined how/if the Pathways Model applies to young adult gamblers. One study, conducted by Gupta, Nower, Derevensky, Blaszczynski, Faregh, and Temcheff (2013) used measures of personality, ADHD, gambling severity, and reasons for gambling in a LCA to empirically investigate the validity of the Pathways Model with a sample of 109 adolescent problem gamblers. LCA revealed five classes, with three resembling those proposed in the Pathways Model, one that was a depression-only class, and another that included problem gamblers with both internalizing and externalizing disorders.

While the study conducted by Gupta et al. (2013) provided support for the Pathways Model, the findings are limited to problem gamblers, and do not address sub-clinical or non-problem gamblers. More research is needed that investigates a broad cross-section of young adult gamblers, including recreational and at-risk gamblers. From an etiological perspective, we would expect the Pathways Model to inform our understanding of the development of the gambling subtypes, even at subclinical levels of risk. This has obvious implications for early screening and prevention programmes for disordered and problem gambling.

In a review of the subtyping literature, Milosevic and Ledgerwood (2010) concluded that future research should also examine the association between gender and gambling subtypes. They hypothesized that a greater proportion of emotionally vulnerable gamblers would be female and that men would be overrepresented in the antisocial impulsivist subtype of gamblers.

Using the Pathways Model as an etiological framework, the current study examined a broad sample of young adult gamblers, including non-problem, low-risk, moderate-risk and

problem gamblers.

Our aims were: (1) to utilize LCAs to determine if different subtypes of gamblers could be derived using measures of anxiety, depression, alcohol and drug problems, and impulsivity; and (2) to validate the class solution that emerged by utilizing multinomial logistic regression to test whether or not differences in gambling severity and demographic characteristics (e.g., gender) that may act as risk factors for developing gambling problems could predict class membership (subtype).

A key strength of the design is that our analysis was conducted on data obtained from a provincially representative sample of young adult gamblers. This study adds to the growing body of research on gambling subtypes and provides support for the premise that the Pathways Model may be useful as a general etiological framework to understanding gambling subtypes in addition to categorizing gamblers broadly - with important implications for early screening and prevention efforts.

Method

Participants and Procedure

Data from the Manitoba Longitudinal Survey of Young Adults (MLSYA) were used to complete this study. The Manitoba Gambling Control Commission, the Addictions Foundation of Manitoba, and the Manitoba Lotteries Corporation created the MLSYA dataset in an attempt to learn more about young adult Manitobans' changing gambling behaviours and attitudes and about how these changes relate to a broad spectrum of protective and risk factors. In November 2007, Prairie Research Associates Inc. (PRA) recruited participants and collected the MLSYA data. The sample is partly a convenience sample and therefore it is not truly random. It is reasonably representative of the Manitoba population, but does over represent participants living

in Winnipeg (80% of the sample compared to 55% of the population). Wave 1 participants were recruited through random-digit dialing, onsite casino recruitment, advertisements at post-secondary institutions and video lottery terminal lounges, the MLSYA website and toll-free telephone number, and participant referrals. Wave 1 participants completed a telephone survey and then were sent an additional survey by email or mail. At wave 2, participants who completed wave 1 were contacted by phone and/or email and asked to again complete a survey by telephone and then were sent a second survey by email or mail.

The initial sample ($N = 679$), which was recruited between December 2007 and July 2008, included young adult Manitobans (*mean age* = 18.92 years, $SD = .791$). The current study was based on data collected one year later, during Wave 2 ($N = 624$; attrition rate 8.1%; *mean age* = 19.95 years, $SD = .829$). The final sample ($N = 566$) after non-gamblers ($N = 58$; 9.3%) were removed included young adult Manitoban gamblers (*mean age* = 19.97 years, $SD = .821$). We focused on Wave 2 because it was during this wave that data on impulsivity (a major characteristic of the antisocial-impulsivist subtype in the Pathways Model) were collected. During Wave 2, participants completed a telephone interview (30 to 45 minutes), and then opted to complete either an on-line or mail-in survey that employed complex skip logic and included both open- and closed-ended questions. All participants in the final sample reported gambling on at least one occasion at Wave 2. Missing values were estimated using the full information maximum likelihood (FIML) procedure.

Data Analysis

This study was quantitative in nature and involved secondary data analysis of an anonymized database; as such, ethics approval was not required. To investigate the first aim in the current study we used LCA. Both categorical and continuous variables were used in the

statistical procedures. All recoding of variables and statistical analyses were completed using M*plus* 7 (Muthén & Muthén, 1998-2017) and SPSS v22.

Subtyping analysis. LCA was used to determine class membership at Wave 2 on the MLSYA using measures of: anxiety (two indicators), major depression, alcohol dependence, drug use, and impulsivity. LCA is a statistical procedure that uses maximum-likelihood estimation (MLE) to divide cases (in this scenario, gamblers) into classes based on their common characteristics. Specifically, the LCA modeling procedure produces criterion endorsement conditional probabilities that reflect the likelihood that a criterion is endorsed, given membership in a particular class (Xian et al., 2008). When conducting a LCA, a number of models are fitted to the data, beginning with a one-class solution (the most parsimonious solution), and then the number of latent classes is increased until the best-fitting statistical model is arrived at by comparing several fit indices including the Akaike information criterion (AIC; Akaike, 1987), Bayesian information criterion (BIC; Schwartz, 1978), entropy, and the Lo-Mendell-Rubin (2001) likelihood ratio test (LMR-LRT). In addition, the characteristic profile plots are used to determine which class solution is the most theoretically meaningful. Lower values on the AIC and BIC usually reflect the best fitting latent class model. Entropy is a standardized summary measure that is used to assess classification accuracy based on the estimated model's posterior probabilities. The entropy statistic ranges from 0-1 with higher scores reflecting better classification of individuals within the model. The LMR-LRT is a likelihood ratio-based method for comparing models. This significance test determines if adding another class to the solution (k + 1) results in a statistically significant improvement in fit. A non-significant value for this index indicates that the model with one fewer class should be accepted.

Secondary Analysis. A secondary analysis using multinomial logistic regression was performed to examine the relationship between class membership (dependent variable), participant demographics (factors), and severity of gambling problems (covariate).

Variables Used in the Subtyping Analysis

Barratt Impulsiveness Scale (BIS-11). The Barratt Impulsiveness Scale (BIS-11; Patton, Stanford, & Barratt, 1995) is a 30 item self-report questionnaire designed to assess the personality/behavioural construct of impulsiveness. The BIS-11 is the most commonly administered self-report measure of impulsiveness, and is used for clinical and research applications. This questionnaire was originally developed by Ernest S. Barratt in 1959 to relate impulsiveness and anxiety to psychomotor efficiency. It is currently in its 11th revision (Patton et al., 1995). Stanford et al. (2009) found both the internal consistency and the test-retest reliability of the total score of the BIS-11 to be good (Cronbach's α = 0.83; Spearman's Rho = 0.83). The total scores in Wave 2 were used in the present analysis. The Cronbach's α coefficient for the overall BIS-11 scale used in the present study was good at .84 and had acceptable skew and kurtosis.

Select Scales from the Composite International Diagnostic Interview Short Form (CIDI-SF). The CIDI-SF (Kessler, Andrews, Mroczek, Ustun, & Wittchen, 1998) is a fully structured set of scales developed from the larger Composite International Diagnostic Interview (CIDI) by the World Health Organization (WHO). The CIDI-SF was designed to allow for a quick screen for the most commonly occurring psychiatric disorders assessed with the CIDI. The current version of the CIDI-SF was designed to screen for DSM-IV (APA, 2000) disorders. Based on the criteria described below, we identified individuals who did, or did not, meet criteria for past-year generalized anxiety disorder (GAD), obsessive compulsive disorder (OCD), and

major depression (MD) at Wave 2, based on their responses to items in the relevant scales of the CIDI-SF.

The GAD scale has a 99.6% classification accuracy compared to the full CIDI (Kessler et al., 1998). Probable GAD cases were identified using the 90% predictive cut point, requiring three of six specific anxiety symptoms to be present for more days than not for the past six months, to be consistent with the DSM-IV (see Bulloch, Williams, Lavorato, & Patten, 2014). A dichotomous variable (0 = non-probable GAD; 1 = probably GAD) was used as an indicator variable in the LCA.

The OCD scale assesses the presence of obsessive thoughts or compulsive behaviours/thoughts and whether they are recognizable or unrecognizable, and causing marked distress or significant interference. Each category endorsed contributes a score, with possible overall scores ranging from 0-3. Individuals obtaining a score of 3 were identified as probable cases of OCD. A dichotomous variable (0 = non-probable OCD; 1 = probable OCD) was used as an indicator variable in the LCA.

The MD scale has a 93.2% classification accuracy compared to the full CIDI (Kessler, et al., 1998). Probable cases of major depressive episode were identified using the 90% predictive cut point, requiring five of nine specific depressive symptoms during the same two-week period, to be consistent with the DSM-IV (see Bulloch, Williams, Lavorato, & Patten, 2014). A dichotomous variable (0 = non-probable MD; 1 = probable MD) was used as an indicator variable in the LCA.

Select Scales from the Canadian Community Health Survey (CCHS). The CCHS (Statistics Canada, 2003) is a cross-sectional survey that collects information related to health status, health care utilization and health determinants for the Canadian population. The

researchers who carried out the MLSYA used the same instruments included in the CCHS, Cycle 2.1 to measure alcohol and drug dependence, using the relevant scales. The derived variables used here were calculated using instructions from Statistics Canada contained in CCHS documents, as described below.

Responses to questions in the *Alcohol Dependence Scale* were used to derive a measure of alcohol dependence within the past 12 months. Here, alcohol dependence was defined as tolerance, withdrawal, loss of control, or social or physical problems related to alcohol use. Respondents in all four waves of the MLSYA were first asked the question "how often in the past 12 months have you had five drinks on one occasion?" Those who answered at least 'once a month' were then asked a series of nine questions designed to assess alcohol dependence during the past year. For example: 'In the past 12 months, did you ever find that you had to drink more alcohol than usual to get the same effect or that the same amount of alcohol has less effect on you than usual?' Possible scores range from 0 to 9 with higher scores indicating a greater chance of alcohol dependence. This continuous variable was used as an indicator variable in the LCA. The Cronbach's α coefficient for the overall Alcohol Dependence scale used in the present study was acceptable at .79 and had acceptable skew and kurtosis.

The *Drug Dependence Scale* was used to derive a measure of drug use within the past 12 months. Two dichotomous variables were used as indicator variables in the LCA: 1) regular drug use (1 to 3 times per month or more) over the past 12 months (0 = no; 1 = yes); and 2) any drug use over the past 12 months (0 = no; 1 = yes).

Variables Used in the Secondary Analysis

Demographic variables. A number of demographic variables were utilized in a secondary analysis in an attempt to further validate the LCA solution. As noted below, in several

cases, some of the original categories used in the MLSYA dataset were combined or dropped based on a preliminary examination of response frequencies. The variables utilized included:

- age: in years;
- gender: coded as 1 = female; 2 = male;
- ethnicity: the original 11 categories were collapsed to 4 categories, coded as 1 = European; 2 = Aboriginal/Metis/First Nations; 3 = Filipino; 4 = all others;
- total personal income (proxy for socioeconomic status): coded as 1 = < $8000; 2 = $8000 to $11,999; 3 = $12,000 to $19,999; 4 = $20,000+);
- household composition: the original 11 categories were collapsed into 2 categories, coded as 1 = living independently; 2 = living with family;
- marital status: coded as 1 = single; 2 = in a relationship; 3 = married/common-law; and
- highest level of education completed: the original six categories were collapsed into two categories, coded as coded as 1 = high-school or less; 2 = some post-secondary or completed post-secondary);

Problem gambling. Participant raw scores on the Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001) were also included in the secondary analysis. The PGSI is a 9-item measure of problem gambling over the past 12 months. Participants are asked questions such as "Thinking about the last 12 months, have you felt that you might have a problem gambling?" or "Thinking about the past 12 months, has your gambling caused any financial problems for you or your household?" Potential responses are 0 (*Never*), 1 (*Sometimes*), 2 (*Most of the time*), and 3 (*Almost always*). Total scores can range from 0 to 27 with scores of 8 or more indicating problem gambling with negative consequences and a possible loss of control. In the analysis, this was treated as a continuous variable, given (a) the low incidence of problem

gambling (1.6%) that was observed in Wave 2; and (b) our desire to take advantage of the full range of variability in scores on this measure.

Results

Descriptives

Descriptive statistics for variables used in the LCA and participant demographics are found in Tables 2.1 and 2.2, respectively. PGSI descriptive statistics are found in Table 2.3.

Table 2.1
LCA Indicator Variable Information in Wave 2 of MLSYA

Variable		*N*	*%*	*Mean (SD)*
BIS-11 (30-120)		547		63.82 (10.31)
Alcohol Dependence Scale (0-9)		566		0.84 (1.36)
	0	363	64.1	
	1+	203	35.9	
Regular Drug Use (Past 12 Months)		552		
	No	312	56.1	
	Yes	244	43.9	
Any Drug Use (Past 12 Months)		556		
	No	357	58.1	
	Yes	257	41.9	
Meet criteria for GAD		566		
	No	547	96.6	
	Yes	19	3.4	
Probable Caseness for OCD		566		
	No	546	96.5	
	Yes	20	3.5	
Probable Caseness for MD		566		
	No	498	88.0	
	Yes	68	12.0	

Note: percentages are expressed with regard to the total number of cases per indicator variable. GAD: generalized anxiety disorder; OCD: obsessive-compulsive disorder; MD: major depression

Table 2.2
Demographic Information for Gamblers in Wave 2 of MLSYA

Socio-Demographic Characteristics		
	N	*%*
Gender		
Male	274	47.8
Female	292	52.2
Age		
18-19	185	32.7
20-22	272	67.3
Ethnicity		
All others	65	12.1
European	411	76.8
Aboriginal/Metis/First Nations	34	6.4
Filipino	25	4.7
Total personal income		
$20,000 +	143	29.2
$12,000 to less than $20,000	114	23.3
$8000 to less than $12,000	129	26.4
Less than $8000	103	21.1
Household composition		
Living with family	457	80.7
Living Independently	109	19.3
Marital status		
Married/common law	16	2.8
Single	349	61.7
In a relationship	201	35.5
Highest level of education completed		
Some post-secondary or completed post-secondary	395	75.8
High-school or less	126	24.2

Table 2.3
PGSI Scores by Category in Wave 2 of MLSYA (*N = 566*)

Category	*n*	*%*
Non-problem gambler	431	76.1
Low-risk gambler	114	20.1
Moderate-risk gambler	12	2.1
Problem gambler	9	1.6

Estimating the Number of Latent Classes

Five latent class models, from a one-class to a five-class model, were tested. Table 2.4 displays the fit indices for these models. An examination of the LMR-LRT statistic across all models indicated that the four and five class models could be rejected due to insignificant *p* values. When comparing the 2- and 3-class models, the latter had stronger statistical support. Although the entropy statistic is higher for the two-class model, when compared to the three-class model, the AIC, BIC and SSABIC statistics were also larger, which provides less support for the 2-class model. This indicated that the *k*-1-class model (2-class model) should be rejected in favor of the 3-class model. In addition, a comparison of the characteristic profile plots also supports the 3-class model as the most theoretically meaningful. At first examination of the fit statistics (ignoring the LMR-LRT) the four-class model appeared to represent the data better than the three-class model. The AIC, BIC and SSABIC values are lower, and the entropy value is larger. However, after visually inspecting and comparing the 3- and 4-class solutions, we concluded that the 3-class solution was a more elegant solution and was more theoretically meaningful. The four-class solution contained two classes that appeared to be derived from the impulsive class in the three-class solution. The two new classes in the four-class solution were very similar with the exception of one class having higher impulsivity scores and the other having lower anxiety scores. In addition, we reasoned that our decision to select the 3-class over

the 4-class model can also be justified as the LMR-LRT for the 4-class solution was non-significant, thus indicating the 3-class solution was preferred. Thus, after significant reflection, and taking into consideration that in addition to fit indices, interpretability is also a key factor in determining which class model to retain, we decided the 3-class solution represented the data best.

Table 2.4
Selected Fit Indices for 2- to 5-Class Latent Class Models Among Young Adult Gamblers (N = 566).

Number of Classes in the Model	Fit Statistics				
	AIC	BIC	SSABIC	Entropy	LMR-LRT
2-Class	7933.086	8015.519	7955.203	0.904	<.01
3-Class	**7739.828**	**7861.309**	**7772.422**	**0.853**	**<.001**
4-Class	7467.905	7628.433	7510.976	0.928	0.617
5-Class	7415.659	7615.234	7469.206	0.936	0.093

Note. AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; SSABIC = sample-size adjusted BIC; LMR-LRT = Lo-Mendell-Rubin Likelihood Ratio Test. Bold print indicates the best fit statistic across the five models.

Characteristics of the Three-Class Model

The overall prevalence and conditional probabilities for the three-class model are shown in Table 2.5. Latent Class 2 was the largest class comprising 59.90% of the sample. The criterion endorsement probabilities in this class were low in comparison to the other two classes. Therefore, we classified this as a *non-problem gambler* class, most closely resembling the behaviourally conditioned gambler described in the Pathways Model. Approximately 27.4% of the sample was categorized into Latent Class 1. Compared to the other two classes, Latent Class 1 had the highest probabilities of endorsing regular drug use in the past 12 months, and any drug

use in the past 12 months; meeting criteria for GAD; and meeting criteria for probable OCD and major depression. This pattern of criterion endorsement most resembled the *emotionally vulnerable gambler* described in the Pathways Model. Gamblers in Latent Class 3 (12.72% of the sample) had the highest scores on impulsivity compared to the other two classes, and demonstrated the highest probability of endorsing alcohol dependence. We classified this as the *impulsive gambler* class, as it most resembled the antisocial impulsivist gambler in the Pathways Model.

Table 2.5
Summary of the Latent Class Solution (*N* = 566).

	Latent Classes		
	Class 1[a]	Class 2[b]	Class 3[c]
	Means of continuous variables		
BIS-11 (30-120)	66.50	61.13	70.13
Alcohol Dependence Scale (0-9)	.785	.225	3.623
	Conditional probabilities of categorical variables		
Regular Drug Use (Past 12 Months)	.566	0	.429
Any Drug Use (Past 12 Months)	1	.129	.756
Meet criteria for GAD	.059	.025	.024
Probable Caseness for OCD	.065	.022	.039
Probable Caseness for Major Depression	.208	.079	.138

[a] Emotionally Vulnerable Gambler: latent class prevalence 27.4%
[b] Non-Problem Gambler: latent class prevalence 59.90%
[c] Impulsive Gambler: latent class prevalence 12.72%

Secondary Analysis

Odds ratios (OR) and 95% CIs for the demographic factors and the covariate of PGSI are presented in Table 2.6. Socio-demographic factors and PGSI scores as a function of the three latent classes are provided in Table 2.7. Older gamblers (i.e., those aged 20-22) who earned between $8000 to less than $20,000 total personal income per year and obtained higher scores on the PGSI were less likely to belong to the impulsive gambler class (relative to the non-problem gambler class). Being European and obtaining higher scores on the PGSI were significantly associated with increased odds of being classified into the emotionally vulnerable gambler classes (relative to the non-problem gambler class). Gamblers who reported living independently (as opposed to those living with family members) had increased odds of being classified into the emotionally vulnerable and impulsive gambler classes (relative to the non-problem gambler class). Gender was not significantly associated with any specific class of gambler.

Discussion

The Pathways Model is a theoretical model incorporating a comprehensive list of environmental, developmental, neuro-biological, and psychological factors to explain three developmental pathways to gambling problems. It was originally proposed to explain adult problem gambling (Blaszczynski & Nower, 2002) but was later expanded to include adolescent problem gambling (Nower & Blaszczynski, 2004). Gupta et al. (2013) investigated the efficacy of the model for adolescent problem gamblers. To our knowledge, this is the first LCA study informed by the Pathways Model, to examine a general sample of young adults that includes recreational, as well as low, moderate, and high risk gamblers. It also adds to a growing number of subtyping studies examining community-based samples (Edgerton, Melnyk & Roberts, 2014;

Table 2.6
Odds ratios and 95% confidence intervals for the three-class latent class model with covariates.

Covariates	Latent Class 1 *'Emotionally Vulnerable'*	Latent Class 3 *'Impulsive'*
Gender		
Male (referent)		
Female	0.869 (0.538-1.402)	0.854 (0.456-1.602)
Age		
18-19 (referent)		
20-22	0.889 (0.523-1.510)	**2.110 (1.085-4.102)**
Ethnicity		
All others (referent)		
European	**2.580 (1.122-5.931)**	1.571 (0.592-4.170)
Aboriginal/Metis/First Nations	2.376 (0.694-8.133)	2.137 (0.531-8.594)
Philipino	0.657 (0.139-3.111)	0.329 (0.033-3.331)
Total personal income		
$20,000 + (referent)		
$12,000 to less than $20,000	1.038 (0.551-1.953)	**0.360 (0.150-0.864)**
$8000 to less than $12,000	0.802 (0.420-1.530)	**0.232 (0.093-0.582)**
Less than $8000	0.873 (0.431-1.767)	0.491 (0.213-1.134)
Household composition		
Living with family (referent)		
Living Independently	**2.242 (1.232-4.079)**	**2.218 (1.035-4.751)**
Marital status		
Married/common law (referent)		
Single	4.008 (0.949-16.921)	6.832 (0.736-63.399)
In a relationship	3.332 (0.785-14.150)	4.144 (0.436-39.341)
Highest level of education completed		
Some post-secondary or completed post-secondary (referent)		
High-school or less	1.215 (0.721-2.048)	0.912 (0.441-1.884)
PGSI	**1.323 (1.127 – 1.552)**	**1.340 (1.125-1.597)**

Note. Bold print indicates a significant odds-ratio compared to latent class 2 – '*non-problem gamblers'*.

Table 2.7
Sociodemographic Variable and PGSI Information by Latent Class

	Latent Classes					
	Class 1[a]		Class 2[b]		Class 3[c]	
	N	%	N	%	N	%
Gender						
Male	80	51.6	153	45.1	41	56.9
Female	75	48.4	186	54.9	31	43.1
Age						
18-19	46	29.7	106	31.3	33	45.8
20-22	109	73.0	233	68.7	39	54.2
Ethnicity						
All others	9	6.2	48	15.0	8	11.6
European	124	85.5	234	72.9	53	76.8
Aboriginal/Metis/First Nations	9	6.2	18	5.6	7	10.1
Filipino	3	2.1	21	6.5	1	1.4
Total personal income						
$20,000 +	44	32.6	69	24.0	30	45.5
$12,000 to less than $20,000	37	27.4	65	22.6	12	18.2
$8000 to less than $12,000	30	22.2	89	30.9	10	15.2
Less than $8000	24	17.8	65	22.6	14	21.2
Household composition						
Living with family	118	76.1	285	84.1	54	75.0
Living Independently	37	23.9	54	15.9	18	25.0
Marital status						
Married/common law	3	1.9	12	3.5	1	1.4
Single	97	62.6	198	58.4	54	75.0
In a relationship	55	35.5	129	38.1	17	23.6
Highest level of education completed						
Some post-secondary or completed post-secondary	108	75.0	236	76.4	51	75.0
High-school or less	36	25.0	73	23.6	17	25.0
PGSI Category						
Non-problem gambler	104	67.1	285	84.1	42	58.3
Low-risk gambler	41	26.5	49	14.5	24	33.3
Moderate-risk gambler	6	3.9	4	1.2	2	2.8
Problem gambler	4	2.6	1	0.3	4	5.6

[a] Emotionally Vulnerable Gambler
[b] Non-Problem Gambler
[c] Impulsive Gambler

Edgerton, Melnyk & Roberts, 2015; Moon, Lister, Milosevic & Legerwood, 2016; Nower, Silva, Martins, Lin & Blanco, 2013). Although using only a subset of variables that capture gambler characteristics described in the Pathways Model, the current study provides evidence that three subtypes of gamblers, similar to those described in the Pathways Model, can be derived from a comprehensive sample of young adult gamblers in the province of Manitoba.

Although the classes derived in this study are generally consistent with those proposed in the Pathways Model, it is worth discussing some contradictory findings. According to the Pathways Model, antisocial impulsivist gamblers are characterized as participating in excessive alcohol and poly drug experimentation (Blaszczynski & Nower, 2002). In the current study, emotionally vulnerable gamblers had a higher probability of endorsing both past year "regular" and "any" drug use, when compared to the impulsive gamblers. Nonetheless, an examination of Table 2.5 suggests that the impulsive gamblers were more likely to endorse past year "regular" and "any" drug use than the non-problem gamblers, and that the conditional probabilities for endorsement for this class were more similar to the emotionally vulnerable class than to the non-problem gambler class. One explanation for this finding is that, compared with adults in general, young adults are more prone to engage in risky behaviours such as experimenting with illicit drugs (Steinberg, 2008). Thus, this characteristic may not differentiate classes in young adults as well as it does in adults. However, as gamblers age, the propensity to engage in risky behaviours, such as experimenting with illicit drugs, may decline in some gamblers, while remaining stable or increasing in others. Longitudinal research investigating if and how these changes occur over time is needed. Another possible explanation could be that people with emotional vulnerabilities use both drugs and gambling to "self-medicate." According to the self-medication hypothesis, individuals who experience negative emotional states seek out specific substances or behaviours

to alleviate specific symptoms (Khantzian, 1985). Recent research conducted by Li, Lu and Miller (2013) supports this hypothesis. Li et al. examined self-medication and pleasure seeking as dichotomous motivations underlying behavioural disorders. They found that self-medicating problem gamblers were more likely to have other substance dependencies than pure pleasure-seeking gamblers.

The finding that alcohol dependence scores for the impulsive class were higher than for the emotionally vulnerable class was also unexpected. According to the Pathways Model, emotionally vulnerable gamblers are predicted to display the highest level of alcohol dependence, whereas the antisocial impulsivist subtype is hypothesized to have elevated scores on alcohol abuse (Blaszczynski & Nower, 2002). The Pathways Model predicts that the emotionally vulnerable gambler is motivated to gamble in an attempt to modulate pre-existing negative affect stemming from underlying psychopathologies such as anxiety and depression. A diagnosis of alcohol dependence requires the endorsement of three or more items related to factors such as habituation, withdrawal, attempts to reduce or stop drinking, and alcohol use exacerbating anxiety and depression. Therefore, higher scores on alcohol dependence would be expected in gamblers reporting higher scores on depression and anxiety. In contrast, those diagnosed with alcohol abuse are more likely to endorse items related to interpersonal problems with family and friends, impulsive and potentially dangerous behaviour (i.e., driving while impaired or engaging in unprotected sex), and legal problems related to drinking. According to the Pathways Model the antisocial impulsivist gambler is defined by features of impulsivity and antisocial personality disorder that lead to severe maladaptive behaviours, such as those reported by individuals diagnosed with alcohol abuse. Our findings did not support these predictions.

Another unexpected finding in this study was that gender was not significantly associated with any specific class of gambler. The results from past subtyping studies have demonstrated that men are more likely to be classified as antisocial impulsivist gamblers whereas women are more likely to be classified as emotionally vulnerable gamblers (Ledgerwood & Petry, 2010). Research has also found that compared to male gamblers, females are more likely to endorse being motivated to gamble to escape negative emotions (Wenzel and Dahl, 2009); to use electronic gambling machines to escape stress, loneliness and boredom (Schull, 2002); and to gamble to regulate mood (Loyd et al., 2010). A possible explanation for gender not being associated with class may be that gender differences are more pronounced in problem gamblers but are not as apparent when examining a broad sample of gamblers. Future research examining the association of gender and gambling subtype in this population is therefore warranted.

Living independently was associated with higher odds of being classified into the emotionally vulnerable and impulsive gambler classes in this study. This finding is interesting considering that life transitions associated with assuming adult roles, such as living independently of parents, have been associated with greater gambling involvement (Welte, Barnes, Tidwell, & Hoffman, 2008). People who transition from living with parents to living independently may experience increased feelings of loneliness, especially with the loss of an established social support system (Bernardon, Babb, Hakin-Larson, & Gragg, 2011). In order to escape these feelings, some young adults may turn to gambling as a way of coping with these aversive feelings. In addition, young adults who are higher in trait impulsivity may seek out gambling opportunities more frequently after transitioning from living at home with parents to living independently. One factor that may account for this increase in gambling behaviour is parental monitoring. Parental monitoring is a protective factor that has been associated with

reduced engagement in potentially problematic behaviours (i.e., alcohol and drug misuse, unprotected sex, and gambling). For instance, Barnes, Welte, Hoffman, and Dintcheff (2005) found that, after controlling for several sociodemographic and individual factors, higher levels of parental monitoring resulted in less alcohol misuse, other drug use, and delinquency among adolescent males. Higher parental monitoring has also been found to be associated with lower odds of gambling among adolescents (Vachon, Vitaro, Wanner, & Tremblay, 2004). The transition to independent living therefore seems to be a potential risk factor for the development of gambling problems in young adults, especially among those individuals who are more dependent on parental socialization.

The finding that PGSI scores were associated with only slightly elevated odds of being assigned to the emotionally vulnerable and impulsive gambler class, was also unexpected. This finding may be due to the epidemiological sample utilized for this study. Only a small percentage of the participants (1.6%) met sufficient criteria to be classified as problem gamblers (PGSI score of 8 or more).

Limitations and Future Directions

The above findings should be interpreted within the context of the following limitations. First, because this study involved secondary data analysis, variables matching some important characteristics of gamblers outlined in the Pathways Model (e.g., antisocial personality disorder, ADHD, suicidality, family history, and coping skills) were not available. Therefore, although the subtypes derived in this study resemble those proposed by Blaszczynski and Nower (2002), a comprehensive test of the model was not possible and these findings should be viewed as tentative. In light of this limitation, prospective studies examining young adult gamblers should utilize a full range of instruments that measure all the characteristics discussed in the Pathways

Model. Second, this study was cross-sectional in nature and so does not provide information about the temporal aspects of the Pathways Model. Two recent studies have examined young adult gambling trajectories in the MLSYA, involving four waves of data collection over a four-year period (Edgerton, Melnyk & Roberts, 2014; Edgerton, Melnyk & Roberts, 2015). These two studies provided unique insights about how young adult gamblers transition over time in the MLSYA, and what factors are predictive of increased gambling problems. However, the research was not designed to test the Pathways Model, specifically. More longitudinal studies exploring how gamblers change over time are needed. For example, future research could examine if gamblers transition between classes over time or remain in their original class.

Third, the findings of this study are not generalizable beyond young adult gamblers in the province of Manitoba. Future studies examining a nationally representative sample of gamblers could clarify the applicability of the Pathways Model to Canadian gamblers in general.

Conclusion

The current study provides support for the Pathways Model with regard to a broad sample of young adult gamblers in Manitoba, Canada. This study also identified some aspects of the model that may apply only to problem gambler populations. The knowledge that young adult gamblers in general can be identified as falling into subtypes based on differing characteristics, such as co-occurring psychopathologies and personality traits, that are similar to those proposed in the Pathways Model may inform the development of theoretically-based prevention programmes and clinical interventions tailored to address the underlying factors that contribute to gambling problems in individual cases.

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CHAPTER 3: A LONGITUDINAL EXAMINATION OF GAMBLING SUBTYPES IN YOUNG ADULTHOOD

Keywords: Gambling Subtypes, Pathways, Young Adult, Emerging Adulthood, Latent Mixture Modeling, Latent Transition Analysis

Except for some minor formatting changes, Chapter 3 is reprinted here with permission as it appears in:

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My Contribution to the Publication

The goal of the research described in this chapter was to test the temporal stability of Blasczynski and Nower's (2002) Pathways Model. Although a number of researchers have attempted to validate this model using various populations (e.g., Gonzalez-Ibanez, 1994; Ledgerwood & Petry, 2006; Turner, Jain, Spence, and Zangeneh, 2008; Bonnaire, Bungener, & Varescon, 2009; Vachon & Bagby 2009), longitudinal research investigating the temporal aspects of this model is lacking. It is not known, for example, if gamblers originally classified as behaviourally conditioned change in a way that would make them more likely to be classified as emotionally vulnerable gamblers over time. Questions such as this can only be addressed through longitudinal research following gamblers as they move through emerging adulthood—a time characterized by tremendous change. Understanding the temporal nature of factors that may influence the development of problem and pathological gambling is vital to better understanding the etiology of disordered gambling. In addition, identifying how such factors progress over time in gamblers who do *not* develop gambling problems may suggest possible protective mechanisms.

I conducted the literature review, designed the study, and requested permission to access the MYLSA database. I determined the methods used for data analysis in consultation with Dr. Keough and conducted the analyses for this study. I drafted and revised the manuscript based on feedback from Drs. Keough and Jakobson, and then revised it further based on additional feedback from Drs. Bolton and Edgerton. I selected the journal, *International Gambling Studies*, to which we submitted the manuscript after I received approval to proceed from all co-authors. Based on the reviewers' comments that we received, I revised the manuscript in consultation with Drs. Keough and Jakobson and resubmitted the manuscript along with our

responses to the reviewers. In this chapter, we used the term latent mixture modeling in place of the term latent class analysis, at the request of an anonymous reviewer.

Abstract

In previous research informed by the Pathways Model (an etiological framework for problem and disordered gambling), latent mixture modeling was used to identify subtypes of gamblers based on measures of impulsivity, anxiety, depression, drug use, and alcohol dependence. The current study extended these findings by: (a) determining if similar subtypes would be identified in the same sample two years later; and (b) utilizing latent transition analysis (LTA) to determine if class membership remained stable over this time period. The sample (N = 566) included young adult gamblers. In line with previous work on Wave 2 of these data and theretical considerations, a three class model of gamblers was retained at Wave 4: *Non-Problem*, *Emotionally Vulnerable*, and *Impulsive*. The LTA suggested that the majority of Non-Problem gamblers remained in the same class over time. In contrast, Emotionally Vulnerable gamblers were most likely to transition into the Non-Problem Gambler class, and Impulsive Gamblers were equally likely to transition into the Non-Problem and Emotionally Vulnerable classes. Our study provides evidence for the subtypes of gamblers outlined in the Pathways Model. It is also the first study to provide evidence that membership within Emotionally Vulnerable and Impulsive gambling subtypes is unstable during young adulthood.

Introduction

Gambling is a common behaviour that involves risking something of value with the hope that one may gain something more valuable in return. Young adulthood is a developmental period associated with increased engagement in risky behaviours, including gambling. Young adults have been shown to be at a higher risk for developing gambling problems compared to adults generally (Calado, Alexandre, & Griffiths, 2017; Huang & Boyer, 2007; Shaffer & Hall, 2001), with prevalence rates estimated at 2-3% in Canada (Cox, Yu, Afifi, & Ladouceur, 2005; Huang & Boyer, 2007). Increased rates of gambling are associated with behavioural, psychosocial, interpersonal, financial, and legal difficulties (Floros, 2018). For instance, a recent scoping review of problem gambling and delinquent behaviours conducted by Kryszajtys et al. (2018) reported a consistent finding that young problem or disordered gamblers, compared to non-gambling peers, are more likely to commit delinquent acts including both violent and non-violent behaviours. Young gamblers are also more likely than peers to report engaging in risky behaviours such as binge drinking and unprotected sex (LaBrie, Shaffer, LaPlante, & Wechsler, 2003).

Research has demonstrated age-related reductions in addictive behaviours that have a non-linear association with age. Patterns are typified by an increase in risky behaviours during late adolescence, which usually peak around ages 18 to 22 and then start to rapidly decline in the mid-20s (Jackson, Rogers, & Sartor, 2016). These reductions in risky behaviours during young adulthood have been referred to as “maturing out.” Similar trends have been demonstrated in studies of adolescent and young adults regarding their gambling behaviour (Slutske, Jackson, & Sher, 2003). This research indicates that, although the majority of gambling-related problems resolve naturally, some individuals continue to display disordered gambling later in life. Given

the vulnerability of this population to gambling problems, and the variability in gambling behaviour during this time period, longitudinal research examining young adult gamblers is needed to better understand why some individuals mature out and others continue to experience difficulties. Using the Pathways Model proposed by Blaszczynski and Nower (2002) as an etiological framework, the current study examined the temporal stability of gambling subtypes over the course of young adulthood.

Recent research, including studies examining the Pathways Model, has supported the premise that problem gamblers are not homogenous, but instead fall into different subtypes based on differing characteristics (see Milosevic & Ledgerwood, 2010 for a review of this literature). Based on clinical and research findings, Blaszczynski and Nower (2002) suggested that problem gamblers are similar in that they are all exposed to similar ecological and cultural factors, share similar cognitive processes and distortions, and are affected similarly by the contingencies of reinforcement in gambling tasks. However, problem gamblers can be uniquely subtyped based on individual differences, affective disturbances, and biological impulsivity—factors that play a role in the etiology of their gambling problems.

In their Pathways Model, Blaszczynski and Nower describe three subtypes of problem gamblers: (1) Behaviourally Conditioned; (2) Emotionally Vulnerable; and (3) Antisocial-Impulsivist. *Behaviourally Conditioned* problem gamblers differ from the other two subtypes in that they demonstrate low levels of pre-morbid psychopathology, substance abuse, impulsivity and erratic or disorganized behaviours (Blaszczynski & Nower, 2002). They report alcohol abuse, depression, and anxiety problems but these manifest as a result of their gambling behaviour. They typically experience less severe gambling problems, which are chiefly influenced by cognitive distortions and the effects of conditioning (Blaszczynski & Nower,

2002). According to the Pathways Model, this type of gambler fluctuates between periods of normal and problem gambling. This may suggest that the Behaviourally Conditioned gambler is characterized by dynamic change and that this pathway may be more unstable over time.

Emotionally Vulnerable problem gamblers differ from Behaviourally Conditioned problem gamblers in that they present with biological and emotional vulnerabilities that result in premorbid anxiety and depression. These problem gamblers share a history of negative family background experiences and life events that contribute to low self-esteem, feelings of inferiority, and perceived inadequacy (Gupta, Nower, Derevensky, Blaszczynski, Faregh, & Temcheff, 2013). Emotionally Vulnerable problem gamblers demonstrate poor coping and problem-solving skills in the face of these difficulties and are motivated to gamble primarily to relieve or escape negative affective states. Mood and anxiety disorders are often episodic and fluctuate quite substantially (American Psychiatric Association, 2016). Gambling behaviours within this group should coincide with shifts in mood (i.e., greater gambling engagement when depressed). As mood and anxiety problems spike during young adulthood (Gore et al., 2011; Iorfino, Hickie, Lee, Lagopoulos, & Hermens, 2016), elevated emotional problems and gambling would be expected during this time and it is sensible to expect some instability within this pathway as a result.

Antisocial Impulsivist problem gamblers differ from the aforementioned problem gambling subtypes in that they present with features of impulsivity and antisocial behaviour. These traits predispose this subtype of problem gambler to behavioural problems including: irritability, low tolerance for boredom, criminal behaviour, substance abuse, excessive alcohol and poly-drug experimentation, poor interpersonal relationships, and suicidality (Blaszczynski, Steel, & McConaghy, 1997). In addition, Antisocial Impusivist problem gamblers report a family

history of antisocial and alcohol problems. Within the Pathways Model, this subgroup is characterized by neurological and neurochemical dysfunction, resulting in traits of impulsivity and anti-social disorder (Nower & Blaszczynski, 2006). Since trait impulsivity is by definition constant, one would expect stability in this pathway over time. Nonetheless, this may not be the case during young adulthood, as prefrontal areas related to impulse control are still undergoing development during this time frame (Scheres, Tontsch, Thoeny & Sumiya, 2014).

Although research supporting the applicability of the Pathways Model to adult problem gamblers has grown in recent years (Milosevic & Ledgerwood, 2010; Moon, Lister, Milosevic & Ledgerwood, 2017; Nower & Blaszczynski, 2017; Nower, Martins, Lin, & Blanco, 2013), only lately have researchers sought to investigate its relevance to younger gamblers (i.e., adolescents and young adults). In a cross-sectional study examining 109 adolescent problem gamblers (ranging in age from 13 to 18 years), Gupta et al. (2013) identified five classes of gamblers by performing a latent class analysis on measures of ADHD, personality, reasons for gambling, and gambling severity. Three of the subtypes resembled those described in the Pathways Model. Specifically, as hypothesized in the model, there was a subtype characterized by a lack of psychopathology; a subtype with a history of family conflict, depression, self-hatred, and suicidality; and a subtype that was antisocial and impulsive. A unique finding in this study was a fourth “depression only” subtype. The authors proposed that this subtype may have emerged due to their use of an adolescent sample. Gupta et al. (2013) also concluded that the fifth subtype, which was characterized by both internalizing and externalizing symptoms, was consistent with the Pathways model in that the Emotionally Vulnerable and Antisocial Impulsivist pathways share indicators in emotional functioning. Although not fully consistent with the Pathways

Model, these results provided preliminary support for using the Pathways Model as a general etiological framework with adolescent problem gamblers.

There were some notable limitations to the study by Gupta and colleagues (2013). First and foremost, as noted by the authors, their study was cross-sectional in nature and so it could not examine the temporal factors outlined in the Pathways Model. Given that adolescence is a time of rapid change and development, longitudinal research is needed to see if youth transition between classes over time due to variations in factors associated with gambling problems, such as depression and anxiety. Second, their sample size was very small and this may have limited the number of latent classes that could be extracted. Finally, like most other research on the Pathways Model, their study focused only on at-risk or problem gamblers. This is presumably because Blaszczynski and Nower (2002) explicitly state that their Pathways Model only applies to people with moderate to severe gambling problems. However, by virtue of it being a developmental model, the pathways (and their precursors) should begin to emerge long before individuals display serious gambling problems. For this reason, more studies need to be done using broad samples of young adult gamblers to begin fleshing out the etiological factors and temporal dynamics of gambling pathways. Such research has the potential to strengthen our understanding of how young adults move from being recreational to problem gamblers over time.

In previous research (Dowd, Keough, Jakobson, Bolton, & Edgerton, 2018), the Pathways Model provided an etiological framework to examine a broad sample of young adult gamblers from the Manitoba Longitudinal Survey of Young Adults (MLSYA). Non-problem, low-risk, moderate-risk, and problem gamblers were included in the sample (n = 566) with the aim of determining if different subtypes of gamblers could be derived using measures of anxiety,

depression, alcohol and drug problems, and impulsivity. Latent mixture modeling revealed three classes of gamblers: Emotionally Vulnerable, Impulsive, and Non-Problem. The Emotionally Vulnerable class was characterized by higher criterion endorsement probabilities on drug use, anxiety and depression; the Impulsive class demonstrated higher criterion endorsement probabilities on impulsivity and alcohol dependence; and the Non-Problem class differed from the other two classes by their overall lower probability of endorsing problem scores any of the measures.

A major strength of this study was that it included a provincially representative broad sample of young adult gamblers. However, similar to the Gupta et al. (2013) study, this study was cross-sectional in nature and so it was not able to provide information regarding the temporal aspects of the Pathways Model. Longitudinal research examining the temporal aspects of this model is required to allow clinicians and policy makers to incorporate this information into intervention and prevention strategies. Examining the temporal stability of the model during young adulthood is especially important.

One study to date has tested temporal predictions made in the Pathways Model regarding differences in age of onset of gambling and change in gambling severity over time. Allami et al. (2017) were interested in seeing if subtypes of gamblers could be found at age 12, and how these related to gambling problems longitudinally. The authors collected self-report data from two samples of young people at ages 12, 14, 16 and 23. The final sample used in the main analyses was composed of 180 participants who were at risk for or experiencing problem gambling by mid-adolescence or early adulthood. Conducting Latent Profile Analyses on measures of depression, anxiety, impulsivity, hyperactivity, and antisocial/aggressive behavior, Allami et al. (2017) identified four profiles of adolescents who were at risk for or experiencing gambling

problems. Three profiles were consistent with those described in the Pathways Model (Biologically Vulnerable, Emotionally Vulnerable, and Behaviorally Conditioned), while a fourth profile resembled a combination of Emotionally Vulnerable and Biologically Vulnerable gamblers. This final subtype was similar to the subtype described by Gupta et al. (2013) that was characterized by both internalizing and externalizing symptoms.

Allami et al. (2017) next looked at how gambling subtypes defined at age 12 related prospectively to gambling and other problems reported at ages 16 and 23. Participants classified into the fourth subtype were excluded from these analyses due to low participant count (n = 8). Allami at al. found that individuals included in the three profiles under study did not differ in terms of age of onset or frequency of gambling. This finding does not support the hypothesis made in the Pathways Model that Biologically Vulnerable gamblers commence gambling at an earlier age than gamblers in the other two subtypes. An examination of scores on the South Oaks Gambling Screen at ages 16 and 23 revealed no differences between groups at age 16. By age 23, however, the Emotionally Vulnerable and Behaviourally Conditioned gamblers' problems had declined, whereas Biologically Vulnerable gamblers problems increased. This finding supports the "maturing out" hypothesis for Emotionally Vulnerable and Behaviourally Conditioned gamblers, but suggests that the Biologically Vulnerable gamblers may be at risk for escalation in gambling problems, at least between the ages of 16 and 23. A strength of this study was that it attempted to test some temporal aspects of the Pathways Models (i.e., age of gambling onset, and gambling frequency and problem severity). However, the design employed did not allow Allami et al. to determine if gambling subtypes remained stable between ages 16 to 23 or if gamblers transitioned between profiles over time. In fact, to our knowledge no study to date has examined if youth gamblers, once subtyped, transition between subtypes as they move though

this period of development. In addition, the relatively small sample size used in the Allami et al. study may have impacted the authors' ability to effectively identify differences between groups, as it is considerably smaller in size than those typically recommended in studies using latent profile analysis.

The Current Study

As noted earlier, most research to date has examined how the Pathways Model applies to problem and pathological gamblers (Allami et al., 2017; Gupta et al., 2013; Milosevic & Ledgerwood, 2010; Moon, Lister, Milosevic & Ledgerwood, 2017; Nower & Blaszczynski, 2017; Nower, Martins, Lin, & Blanco, 2013). Although originally intended to be applied to this population, the Pathways Model might also be effectively applied to gamblers existing along a spectrum of risk (i.e., before they have developed disordered gambling). Only one study to date has sought to test the relevance of the Pathways Model in a broad sample of young adult gamblers (Dowd et al., 2018). The current study extended this work by exploring if and how youth gamblers, once subtyped, transition between subtypes as they move through young adulthood, using a longitudinal design.

The first aim of the current study was to use latent mixture modeling to determine if the three-class model described in previous work at Wave 2 of the MLSYA remained stable over time (i.e., two years later at Wave 4). We hypothesized that a three-class model similar to the one described at Wave 2 in Dowd et al. (2018) would be supported at Wave 4. The second aim was to use Latent Transition Analysis (LTA) to investigate whether individuals transitioned between classes over time (i.e., from Wave 2 to Wave 4). We expected to see higher instability (i.e., higher probability of transitioning out of original class) in the Emotionally Vulnerable class as a result of their higher probability of experiencing serious emotional problems. In contrast, we

hypothesized higher stability (i.e., lower probability of transitioning out of original class) in the Non-Problem and Impulsive classes, given that (a) Non-Problem gamblers are lower in psychopathology that is likely to lead to temporal instability; and (b) the Impulsive class is characterized by trait impulsivity which by definition should be stable over time. To our knowledge, this is the first study to use the Pathways Model to investigate temporal changes in gambling classes over time in a provincially representative broad sample of young adult gamblers.

Materials and Methods

Procedure

The Manitoba Liquor and Gaming Authority gave permission for secondary analysis of select data from the MLSYA dataset (a project funded by the Manitoba Gaming Control Commission, Addictions Foundation of Manitoba, and the Manitoba Lotteries Corporation; http://digitalcollection.gov.mb.ca.uml.idm.oclc.org/awweb/pdfopener?smd=1&did=17604&md=1). As the data were de-identified, ethics approval was not required for the present study. Participants in the MLSYA were recruited through convenience sampling in casinos; random digit dialing; the MLSYA website; advertisements at video lottery terminal lounges; post-secondary institutions; and referrals from participants already recruited. Data collection took place over four waves from November 2007 to December 2011. During each wave, participants completed a telephone survey, followed by a second survey sent to them via mail or email. The overall participant retention rate at Wave 4 was 76%.

Participants

Participants in the current study were 566 young adult Manitoba gamblers (M_{age} = 19.97 years, SD_{age} = 0.821) who reported gambling on at least one occasion at Wave 2. Fifty-eight non-

gamblers (9.3%) were excluded from the original sample at Wave 2. Our analyses focused on Wave 2 and Wave 4 because it was during these waves that data on impulsivity (a major characteristic of the antisocial-impulsivist subtype in the Pathways Model) were collected. Missing values were estimated using the FIML procedure (Muthén & Muthén, 2017).

Measures

Impulsiveness. The Barratt Impulsiveness Scale (BIS-11; Patton, Stanford, & Barratt, 1995), a 30-item instrument, was used to measure the construct of impulsiveness in the present study. The internal consistency and the test-retest reliability of the total score of the BIS-11 are good (Cronbach's $\alpha = 0.83$; Spearman's Rho = 0.83; Stanford et al., 2009) The alpha coefficient for the overall BIS-11 scale used in this study was good at both Waves 2 (Cronbach's $\alpha = 0.84$) and 4 (Cronbach's $\alpha = 0.83$). The total scores in Wave 2 and Wave 4 were used in the present analyses. Based on guidelines suggested by Kline (2011), the impulsiveness variable had acceptable skew (< 3.0) and kurtosis (<10.0) at both waves of data collection. The test-retest reliability of the BIS-11 across waves was also acceptable ($r = .71$).

Alcohol dependence. The Alcohol Dependence Scale is a modified measure of past year alcohol dependence derived from the Canadian Community Health Survey, Cycle 2.1 (Statistics Canada, 2003). Possible scores range from 0 to 9 with higher scores indicating a greater chance of alcohol dependence and scores of 3 or higher indicating probable dependence. A Cronbach's α of 0.79 at Wave 2 and 0.76 at Wave 4 demonstrated acceptable internal consistency. This continuous variable was used as an indicator variable in the latent mixture model and LTA. The alcohol dependence variable had acceptable skew (< 3.0) and kurtosis (<10.0) at both waves of data collection (Kline, 2011).

Drug use. The Drug Dependence Scale from the Canadian Community Health Survey, Cycle 2.1 (Statistics Canada, 2003) was used to derive a measure of drug use within the past 12 months. Two dichotomous variables were used as indicator variables in the latent mixture model and LTA: 1) regular drug use (1 to 3 times per month or more) over the past 12 months (0 = no; 1 = yes); and 2) any drug use over the past 12 months (0 = no; 1 = yes).

Psychiatric disorders. The next three measures were taken from the World Health Organizations Composite International Diagnostic Interview Short Form (CIDI-SF; Walters, Kessler, Nelson, & Mroczek, 2002). This diagnostic interview was designed to evaluate individuals for psychiatric disorders contained within the in the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 1994).

The Generalized Anxiety Disorder (GAD) scale was used as a measure of past year GAD. This dichotomous variable (0 = non-probable GAD; 1 = probable GAD) was used as an indicator variable in the latent mixture model and LTA. The Obsessive-Compulsive Disorder (OCD) scale measures probability of caseness for diagnosis of OCD. Possible overall scores ranged from 0-3. Participants with a score of 3 were identified as probable cases of OCD. This dichotomous variable (0 = non-probable OCD; 1 = probable OCD) was used as an indicator variable in the latent mixture model and LTA. Finally, the Major Depression scale was used as a measure of caseness for major depressive episode (MDE). Individuals with five of nine specific depressive symptoms over a two-week period were considered probable cases of MDE. The dichotomous variable (1 = probable non-caseness MDE; 0 = probable caseness MDE) was used as an indicator variable in the latent mixture model and LTA.

Analytical Plan

Latent mixture model analysis. Using the same sample as that described above, Dowd et al. (2018) determined that a three-class solution fit the data at Wave 2. As a preliminary step in model selection, we performed exploratory cross-sectional latent mixture model analyses to determine if a three-class model was also supported at Wave 4. We fitted two to five latent class models to the data at Wave 4 and then compared these models to the three-class model from the previous study. First and foremost, in the process of model selection we visually inspected all models to examine the distinctiveness and theoretical meaningfulness of the subgroups. This is a main consideration when determining the number of latent subgroups supported by the data (Yang, 2006). Next, we examined a combination of statistical indicators to determine model fit. We compared models on the basis of several fit indices including the Akaike information criterion (AIC; Akaike, 1987), Bayesian information criterion (BIC; Schwartz, 1978), sample-size adjusted BIC (SSABIC; Muthén & Muthén, 2017), entropy, and the Lo-Mendell-Rubin (2001) likelihood ratio test (LMR-LRT). Lower values on the AIC, BIC and SSABIC usually reflect the best fitting latent class model. Entropy estimates range from 0-1 with higher values reflecting a better solution. The LMR-LRT was used to examine whether a model with *k* classes fit the data significantly better than a model with *k* - 1 classes. A non-significant LMR-LRT indicates that a model with *k* - 1 classes provides a more parsimonious fit to the data than a model with k classes. Therefore, model selection was based on conceptual and theoretical considerations, as well as on statistical fit indices. Finally, an additional consideration when retaining a model is the size of the smallest subgroup (relative to the full sample). In order to avoid overfitting, it is recommended that the smallest subgroup should be no less than 5% of the total sample size (Wang & Wang 2012; Wickrama et al. 2016).

Latent transition analysis. LTA is a longitudinal extension of latent mixture modeling that allows one to model movements between groups (or classes) over time. After determining the optimal number of classes at each time point, we performed LTA to examine changes in class membership across time. Specifically, we were interested in the estimated transition probabilities, as these provide information about the stability of class membership (or lack thereof) across the two waves. One assumption of LTA is that the class structure is invariant across time; therefore, the parameters for the class indicators were constrained to be equal at the two waves of data collection. Prior to constraining parameters, we explicitly tested invariance by comparing models with constrained vs. freely estimated parameters across waves. Results showed that constraining the parameters across waves did not lead to an appreciable change in model fit (**Δ**SSABIC < 5.0; Kankaraš, Moors, & Vermunt, 2010; Schoot, Lugtig, & Hox, 2012). Full information maximum likelihood (FIML) was used to address missing data; therefore, the entire sample of gamblers was used to identify transition probabilities (n = 566). Both the latent mixture model analysis and LTA were conducted using Mplus (Muthén & Muthén, 2017) with maximum likelihood as the estimator.

Results

Missing Data Analysis

Prior to conducting the main analyses, a missing data analysis was conducted to examine potential baseline differences (at Wave 2) between participants who had data at both waves relative to those with missing data at Wave 4. A new binary variable was created to denote missingness (incomplete data = 0 and complete data = 1). Two independent t-tests were used to assess baseline differences in measures of impulsivity (BIS-11) and alcohol dependence (Alcohol Dependence scale); and chi-square tests were used to examine potential associations

between categorical indicators and missingness. No significant differences were found between participants on alcohol dependence who had data at both waves relative to those with missing data at Wave 4. There was a statistically significant difference in level of impulsivity, $t(564) = 2.31$, $p = .021$, $d = .288$, with participants who had missing data at Wave 4 ($M = 66.44$, $SD = 10.72$) having higher scores than those who had data at both waves ($M = 63.42$, $SD = 10.20$). The effect size of this difference was small, however, so impulsivity likely had a minimal effect on attrition between Wave 2 and Wave 4. Chi-square tests of independence revealed that data missingness was independent of regular past year drug use, χ^2 (1, $N = 566$) = 2.10, $p = .35$; past year drug use ever, χ^2 (1, $N = 566$) = 2.01, $p = .37$; GAD, χ^2 (1, $N = 566$) = 0.00, $p > .99$; OCD, χ^2 (1, $N = 566$) = 1.80, $p = .41$; and depression, χ^2 (1, $N = 566$) = 0.67, $p = .41$.

Latent Mixture Modeling at Wave 4

See Table 3.1 for the fit statistics for models with two through five classes. In general, SSABIC values decreased across models with two to five classes and entropy remained high in all class models. This suggests that the models (as a whole) had good classification quality. While one could argue that the model with six classes provided a better fit to the data (from a statistical perspective), visual inspection revealed several classes that were largely overlapping (i.e., not very distinct from one another in terms of the pattern across the variables used in the latent mixture model). Also, models with greater than three classes also contained groups that were very small (<5% of the total sample). Accordingly, we chose to retain the model with three classes – as this model aligned with previous work on this data set (Dowd et al., 2018) and theoretical considerations.

Table 3.1
Selected Fit Indices for 2- to 5-Class Latent Class Models among Young Adult Gamblers (N = 566).

Number of Classes in the Model	Fit Statistics					
	AIC	BIC	SSABIC	Entropy	LMR-LRT	Smallest Class Size (% of total sample)
2-Class	6426.632	6509.065	6448.749	0.926	0.1272	30.10
3-Class	**6238.543**	**6360.023**	**6271.137**	**0.880**	**<.005**	**13.43**
4-Class	6215.313	6375.841	6258.384	0.971	0.0747	4.05
5-Class	6008.296	6207.871	6061.843	0.930	0.0192	2.35

Note. AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; SSABIC = sample-size adjusted BIC; LMR-LRT = Lo-Mendell-Rubin Likelihood Ratio Test. Bold print indicates the retained model.

As can be seen in Table 3.2, 17.67% of the sample was categorized into latent Class 1. This class had the highest probabilities of: regular drug use in the past 12-months; any drug use in the past 12-months; and probable diagnosis of GAD and OCD. This class also had a high probable caseness for depression. This pattern most closely resembled the *Emotionally Vulnerable gambler* in the Pathways Model. Latent Class 2 included most participants (68.91%) and individuals in this class had the lowest scores on all variables in the latent mixture model (relative to the other two classes). Therefore, we labelled this the *Non-Problem Gambler* class. Finally, the remaining 13.43% of participants were classified in latent Class 3. Relative to the other classes, this class had the highest mean scores for both impulsivity and alcohol dependence. Individuals in this class were highly likely to endorse any drug use in the past 12-months and they also had a high probable caseness for MDE. We classified this as the *Impulsive Gambler* class, as the pattern most closely resembled the impulsivity-antisocial gambler subtype described in the Pathways Model. As a whole, the latent mixture model solution at Wave 4 (and

the corresponding patterns of class differences) matched the three-class solution at Wave 2 described by Dowd et al. (2018).

Table 3.2
Summary of the Latent Class Solution (*N* = 566).

	Latent Classes		
	Class 1[a]	Class 2[b]	Class 3[c]
	Means of continuous variables		
BIS-11 (30-120)	64.60	59.20	66.43
Alcohol Dependence Scale (0-9)	.337	.133	2.744
	Conditional probabilities of categorical variables		
Regular Drug Use (Past 12 Months)	.574	0	.374
Any Drug Use (Past 12 Months)	1	.081	.736
Meet criteria for GAD	.106	.024	.013
Probable Caseness for OCD	.010	.008	0
Probable Caseness for Major Depression	.167	.075	.176

[a] Emotionally Vulnerable Gambler: latent class prevalence 17.67%
[b] Non-Problem Gambler: latent class prevalence 68.91%
[c] Impulsive Gambler: latent class prevalence 13.43%

LTA on Waves 2 and 4

An LTA was conducted to derive the estimated transition probabilities for each class across Waves 2 and 4 (see Table 3.3). The probability of remaining an Emotionally Vulnerable Gambler (Class 1) at Wave 4 was low (0.255), with the majority of individuals in this class transitioning into the Non-Problem gambling group over time (0.698). The probability of remaining a Non-Problem gambler (Class 2) from Waves 2 to 4 was very high (0.931). Finally, the likelihood of remaining an Impulsive Gambler (Class 3) across waves was very low (0.119).

Impulsive Gamblers had a similar chance of transitioning to either Non-Problem (0.448) or Emotionally-Vulnerable (0.434) classes over the two-year study period. Overall, the results of the LTA suggest that the only class that remained highly stable over time was the Non-Problem gambling class. There was considerable movement in the Emotionally Vulnerable and Impulsive Gambler class over the course of the two-year study period.

Table 3.3
Latent Transition Probabilities for the Three Classes between Waves 2 and 4.

	1	2	3
1. *Emotionally Vulnerable Gambler*	**0.255**	0.698	0.047
2. *Non-Problem Gambler*	0.062	**0.931**	0.007
3. *Impulsive Gambler*	0.434	0.448	**0.119**

Note. Bolded values reflect class membership stability across time.

Discussion

This longitudinal study of a provincially representative broad sample of young adult gamblers, extends previous findings suggesting that gamblers are heterogeneous and can be differentiated into subtypes based on characteristics such as impulsivity, drug and alcohol use, depression, and anxiety. Similar to previous work utilizing data from Wave 2 of the MLSYA (Dowd et al., 2018), we retained a model with three latent classes of young adult gamblers at Wave 4: Emotional Vulnerable Gambler (17.67%), Non-Problem Gambler (68.91%), and Impulsive Gambler (13.43%). These findings are generally consistent with the three subtypes of gamblers described in the Pathways Model.

A major strength of the current study is that, in addition to deriving subtypes of young adult gamblers, we also included a longitudinal analysis that examined the class prevalences and

transitions between classes over a two-year period (i.e., between Wave 2 to Wave 4). We found that young adult gamblers in the Emotionally Vulnerable class had a high probability of transitioning to the Non-Problem Gambler class over time. This result supported our prediction that the Emotionally Vulnerable class would be unstable. The Non-Problem gambler class was very stable over time as the likelihood of remaining a Non-Problem gambler was very high. This finding supported our prediction that the Non-Problem Gambler class would also be stable over time. Lastly, the Impulsive Gambler class was very unstable, as the probability of remaining in this class over time was very low. This result contradicted the hypothesis that the Impulsive Gambler class would remain stable over time due to the trait-like nature of impulsivity. Instead, it supported the premise that impulsivity may be transient during young adulthood, possibly as a result of prefrontal cortical development (Canale, Vieno, Grifiths, Rubaltelli, and Santinello, 2015; Scheres, Tontsch, Thoeny & Sumiya, 2014). Gamblers who transitioned out of the Impulsive Gambler class were just as likely to end up in either the Emotionally Vulnerable class or the Non-Problem Gambler class at Wave 4. This finding was also very intriguing as one would potentially expect, based on the shared characteristics of Impulsive and Emotionally-Vulnerable gamblers outlined in the Pathways Model, that the likelihood of transitioning from the Impulsive Gambler class to the Emotionally Vulnerable class to be higher compared to the probability of transitioning into the Non-Problem class. This finding demonstrates that impulsivity, at least in young adult gamblers, may be a poor predictor of future class membership. This finding is also worth considering alongside the results of Gupta et al. (2013) that impulsivity overlapped classes of adolescent gamblers. Our findings lend support to their premise that classes may reflect variation in intensity of traits such as impulsivity, as opposed to distinctiveness of traits.

Overall our findings suggest that, when transitions occurred, the general pattern was that gamblers were most likely to transition into the Non-Problem Gambler class as they matured. When considering this pattern in combination with the finding that Non-Problem gamblers from Wave 2 were most likely to remain in this class over time, the general trend was toward a reduction of problematic behaviour over time. These findings provide additional support for the "maturing out" hypothesis described in other studies of risky behaviour in young adult populations (Jackson, Rogers, & Sartor, 2016; Slutske, Jackson, & Sher, 2003). While our data are consistent with natural maturing out of gambling problems as individuals move through young adulthood, we cannot rule out that regression to the mean also contributed to these patterns. The results of this study highlight the importance of longitudinal research examining the temporal aspects of the Pathways Model, especially during developmentally active periods such as young adulthood.

There are a number of important theoretical and clinical implications of this study worth noting. First, evidence from this study supports the premise that young adult gamblers are not a homogeneous group (Milosevic & Ledgerwood, 2010). Consequently, rather than treating gambling problems using a *one size fits all* approach, clinicians would potentially do better to screen gamblers for these characteristics and customize treatment planning and prevention efforts around them. Second, the results of this study suggest that although these subtypes in young adults remain similar over time, there is considerable movement of gamblers across subtypes during this period of development. This information is very important because it highlights the temporal instability of class membership. Clinicians should expect that gamblers they assign to the impulsive or emotionally vulnerable subtypes are likely to transition to other subtypes over time and take this information into consideration.

This study had some limitations. First, due to the fact that we utilized secondary data analysis, it was not possible for us to include measures of ADHD or antisocial behaviour, family background history, coping style, and gambling-related cognitions such as decision making, which are all characteristics considered in the Pathways Model (Blaszczynski & Nower, 2002). Moreover, due to the variables we included in this study, we did not find clear evidence of a group resembling the Behaviorally Conditioned subtype described in the Pathways Model. The Non-Problem subtype has similarities to this subtype in that it is defined as being low on co-occurring psychopathologies, but this is equally true of recreational gamblers. We suspect that including measures of cognitive distortions and decision-making may have allowed us to differentiate Behaviourally Conditioned from recreational gamblers in our Non-problem group. Future studies should replicate our research design but incorporate additional indicator variables that measure all characteristics identified in the Pathways model to account for this limitation.

Second, because impulsivity was measured during only two waves of data collection in the MLSYA, our longitudinal analysis was limited to a two-year period. Future longitudinal studies examining transitions over time should ideally include more time points, or a longer period of time between waves of data collection, to capture change across the full period of young adulthood.

Third, the findings of this study are only generalizable to the population of young adult gamblers in Manitoba. Furthermore, any generalizations should be made with caution due to the fact that convenience sampling was employed in this study. Future research is needed to see if similar findings hold when using nationally representative data. Finally, future researchers may want to consider including “role transitions” into their longitudinal models of gambling pathways. We found support for a large maturing out effect in our study, which may relate to

factors such as becoming a parent, getting married, leaving university, etc. (Jackson, Rogers, & Sartor, 2016; Patrick et al., 2018). It would be interesting and informative to understand how these factors influence persistence in or transition out of gambling pathways.

Despite its limitations, this study makes an important contribution to the subtyping literature as it was the first of its kind to use LTA to measure transitions between classes of young adult gamblers over time. The findings contribute to our understanding of how gamblers change during young adulthood and will help researchers create frameworks for understanding how risk and protective factors influence the development and continuance of gambling problems. Identifying subtypes of gamblers and understanding their temporal stability will help clinicians develop more refined and individualized methods to assess and treat problem gamblers.

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CHAPTER 4: GENERAL DISCUSSION

Summary of Findings

The overall purpose of this dissertation was to examine if young adult gamblers in Manitoba could be subtyped according to specific characteristics as previously outlined in the Pathways Model (Blaszczynski & Nower, 2002) and then to investigate the stability of these subtypes longitudinally. Research has steadily increased over the last several decades proposing the utility of subtyping disordered gamblers, as their homogeneity as a population has been called into question (Milosevic & Ledgerwood, 2010). The premise that disordered gamblers are heterogeneous has theoretical, clinical, and societal implications. For example, treatment and prevention strategies for disordered gambling may be more effective if customised to address the underlying reasons the problems developed. Despite this, the majority of the research investigating subtypes of disordered gamblers has focused on adult populations and been cross sectional in nature (Moon, Lister, Milosevic, & Ledgerwood, 2017; Nower & Blaszczynski, 2017; Nower, Martins, Lin, & Blanco, 2013). Because disordered gambling has a developmental trajectory it is important for researchers to conduct longitudinal studies to uncover how gambling behaviour changes over time and what factors contribute to this change. The developmental period of young adulthood is of specific interest in this regard, because individuals at this stage of life are at a greater risk for engaging in risky behaviours, including disordered gambling (Calado, Alexandre, & Griffiths, 2017; Huang & Boyer, 2007; Shaffer & Hall, 2001). This developmental period is often characterized by dramatic change and little is known about the stability of gambler subtypes as they transition into later adulthood. Therefore, the studies contained within this dissertation focused on this more vulnerable population of gamblers.

Study 1. The main objectives of Study 1 were (a) to utilize LCAs to determine if different subtypes of gamblers could be derived using measures of anxiety, depression, alcohol and drug problems, and impulsivity; and (b) to validate the class solution that emerged by utilizing multinomial logistic regression to test whether gambling severity and specific demographic variables (e.g., gender) could predict class membership (subtype). LCA performed on data from Wave 2 of the MLYSA revealed that a three-class solution was the best fitting model taking all seven indicator variables into consideration. The classes identified resembled the behaviourally conditioned, emotionally vulnerable, and impulsive gambler classes described in the Pathways model, and that membership in each of these groups was associated with a unique set of demographic risk factors. This study provides support for the Pathways Model as an etiological framework for understanding gambling subtypes in a broad sample of young adult gamblers existing along a spectrum of risk for developing gambling problems.

Study 2. The first aim of Study 2 was to use latent mixture modeling to determine if the three-class model derived in Study 1 at Wave 2 of the MLSYA remained stable over time (i.e., two years later at Wave 4). The second aim was to use Latent Transition Analysis (LTA) to investigate whether individuals transitioned between classes over time (i.e., from Wave 2 to Wave 4). As hypothesized, a three-class model similar to the one described at Wave 2 was supported at Wave 4. The results of the LTA revealed that only gamblers in the non-problem gambling class had high probabilities of remaining in the same class over time (i.e., remained highly stable). When transitions did occur, emotionally vulnerable gamblers were most likely to transition to the non-problem gambling class and the Impulsive gamblers were equally likely to transition to the non-problem and emotionally vulnerable class over time. Overall, these results support the “maturing out” hypothesis (O’Malley, 2005). To my knowledge, this is the first study

to use the Pathways Model to investigate temporal changes in gambling classes over time in a provincially representative broad sample of young adult gamblers.

Theoretical Contributions

The present findings make a number of important theoretical contributions to the literature. First, both studies provide support for the applicability of Pathways Model to understand the heterogeneity of young adult gamblers from a broad provincially representative community sample in the province of Manitoba. Most research investigating the Pathways Model to date has focused on samples of gamblers who have at least some risk of disordered gambling (Milosevic & Ledgerwood, 2010; Moon, Liser, Milosevic, & Ledgerwood, 2016; Nower, Martins, Lin, & Blanco, 2013). Sampling methods employing this strategy are reasonable because the Pathways Model was originally proposed to explain disordered gamblers. However, it is also possible that the characteristics that define subtypes of disordered gamblers in the Pathways Model apply to non-problem gamblers as well. It is reasonable to expect that the characteristics that define the different subtypes (i.e., the endorsement of depression, anxiety, impulsivity, etc.) influence the development of gambling problems in ways unique to each subtype but are not necessary or sufficient for gambling problems to occur. With this in mind, one may even expect to find subtypes based on such characteristics existing in non-problem gambler populations as well. The results of the research contained within this dissertation demonstrate that it is possible to derive subtypes of gamblers similar to those described in the Pathways Model using a sample of gamblers that exist on a continuum of severity from recreational to disordered gambling. This finding is significant because it shows that the Pathways Model can be employed for longitudinal studies that explore how recreational gamblers eventually develop gambling problems over time. Such studies are especially important

as they may help inform the creation of more targeted prevention and treatment strategies that take subtype characteristics as well as developmental information jointly into consideration.

Second, this is the first study to provide information about the temporal stability of gambling subtypes derived from characteristics outlined in the Pathways Model. Based on the finding of Study 2, it appears that although the class structure remains relatively stable over a two-year period of time, individual gamblers in the impulsive and emotionally vulnerable classes have a high likelihood of transitioning between subtypes over time. For example, impulsive gamblers are equally likely to transition from impulsive class to emotionally vulnerable and non-problem classes, while the emotionally vulnerable gamblers have a high probability of transitioning to the non-problem gambling class. These findings are likely the most novel and important contribution this dissertation makes to the subtyping literature. Although it is known that young adulthood is a developmental period typified by tremendous change, little research has focused on the internal stability of subtypes during this timeframe. Considering that the Pathways Model is a developmental model, it is vital that more research be dedicated to examining the temporal stability of the subtypes proposed within this theory. It is important to note that the LTA completed in Study 2 of this dissertation examined the transitions across a relatively short period of development and future studies should investigate these transitions over longer developmental periods.

Third, the probability of endorsing past year regular and any drug use was similar between emotionally vulnerable and impulsive gambler classes in both studies contained in this dissertation. This demonstrates that, at least during young adulthood, both emotionally vulnerable and impulsive gamblers in Manitoba are very likely to be using some form of drugs. This finding is in line with most research examining risky behaviour during young adulthood

(Canadian Centre on Substance Abuse, 2013). What is not known from this study is if class membership is associated with the use of specific types of drugs. According to the Pathways Model (Blaszczynski & Nower, 2002) emotionally vulnerable gamblers display higher levels of alcohol dependence but no predictions are made regarding their patterns of illicit drug use. Antisocial impulsivist gamblers in this model are hypothesized to demonstrate behavioural problems including substance abuse, excessive alcohol use, and polydrug experimentation (Blaszczynski & Nower, 2002). However, research is limited exploring these patterns of substance use within the pathways. Ledgerwood and Petry (2010) found that, in comparison to emotionally vulnerable gamblers in their study, the antisocial impulsivist gamblers reported more addiction-related issues, including a family history of addiction (i.e., alcohol, drug, or gambling problem) and increased treatment-seeking for a drug or alcohol problem.

Clinical Implications

The results of this research support the premise made by other researchers (Blaszczynski & Nower, 2002; Milosevic & Ledgerwood, 2010) that it may be advisable to customize treatment interventions and prevention efforts rather than using approaches that conceptualize disordered gamblers as a homogeneous population. For instance, individuals in the emotionally vulnerable gambler class in Study 1 were more likely than the other two classes to endorse problems with anxiety and depression. One might assume, on this basis, that gamblers in this class are motivated to gamble in an effort to escape or modify negative emotional states. If this is the case, individuals in this group would likely benefit from interventions that focus on specific co-occurring psychological vulnerabilities and that aim to help them replace gambling behaviour with alternative coping strategies to better manage emotional distress. It is worth noting that, in Study 2, the likelihood for probable caseness for depression had increased in the impulsive

gambler class such that it was similar to that found in the emotionally vulnerable gamblers. This finding highlights the importance of longitudinal research informing clinicians about how subtypes change over time. Such information should be taken into consideration especially if clients are being treated on multiple occasions over several years. Impulsive and emotionally vulnerable gamblers were also found to have high likelihoods of transitioning between classes. This instability needs to be taken into consideration if subtyping is utilized for treatment planning. What is not known is if this instability is just an artifact of young adulthood, or if it would also be found at later developmental periods as well. More longitudinal research utilizing procedures such as LTA is needed to investigate such questions.

Both studies in this dissertation indicate that gamblers in the emotionally vulnerable and impulsive gambler classes endorse regular drug use. Screening and treatment efforts should therefore take these findings into consideration as treatment of co-occurring substance use disorders would be indicated. The finding that individuals in the impulsive gambler class have substantially higher mean scores on alcohol dependence is also clinically relevant. Clinicians would do well to screen treatment seeking gamblers for both impulsivity and alcohol dependence to ensure that both problems are addressed concurrently in treatment.

Future Directions

Although Study 2 in this dissertation provided important information about how gamblers transition over time between subtypes, the analysis was limited to changes over a two-year period due to data on impulsivity only being available at two time points. Ideally, future studies that employ this design should include more time points—especially following gamblers from adolescence into adulthood (i.e., through emerging adulthood)—in order to test the temporal hypotheses in the Pathways Model thoroughly. For instance, it might be interesting to investigate

if instability in subtypes decreases over time as gamblers move into later adulthood. More longitudinal studies investigating the temporal stability of subtypes over the lifespan are therefore recommended.

As with all studies involving secondary data, my analyses were limited to the variables available in the MLSYA dataset. I was therefore not able to use variables capturing all characteristics described in the Pathways Model. Future longitudinal studies should be designed to collect data on as many of these characteristics as possible and to collect this data at every wave of data collection. The inclusion of attention deficit hyperactivity disorder and antisocial behaviour measures would have allowed for a more systematic test of the Pathways Model. In addition, it may be valuable to incorporate more continuous variables in future analyses to better capture variability lost in the use of dichotomous variables. Another interesting avenue of research would be to incorporate multiple methods (e.g., qualitative, third-party, etc.) research components that attempt to capture more subtle information on gambler motivations, especially with those participants who go on to establish chronic gambling problems. For instance, it may be fruitful to investigate if individuals who endorse gambling as a way to modulate affective states also use illicit substances for the same reason. More research investigating the link between behavioural and substance addictions within the framework of the Pathways Model would be beneficial.

Considering that drug use was common amongst both the impulsive and emotionally vulnerable gamblers studied in this dissertation, future researchers should try to determine which types of drugs are preferred by gamblers in the different pathways. For instance, one might anticipate that stimulants may be preferred by impulsivist gamblers as a way of enhancing their cognition and/or by helping them to regulate attention. Research demonstrating a link between

stimulant use and increased risk of gambling problems exists but research elucidating how these factors are related is lacking (Richard, Potenza, Ivoska & Derevensky, 2019). The results in this dissertation demonstrated that, when compared to the other two classes, impulsive gamblers had substantially higher scores on alcohol dependence. This finding is in line with other research that has found a connection between response impulsivity (i.e., difficulties inhibiting thoughts and behaviors, especially in the context of reinforcement) and alcohol use problems (Wardell, Quilty, & Hendershot, 2016). Additional research examining motivations for substance use while gambling is needed to help us better understand the relationship between substance use and behavioural addictions within the different pathways.

The Pathways Model predicts that gambling related cognitive beliefs and distortions (e.g., illusion of control and gamblers fallacy) exist in all pathways but, considering that the pathways differ with regard to the incidence of co-occurring psychopathology and personality characteristics, it is possible that the subtypes may be distinguished on the basis of specific cognitive factors. For example, antisocial impulsivist gamblers are, by definition, hypothesized to have more difficulties with executive function and moral reasoning than gamblers in the other two pathways. Likewise, individuals who experience depression and anxiety are also hypothesized to exhibit cognitive distortions that play a role in the expression of their conditions. Therefore, it would be reasonable to expect measurable differences between the subtypes of gamblers in terms of cognitive distortions.

To my knowledge, the only subtyping study examining the Pathways Model that has included measures of gambling related cognitions in their subtyping analysis was Devos et al. (2020). Utilizing cluster analysis on a mixed sample of community (N = 709) and treatment-seeking (N = 122) gamblers, these researchers were able to derive five subtypes of gamblers

differentiated by their scores on measures of gambling-related cognitions, disordered gambling symptoms (i.e., PGSI scores), emotional distress, and gambling habits. Three of the five subtypes resembled those proposed in the Pathways Model. In addition, a fourth subtype, composed of gamblers who demonstrated a moderate risk of gambling-related problems, was characterized by elevated scores on impulsivity but an absence of gambling-related cognitions. This finding was notable as it contradicts the hypothesis described in the Pathways Model that gamblers in all pathways share cognitive distortions and faulty beliefs related to gambling (Blaszczynski & Nower, 2002). A fifth subtype emerged that was composed of gamblers who had the lowest scores on all factors included in the analysis. Devos et al. theorised that this subtype captured the recreational gamblers in the sample and therefore would not fall within the scope of the Pathways Model, which proposed to describe problem gamblers. However, 10% of the gamblers falling into this final subtype were actually treatment-seeking gamblers.

Little has been written about what factors differentiate recreational gamblers who do not develop gambling problems from behaviourally conditioned gamblers who do. Although the endorsement of cognitive distortions and erroneous beliefs (e.g., gamblers fallacy) about gambling appears to be a risk factor for the development of disordered gambling, it also occurs in many recreational gamblers who never go on to actually develop gambling problems (Yakovenko et al. 2016). One potential explanation for this is that recreational gamblers who eventually develop problems are more vulnerable to the reinforcement properties of gambling activities (i.e., dopaminergic sensitivity) in addition to having gambling-related cognitions. According to Blaszczynski and Nower (2002), gambling-related cognitive distortions and irrational belief structures increase and become more entrenched as gambling levels increase. Therefore, a need exists for additional research investigating how reinforcement pathways

contribute to gambling-related cognitive distortions and how these eventually lead recreational gamblers to become behaviourally conditioned disordered gamblers.

Conclusion

To my knowledge, this was the first series of studies in the gambling subtyping literature to demonstrate that a broad, provincially representative sample of young adult gamblers can be subtyped according to factors outlined in the Pathways Model and that—although these subtypes persist overtime—there is considerable instability at the individual level in terms of how gamblers transition between subtypes while progressing through young adulthood. The findings of this dissertation provide additional support for the Pathways Model as a useful theory for understanding the heterogeneity that exists in gamblers. Future research should build on the studies contained within this document by expanding the number of indicator variables used to evaluate the Pathways Model more comprehensively. In addition, longitudinal studies that build on Study 2 should follow gamblers for longer than two years to help researcher better understand how subtypes change over time.

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