Designing a Longitudinal Cohort Study of Gambling in Alberta: Rationale, Methods, and Challenges

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Abstract

Longitudinal research on the determinants of gambling behavior is sparse. This article briefly reviews the previous seventeen longitudinally designed studies, focusing on the methodology for each study. This is followed by a description of our ongoing longitudinal study entitled the Leisure, Lifestyle, & Lifecycle Project (LLLP). Participants for the LLLP were recruited from four locations in Alberta, Canada, including both rural and urban populations. In the LLLP most participants were recruited using random digit dialing (RDD), with 1808 participants from 5 age cohorts at baseline: 13-15, 18-20, 23-25, 43-45, and 63-65. Individuals completed telephone, computer, and face-to-face surveys at baseline, with the data collection occurring between February and October, 2006. At baseline, a wide variety of constructs were measured, including gambling behavior, substance use, psychopathology, intelligence, family environment, and internalizing and externalizing problems. Finally, the conclusions that can be drawn thus far are discussed as well as the plans for three future data collections.

Keywords: Gambling; predictors; longitudinal study; methodology; cohort design

Introduction

This paper examines longitudinally designed research that has focused on the determinants of gambling behavior and problem gambling. Our review centers on studies focusing on gambling behavior within the general population and we excluded any treatment-seeking population focused papers. To this point, we have identified 17 longitudinal studies that have either focused specifically on gambling or had gambling as one of the factors or constructs in their study.

The description of previous longitudinally designed research examining gambling behavior is brief since all but one of the studies have been described in detail in previous publications. Studies that are more directly related to the Leisure, Lifestyle, and Lifecycle Project (LLLP), in terms of design or constructs measured, are discussed here, with the remaining studies summarized in Table 1. Ways in which future longitudinal research can expand our knowledge regarding changes over time in gambling behavior are also discussed. We then present our ongoing longitudinal study of gambling, the LLLP, that has now completed one cycle of data collection and will collect three more cycles over the next four years.

To date, only a limited number of studies have examined gambling behaviors and problems prospectively (see Table 1). The earliest study was published in 1993, with the researchers interested in the impact that reaching the legal age to gamble would have on individual's gambling behavior (Winters, Stinchfield, & Fulkerson, 1993a, 1993b). Consequently, they completed a further assessment of this longitudinal study on the gambling behavior of youth as these individuals matured into young adulthood (Winters et al., 1993a, 1993b; Winters, Stinchfield, & Kim, 1995; Winters & Anderson, 2000; Winters, Stinchfield, Botzet, & Anderson, 2002; Winters, Stinchfield, Botzet, & Slutske, 2005).

Insert Table 1

Other researchers examined whether increased levels of impulsivity in early adolescence could predict problem gambling in later adolescence (Vitaro, Ladouceur, & Bujold, 1996; Vitaro, Arseneault, & Tremblay, 1997; Vitaro, Arseneault, & Tremblay, 1999; Vitaro, Brendgen, Ladouceur, & Tremblay, 2001; Vitaro et al., 2004; Wanner et al., 2004). They found that impulsivity at a younger age was predictive of problem gambling later in adolescence (Vitaro et al., 1999, 2001). In a related study, Vitaro et al. (1996) examined the potential relationship between gambling, delinquency, and substance use and found individuals who gambled more frequently were more likely to report incidences of delinquent behaviors and substance use (Vitaro et al., 1996).

Another group of researchers examined the predictors of both gambling and alcohol use among adolescents, by combining data from two separate studies (Barnes, Welte, Hoffman, & Dintcheff, 1999, 2002, 2005). Similar to the finding in Vitaro's et al. (1997) study, these researchers also found that impulsivity and deviant behavior among peers were predictive of gambling behavior.

The study completed by Jacques, Ladouceur, and Ferland (2000) and the further assessment by Jacques and Ladouceur (2006) involved an experimental-control design. This design allowed the researchers to examine the impact of a new casino (i.e., experimental condition) on the gambling behavior of the participants when compared to a group of participants that did not have a casino in close proximity (i.e., control group). The baseline data collection was conducted before the casino started operations. After one year, participants from the experimental group were gambling more and losing more money per day, however by the follow-ups there was no significant difference between the experimental and control conditions on the measures of gambling behavior (Jacques et al., 2000; Jacques & Ladouceur, 2006).

Slutske, Jackson, and Sher (2003) conducted an 11-yr, 4 wave longitudinal study and found that the past year prevalence and lifetime prevalence of problem gamblers, from adolescence through young adulthood, were relatively stable. Despite the stability of the prevalence at the aggregate-level, problem gambling appeared to be more fluid rather than stable (or chronic) at the individual level.

Wiebe, Single, and Falkowski-Ham (2003) and Wiebe, Cox, and Falkowski-Ham (2003) completed a one year follow-up of a gambling prevalence study conducted in Ontario (Wiebe, Single, & Falkowski-Ham, 2001). Results indicated that those individuals classified as at risk or moderate gamblers were gambling less at time 2 as compared to time 1, whereas those individuals classified as having a severe gambling problem did not have much variation in their gambling behavior between time 1 and 2.

Hodgins and el-Guebaly (2004) also completed a prospective study that examined the reasons for relapse among a group of pathological gamblers who had recently quit gambling. Results indicated that relapse rates were very high, with only 8% of participants free of gambling for the entire 12 month period, with many of the participants indicating that they relapsed as a result of some negative life event, like a financial crisis.

Ladouceur, Sylvain, and Gosselin (2007) also conducted a longitudinal study tracking individuals that had excluded themselves from casinos. The goal was to measure gambling behavior and problem gambling during and after their exclusion period. During the period of self-exclusion, on average, there was a significant decrease in the urge to gamble and the DSM-IV scores for pathological gambling (Ladouceur et al., 2007).

LaBrie et al. (2007) reported a unique longitudinal study that assessed Internet-based gambling among a large group of individuals that opened an account with an Internet betting

service provider. The researchers tracked each individual's daily activity to measure the number of bets placed, how much money was bet, and the eventual outcome of the bet (e.g., win or loss). Results indicated that individuals moderated their Internet-based gambling behavior based on their wins and losses (LaBrie et al., 2007).

The last study reviewed comprised an 11-year follow-up of adult drug users (Cottler & Cunningham-Williams, 2000; Cunningham-Williams, Cottler, Compton, & Spitznagal, 1998; Cunningham-Williams et al., 2000, 2005). In that high-risk population, an 11-yr incidence rate of problem/pathological gambling amounted to 12%.

Summary of Methodological Features of Previous Gambling Longitudinal Studies

Table 1 summarizes the methodology for the longitudinal studies described above as well as the others that were not mentioned. There are a number of shortcomings in these previous studies. First, the lack of standardized assessment procedures and a lack of operational definitions of the diagnostic syndromes limit the comparability of results across time periods and across studies. Second, many of the studies focused on adolescent or young adult participants, and did not pay heed to the potential progression and changes inherent in gambling behaviors across age groups, such as middle adulthood and seniors (e.g., Winters et al., 1995; Vitaro et al., 1997; Barnes et al., 1999). Third, the sample sizes for some studies were small, which seriously limits the generalizibilty of the findings (e.g., Abbott et al., 1999; Cottler & Cunningham-Williams, 2000). Fourth, some earlier studies failed to include some or in some cases, any, of the constructs or factors that have been implicated as risk factors in problem gambling (Abbott & Clarke, 2007; Jacques et al., 2000; LaBrie et al., 2007). Fifth, some studies had very limited measures of gambling behavior or only asked the gambling questions at one point in time, which made it difficult to draw conclusions regarding changes in gambling over time (Cunningham-Williams et al., 1998, 2000, 2005; Vander Bilt et al., 2004). Finally, some studies had retention issues, with the

sample size decreasing significantly over the period of the study (e.g., Shaffer & Hall, 2002). With these shortcomings in mind, we attempted to design a more comprehensively designed longitudinal study that would examine gambling behaviors among a range of ages.

Methods for the Leisure, Lifestyle, Lifecycle Project

Hypotheses and Definitions

The Leisure, Lifestyle, Lifecycle Project (LLLP) addresses five research questions: (1) what is the prevalence of gambling behaviors (type, range and degree of involvement) of men and women across the lifecycle? (2) what are the patterns of continuity and discontinuity (including incidence) in gambling behaviors as well as patterns of recovery from problems? (3) what behavior patterns constitute responsible and problem gambling? (4) what is the impact on the various age cohorts of the changes that occur within 5 years in terms of gambling legislation, public attitudes and availability of preventive programs? (5) what are the biopsychosocial variables (risks and resilience) predicting the spectrum of gambling behaviors, from responsible to problematic?

For purposes of this study, **responsible gambling** is conceptualized as gambling that is a rational and sensible choice, based on each individual's circumstance. Gambling is currently non-problematic and does not constitute a significant risk for future problematic gambling (Dickerson, 2003). **At-risk gamblers** in the present study is a concept that is defined as those individuals that are at increased risk of developing a gambling problem in the short- or long-term due to the frequency or amount of gambling they exhibited at baseline. **Problem gambling** is defined as gambling that causes significant harmful effects to the individual gambler, their family, friends, or coworkers (Ferris, Wynne, Single, 1999). The definition of **pathological gambling** is based on the criteria defined in the Diagnostic and Statistical Manual of the American Psychiatric Association (DSM-IV; APA, 1994), which is persistent and recurrent maladaptive gambling behavior.

A **cohort** is defined as a group of individuals experiencing the same event, often birth, during the same time period. A **cohort effect** describes impacts on individuals that follow from membership in one age cohort rather than from membership in another (e.g., "Baby-boomer" effect). **Period effects** refer to influences specific to a particular time period (e.g., the multiplication of gambling opportunities). **Aging effects** refer to changes that occur with age (e.g., age-dependent selection of leisure activities). Cross-sectional data confound aging and cohort effects whereas longitudinal data confound aging and period effects. Farrington (1991) and Glenn (1977) thought it was important to devise a method of disentangling aging and period effects. The LLLP will attempt to disentangle age and period effects associated with gambling behavior through the combination of longitudinal and cross-sectional design.

Background and Rationale for Study

The LLLP will allow for the first determination of a population-based incidence of gambling behavior across the life-cycle, from adolescents to seniors. To date only prevalence data are available (Shaffer & Hall, 2002) or studies that have been limited to certain age cohorts (Barnes et al., 1999; Vitaro et al., 1996). Following several different age cohorts simultaneously ('multiple cohort strategy') has several advantages (Farrington, 1991; Bell 1953). Since a very long time frame can lead to problems of outdated theories, a shorter time frame would decrease the potential of having outdated theories, instruments or policy concerns. The shorter follow-up period reduces the problems of cumulative effects of testing or sample attrition. Following-up several cohorts (rather than one) also should increase confidence in the generalizability of the results. A cohort design that includes participants that have not yet commenced significant levels of gambling should provide invaluable information about the onset of problem gambling and the transitions that occur over time between non-problem gambling and problem gambling behavior (Abbott & Clarke,

2007). Consequently, based on a review of the relevant research, a longitudinal multiple cohort study was selected as the optimal design to address changes in gambling behavior over time.

Based on literature reviews and epidemiological surveys (el-Guebaly & Hodgins, 2000; McGowan, Droessler, Nixon, & Grimshaw, 2000; Smith & Wynne, 2000; van Brunschot, 2000), the critical ages selected were 13-15, 18-20, 23-25, 43-45, and 63-65 year olds. Thirteen to fifteen year olds presumably are experiencing an initiation to gambling interwoven with developmental influences. Inclusion of this age group also allows researchers to examine issues related to the onset of gambling and transitions in gambling behavior over time. Eighteen to twenty year olds are known to be at high-risk for frequent gambling. In Alberta, the legal age for most forms of gambling is 18 years. Ages 23 to 25 years is a time when most individuals address adult family, job responsibilities as well as leisure activities. Ages 43 to 45 years is a mid-adulthood period when individuals have likely addressed several important life tasks and as parents must now educate the next generation as to responsible leisure activities. Finally, 63-65 year olds are preparing for and experiencing retirement and they comprise an age cohort that is understudied. Opinions differ as to the impact of a changing gambling culture on this age group. With this design, it is possible that a 5-year "real-time" strategy will allow a seamless assessment from age 13 to age 30 (the normative years in leisure activity) as well as comparisons with middle adulthood and senior groups during the same period.

There have been few theoretical or conceptual models tested in past research examining gambling behavior. The theoretical models that do exist tend to focus on explaining the most severe forms of gambling, rather than the full spectrum of gambling from low-risk gambling or social gambling to pathological gambling (Raylu & Oei, 2002). Up to now, most researchers developed models that focus on potential physiological predispositions (McCowan & Chamberlain, 2000) and/or psychological factors such as emotional problems, antisocial behavior, impulsivity, or locus

of control that may be related to gambling behavior (Blaszczynski & Nower, 2002; Dickerson & Baron, 2000). The pathways model developed by Blaszczynski and Nower (2002) is an example of a comprehensive model that incorporates constructs from various theoretical frameworks from a wide variety of studies.

We reviewed the conceptual models that attempt to explain the nature and development of gambling behavior and substance abuse. Adapted from an earlier WHO biopsychosocial model of relevance to drug use and dependence (Edwards, Arif, & Hodgson, 1981), the conceptual model designed for this study is presented in Figure 1 and aimed to include all relevant gambling behavior constructs that were measurable with validated instruments. The biopsychosocial and cultural models include a variety of risk and resilience factors such as biological risk, personality, cognitive ability, family environment, extra-familial environment, stressful life events, internalizing and externalizing problems, and issues related to gambling.

Insert Figure 1

Rationale for Measures and Description of Measures

Instrument selection was based on the following parameters: (1) examination of the most reliable and valid instrument available for the constructs outlined in the conceptual model (see Figure 1); (2) the instruments should be applicable to as many age cohorts as possible (in reality few adolescent instruments are applicable to adult cohorts and vice versa); (3) time of administration needed to be considered to ensure subject fatigue was minimized; and (4) cost to use the instruments.

All instruments used in the study are presented in Table 2. The instruments are organized according to the constructs outlined in the conceptual model (Figure 1). In Table 2, it is indicated

whether the instrument was used for adolescents, adults, or both. The source of the instruments and, where applicable, the subscales that were used in this study are listed in Table 3. Refer to the sources listed in Table 3 for a more detailed description of the instruments and their psychometric properties. In this section, we limit ourselves to a brief explanation of the measures of gambling that are included in the LLLP.

Insert Table 2 & Table 3

In addition to assessing lifetime and past month gambling involvement in the initial interview, four additional areas of gambling involvement were assessed. First, *gambling behavio*r was measured by questions from the Canadian Problem Gambling Index (CPGI) (Ferris & Wynne, 2001) asking about the types of gambling engaged in, the frequency of involvement, and the amount of expenditure on each type. As a form of concurrence, gambling behavior was also measured using the Sydney and Laval Universities Gambling Screen, which measures the type of gambling and the gambling behavior of individuals (Blaszczynski, Ladouceur, & Moodie, in press).

In the case of adults, *problem gambling* was assessed using the 9-item Problem Gambling Severity Index embedded in the CPGI (Ferris & Wynne, 2001). Since the CPGI has not been normed for adolescents, problem gambling among adolescents was measured using the Fisher DSM-IV-J-MR for adolescents (Fisher, 2000). This latter instrument consists of 12 items that assess nine of the ten diagnostic criteria for adult problem gambling (CPGI in adults; DSM-IV-MR-J in adolescents; Fisher, 2000). *Pathological gambling* was measured in all cohorts by means of the Composite International Diagnostic Interview's gambling module, which uses the DSM-IV criteria for pathological gambling (CIDI-DSM-IV; APA, 1994).

Attitude toward gambling, a construct measured by combining items from three different surveys: the Alberta Gaming and Liquor Commission (ACCORD Research, 2000); the Canada West Foundation (Azmier, 2000); and morality of gambling (Williams, 2003; Williams, Connolly, Wood, & Nowatzki, 2006). For the present study, some items were revised from the original source. Sixteen items ask participants for their impression of the level of harm associated with various forms of gambling (ACCORD Research, 2000); twelve items ask about participants attitudes toward gambling (Azmier, 2000); and three items deal with the "morality" of gambling and the perceived harms versus benefits of gambling (Williams, 2003; Williams et al., 2006). *Gambling fallacies* were measured using the ten item Gambling Fallacies Scale that examines awareness of and resistance to common gambling fallacies (Williams, 2003; Williams et al., 2006).

Sample Size

A variety of research questions will be addressed over the course of the LLLP, each with different sample size requirements. However, the primary dependent variables are gambling behaviors and gambling disorders. Gambling behavior is common in the Alberta population as 82% of adults report gambling at least occasionally on an annual basis (Smith & Wynne, 2002). The prevalence of gambling disorders is much lower, however. In the most recent Alberta random digit dialing survey, which used the Canadian Problem Gambling Index, 9.8% of adults scored in the low range, 3.9% in the moderate range and 1.3% in the severe range of problems (Smith & Wynne, 2002). In a meta-analysis of North American surveys, the rate of moderate disorders was estimated to be 2.5% and the rate of severe disorders 1.5% (Shaffer & Hall, 2001). The relatively low prevalence of severe disorders poses a challenge to all researchers in the field. Based upon prior research (e.g., Loeber & Farrington, 1994, 1995) we designed a sampling strategy to over sample individuals who were at at-risk of developing gambling problems in the short- or long-term.

Essentially, two samples were recruited; a general population sample, and a sample of individuals who were conceptualized as at-risk gamblers.

Sampling and Recruitment Plan

The original intent was to complete a prospective study of Albertans over a 5-year period (2006 to 2011). The sample was to consist of 2000 individuals from both genders sampled equally in five age groups (13-15, 18-20, 23-25, 43-45, 63-65) divided equally into the general population and higher frequency (at-risk) gamblers. Power analyses suggested that a sample of 400 – 200 at-risk and 200 general population – per age group provided sufficient statistical power for the analyses of interest.

A geographic sampling plan was developed to reflect the urban and rural distribution in Alberta. Approximately 1/3 of the sample was allocated each to the Edmonton metropolitan area and to the Calgary metropolitan area. These large urban areas account for approximately 65% of the Alberta population of 3.3 million. The remaining third of the sample was allocated to Lethbridge (a southern Alberta community of about 80,000), Grande Prairie (a northern Alberta community of about 50,000), and rural areas surrounding these two cities. Within a reasonable traveling distance of Lethbridge and Grande Prairie are a number of smaller centres that vary substantially on dimensions of video lottery terminals availability (the most accessible and hazardous form of gambling in the province), prevailing community norms, population structure, and major industries (Smith & Wynne, 2004).

The plan was to select communities, and assemble random digit dialing (RDD) banks associated with these communities. Weights were to be assigned to the probability of choosing a phone number from this assembled bank such that 35% of the sample from Lethbridge and Grande Prairie would be drawn from the chosen rural communities. The sampling would then proceed by random draw from the weighted telephone lists and quotas filled according to age and risk status.

Random digit dialing (RDD) was to be used to recruit 1000 people for the general population sample, with 200 individuals in each of the five age cohorts. The general population sample was then to provide age and gender specific percentiles on gambling expenditure and gambling frequency. A second wave of RDD sampling was then to recruit 1000 'at-risk' gamblers who were at or above the 70th percentile in either gambling expenditure or gambling frequency (again, stratified by age and gender). The intent of the 'at-risk' sample was to increase the yield of individuals who may be experiencing or likely to develop gambling problems during the course of this longitudinal study.

Procedures and Survey Administration

The startup date for data collection was staggered between the four locations over nine months between February, 2006 and October, 2006. Initial contact with the majority of potential participants was completed using random digit dialing. If the individual stayed on the line, they were asked questions from an initial screener. The computer-aided telephone interviewing (CATI) technology (Freeman, 1983) utilized Case ID numbers, with each respondent assigned an ID number at the beginning.

In the screener, specific inclusion criteria were required for individuals to participate in this study. That is, the individual had to be a resident of the geographic target area (based on main address) and have been a resident of Alberta for a minimum of three months. There were also specific criteria for those 524 participants in the at-risk group. An individual's inclusion in this at-risk group was based on their answers to the frequency of gambling and amount of gambling questions from the cohort screener. Based on results for gambling expenditure and frequency, cutoffs for the 70th percentile were established for each of the age cohorts and gender. The cut-off for adults (18-20, 23-25, 43-45, & 63-65 year olds) was spending more than $10 (absolute value) on gambling in a typical month **or** gambling at least twice a month. The cut-off for adolescents (13-

15) was spending any amount on gambling in a typical month **or** those that gambled at least once in the previous year. A statistical analysis was completed to determine whether there were any significant differences in demographics between the group that met the amount cutoff, the frequency cutoff, or both cutoffs. The analysis indicated that there were no significant differences between these groups.

Eligible respondents completed the telephone interview (approximately 45 minutes for adults & 30 minutes for adolescents), and at the end, a time was booked for the individual to complete a computer-based survey and face-to-face interview. The computer-based survey and face-to-face interview took place at one of four locations. The participants completed the computer-based survey independently and research assistants completed the face-to-face part of the interview with the participants (Life Event Questionnaire, the Wechsler Abbreviated Scale of Intelligence [WASI], and the computer-based version of the Wisconsin Card Sorting Task [WCSC]). This same procedure was used for adolescents, with the parents completing the computer-based survey while their child was completing the face-to-face portion of the interview with a research assistant. On average, the computer-based survey and face-to-face interview took 3 hours to complete for adults and 2.25 hours for adolescents. At the end of the computer-based survey and face-to-face interview, participants were paid $75 to reimburse any expenses incurred as a result of the study.

The combination of a telephone survey, computer-based survey, and face-to-face interview was used for a number of reasons. First, given the entire length of the survey and interview, it was believed that a variety of data gathering techniques would reduce the burden of the survey on participants. Second, the inclusion of face-to-face interviewing provided for enhanced subject engagement, which is an important factor in reducing subsequent attrition (e.g., Boots-Miller et al., 1998). The trade off between a computer-based survey and face-to-face interviews is that greater engagement associated with interviews may result in greater biasing of self-report due to social

desirability. Many studies pertaining to sensitive issues report higher response rates and more accurate responses using a self-administered method of data collection (e.g., Aquilino, 1997; McAllister & Makkai, 1991; Schaeffer, 2000; Supple, Aquilino, & Wright, 1999; Tourangeau & Smith, 1996).

Initial Results for the Leisure, Lifestyle, Lifecycle Project

Sampling and Recruitment

Due in part to budget constraints, recruitment did not yield equal representation in each of the age groups. There were more 13-15 (n=435) and 43-45 (n=403) year old participants and fewer 18-20 (n=315), 23-25 (n=342), and 63-65 (n=313) year olds than originally intended (Table 4). As well, slightly more females (53.7%) than males (46.3%) completed the initial assessment. Finally, recruitment efforts did not yield the planned 1/3 split between Calgary, Edmonton, and smaller communities. There was an over sampling of participants from Calgary (41.7%) and an under sampling of participants from Edmonton (29.6%) and the outlying communities (28.7%).

Insert Table 4

Difficulties with recruiting at-risk gamblers (e.g., difficulty finding people who met the 70% gambling expenditure or gambling frequency levels) led us to use four supplemental recruitment techniques: (1) a media release asked for volunteers for the study; (2) in cases where the casino, bingo hall, or establishment with a VLT machine agreed, posters were placed to advertise the study; (3) advertisements were placed in local papers to facilitate recruitment; and (4) a "snowball" e-mail was sent to individuals who had already participated in the study to get them to tell their friends about the study. Ultimately, only 33 of the total 1808 participants were recruited using these supplemental techniques (1.8%). By the end of data collection at time one on October 21, 2006, we

had 1284 participants from the general population and 524 participants from the at-risk population who participated in the study.

Response Rate

There are a number of techniques for calculating the response rate for telephone surveys. A conservative method is recommended by the Council of American Survey Research Organizations criteria (CASRO, 1982). Essentially it is the number of completed interviews divided by the number of eligible telephone numbers. In this study, the CASRO response rate was 5.35%.

A more liberal approach (Volberg, 2007) uses only the total valid sample as the denominator. There were 1775 fully completed participants (completed telephone & face-to-face survey) out of 17,357 eligible households in this study, which translates to a completion rate of 10.23%. In turn, this can be decomposed into three relevant response rates: the response rate for the initial telephone interview (1775+7260)/17,357 or 52.02%; those having completed the initial interview who agreed to participate in the face-to-face interviews (1775+654)/(1775+7260) or 26.88%; and those having agreed to participate in the face-to-face interview who ultimately completed the interview 1775/(1775+654) or 73.08%.

Sample Demographics and Representativeness

Table 4 shows the demographic characteristics of the 1808 participants that completed the entire study at Time 1 (both telephone and face-to-face interviews). To examine the potential for bias, these distributions were compared with those of the individuals that completed only the telephone interview but did not complete the face-to-face interview. There were no significant differences in these demographic characteristics for the telephone only participants (n=654) compared to the 1808 fully complete participants.

The design also allowed for a comparison of the individuals within the general population who met the criteria for being considered at-risk and the individuals who were recruited as at-risk

by those criteria (i.e., in the at-risk group). The marital status, education and current employment distributions for the adult at-risk group in the general population (N= 387) did not differ from those of the adult at-risk population

The CPGI-PGSI (Ferris & Wynne, 2001) was scored for problem gambling status in order to determine the success of the sampling strategy in recruiting at-risk gamblers. Table 5 shows the counts and rates for those age 18+ within both the general sample and the at-risk sample. The at-risk sampling strategy did provide larger numbers of individuals in the CPGI-PGSI risk categories and in the same proportions as the at-risk sample from within the general population.

Insert Table 5

Survey Weighting

It was decided to develop survey weights to compensate both for the complex sampling design, and for the differences between the sampling plan and the collected sample. This would allow more accurate estimates of population prevalence of relevant aspects of gambling behavior.

Age, sex, and geography specific population projections for July 1, 2006 were available for Alberta (Malo, 2007). These projections were based upon population counts through 2005 for Albertans insured under the Alberta Health Care Insurance Plan, a universal health care plan with virtually complete coverage of Albertans. The geographic regions for which counts were available corresponded closely to the geographies for the current project. The weighting process consisted of the combination of three weighting factors: an age-sex-geography factor derived from these projections, an adjustment based upon the number of individuals in the same age-sex grouping residing in the household as derived from the survey information, and a factor to account for the oversampling of at-risk gamblers. This last factor was derived by first, determining the age-sex-

geography based count of the at-risk gamblers in the general population sample, and second, dividing the weight of all at-risk gamblers in each age-sex-geography grouping of the total sample into that count. Bootstrap weights (Yeo, Mantel, & Liu, 1999) were generated to facilitate data analysis of the data within this complex survey design.

Challenges: What Has Been Learned Thus Far?

Challenges, some unforeseen, were experienced: (1) ethics approval were required from each of the three associated institutions which delayed the project initiation considerably; (2) it was also more difficult to recruit individuals for the general and at-risk populations than anticipated; and (3) the attrition rate was higher than expected and the response rate lower than expected, leading to fewer participants being recruited than intended (1808 versus 2000), a longer period of time to recruit participants (9 months versus 3 months), and higher costs associated with the data collection. Each of these issues is discussed in the following sections.

Recruitment of Participants

There are a number of factors that may have played a role in the lower response rate and higher attrition rate. First, many households now have call display or call block on their phone lines, making it more likely that individuals will screen calls. As well, many individuals no longer have a telephone number associated with a household; they only have a cell phone. This is a growing problem that researchers are having when trying to conduct telephone-based recruiting for studies (Tucker, Brick, Meekins, & Morganstein, 2004; Volberg, 2007). These individuals would not have been included in this study since a cell phone is associated with an individual person and this study used sampling based on individual households. This was a concern particularly for the younger groups, especially the 18-20 and 23-25 year olds, since the younger cohorts may be more likely to only have a cell phone.

Second, in hindsight, having broader age cohorts with a wider width of five years (e.g., 13-17) rather than three years (e.g., 13-15), would have allowed recruitment of more participants in a shorter time period at a lower cost. By having broader age cohorts however, we would have had a reduced developmental specificity, since there would not have been continuous age coverage (e.g., over 5 years our study currently covers 18-30 year olds).

Third, the difficulty in finding participants may have partly been a function of the time of year. The summer months were a particularly difficult time to reach individuals via the telephone and as a result the number of telephone and face-to-face interviews decreased dramatically during July and August.

Fourth, the economy was booming in Alberta during the period of the recruitment from February to October, 2006. This meant that individuals were less likely to be at home to answer the telephone, due to working long hours or living in locations where we could not access them. For example, in the one smaller city in which participants were recruited, many young males were living in hotels/motels and working in the oil and gas industry. Fifth, some individuals that refused to participate stated that $75.00 was not enough incentive to participate. Statements such as "I can make more than that gambling or at work" were common. Thus, increasing the available amount of reimbursement may have helped in the recruitment of participants.

Finally, the low incidence of at-risk gamblers made this group particularly difficult to recruit. The research team originally intended to recruit 1000 participants from the general population and 1000 at-risk gamblers. Soon after recruiting for the at-risk population began however, it became evident that costs were becoming a significant barrier and that it would impossible to recruit 1000 at-risk gamblers. Consequently, in the end, a total of 524 at-risk gamblers were recruited.

Long Period of Recruitment

Based on the rate at which data collection was completed during a pilot study, it was believed that all 2000 participants could be recruited in three months. In fact it took nine months to complete the recruitment and data collection for the 1808 participants. High attrition and low response rate were significant causes of this drastically extended recruiting period. On the other hand, the extended period reduced the chance of a "peak period" bias.

Costs Involved in Face-to-Face Data Collection

The increased cost was directly related to the extra manpower hours and space rental associated with recruitment difficulties including additional telephone interviews, and no-shows or cancellations connected with the face-to-face interviews. Consequently, the researchers had to choose between a reduction in the sample size or a reduction in the number of data collection points. The researchers ultimately decided to recruit as many participants as possible and to limit the number of data collection points to four in five years rather than the original five data collections in five years.

Conclusions

Strengths of the LLLP

Previous studies of the determinants of gambling behavior among adolescents and adults suffer from a number of substantive and conceptual gaps, which need to be addressed by continued research (Abbott & Clarke, 2007; Slutske, 2007). In particular, Slutske (2007) identifies a number of specific gaps in past research on gambling behavior. First, we know little about the causal relations between gambling behavior and other related constructs. The LLLP is the first longitudinal cohort study that measures an extensive array of constructs that have been found to be associated with gambling behavior in previous research (e.g., personality, intelligence, psychopathology, etc.).

Second, the stability and/or change of gambling behavior for individuals and between individuals over time are still unclear. With a baseline of 1808 participants in 5 different age cohorts over a 5 year period, our study should provide information regarding the stability and change of gambling behavior among individuals and between individuals over a 5 year period.

Third, there is a lack of research that focuses on specific factors (e.g., personality, psychopathology, etc.) that may predict the stability or escalation of gambling behavior or gambling problems over time. The LLLP has 1808 participants, 5 cohorts, 4 data collection points, and there are measures of various constructs. This type of research design, with the large sample size, will allow researchers involved in the LLLP to utilize more advanced statistical techniques such as growth curve modeling, structural equation modeling, and hierarchal linear modeling.

Finally, there has been a lack of research on gambling behavior among individuals at certain ages particularly those age 40+ and adolescent girls. The LLLP study includes a baseline of 403 participants between the ages of 43 and 45, 313 participants between the ages of 63 and 65, and 200 adolescent girls at the beginning of the study.

There are a number of benefits that the LLLP will provide to research on gambling behavior, including: (1) the first set of data on the range of gambling behaviors across the lifecycle for both genders as well as their interaction with a set of variables across the biological, psychological, social and environmental range which should inform the debate about the benefits and limitations of exposure to gambling outlets across the lifecycle; (2) this study will provide the first set of population-based incidence data across the life-cycle; (3) the potential for validating screening instruments for problems across the lifecycle also exists; (4) the study will yield a common data bank to be used by researchers from various domains; and (5) the study is supported by a strong multidisciplinary network across various universities.

Plans for the Future

Contact with participants between the next three data collection points will be facilitated through bi-yearly newsletters and a website designed specifically for this study. Individuals will be contacted three more times, approximately every 14-18 months for the other three data collections. The timing of data collection ensures that participants will be interviewed during different months of the year, which will provide valuable information regarding possible seasonal variations in gambling behavior. Data collection in subsequent years will be conducted mainly using web-based surveys, with some participants completing telephone or mail-out surveys. Finally, researchers have been given permission to conduct a genetic sub-study of participants in this study. This will provide valuable information regarding potential genetic markers that may be associated with pathological gambling.

The attrition of the sample during a longitudinal study increases with the duration of the study. Moreover, the typical characteristics of drop-outs in longitudinal research are typically the characteristics of problem gamblers: male, single, minority group status, and substance users (Claus, Kindleberger, & Dugan, 2002; Collins, Ellicson, Hays, & McCaffery, 2000; Morrison et al, 1997). As part of this study we are attempting to minimize attrition through a comprehensive list of tracking contacts, interviewer persistence including the use of unrestricted call backs, ongoing subject contact/engagement, emphasizing the importance of subject's contribution to the study, expressing appreciation through reimbursement of related expenses, and having flexible survey collection methods (Boots-Miller et al, 1998; Collins et al, 2000; Cotter, Burke, Loeber, & Navratil, 2002; Jones, Zhou, & Yates, 2000; Morrison et al, 1997; Salyer, Geddes, Smith, & Mark, 1998).

Repeated assessment of participants may influence their behavioral reports. For example, respondents may learn at the first assessment that more admission of problem behavior prolongs the interview resulting in fewer admissions on subsequent assessment (Loeber & Farrington, 1995).

We will monitor this by examining any inconsistencies in the admission of 'lifetime gambling' or 'gambling in the past 12 months' over the 4 data collections. The inclusion of lifetime gambling questions will facilitate a test of the stability of this measure of gambling behavior and an examination of the validity of the measures as a construct over time.

As noted by other researchers (Abbott & Clarke, 2007), large cohort studies of gambling behavior that extend over multiple years and have various age groups can be both difficult to execute and expensive. The experience with the LLLP thus far has been challenging and enlightening. The hard work and challenges thus far have been worth the effort, since the LLLP is already providing information regarding the similarities and differences between at-risk and general populations along the biopsychosocial and cultural variables. As well, the extensive array of other constructs (e.g., intelligence, social support, religiosity, stressful life events, personality assessment, externalizing problems, etc.) measured in the study will allow for a detailed analysis of the relationship between these other factors and gambling behavior. It is believed that the rich array of information that will be gathered in this longitudinal study will play an important role in researchers gaining a better understanding of gambling behavior and the role that other factors like personality, intelligence, and substance use play in individuals gambling behavior. The results from this study can play an important role in public policy as it relates to factors such as access to gambling and an appropriate legal age for gambling. Finally, it is hoped that the LLLP experience will guide future researcher's attempts at completing longitudinal investigations of the relationship between gambling behavior and other important constructs.

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Figure 1

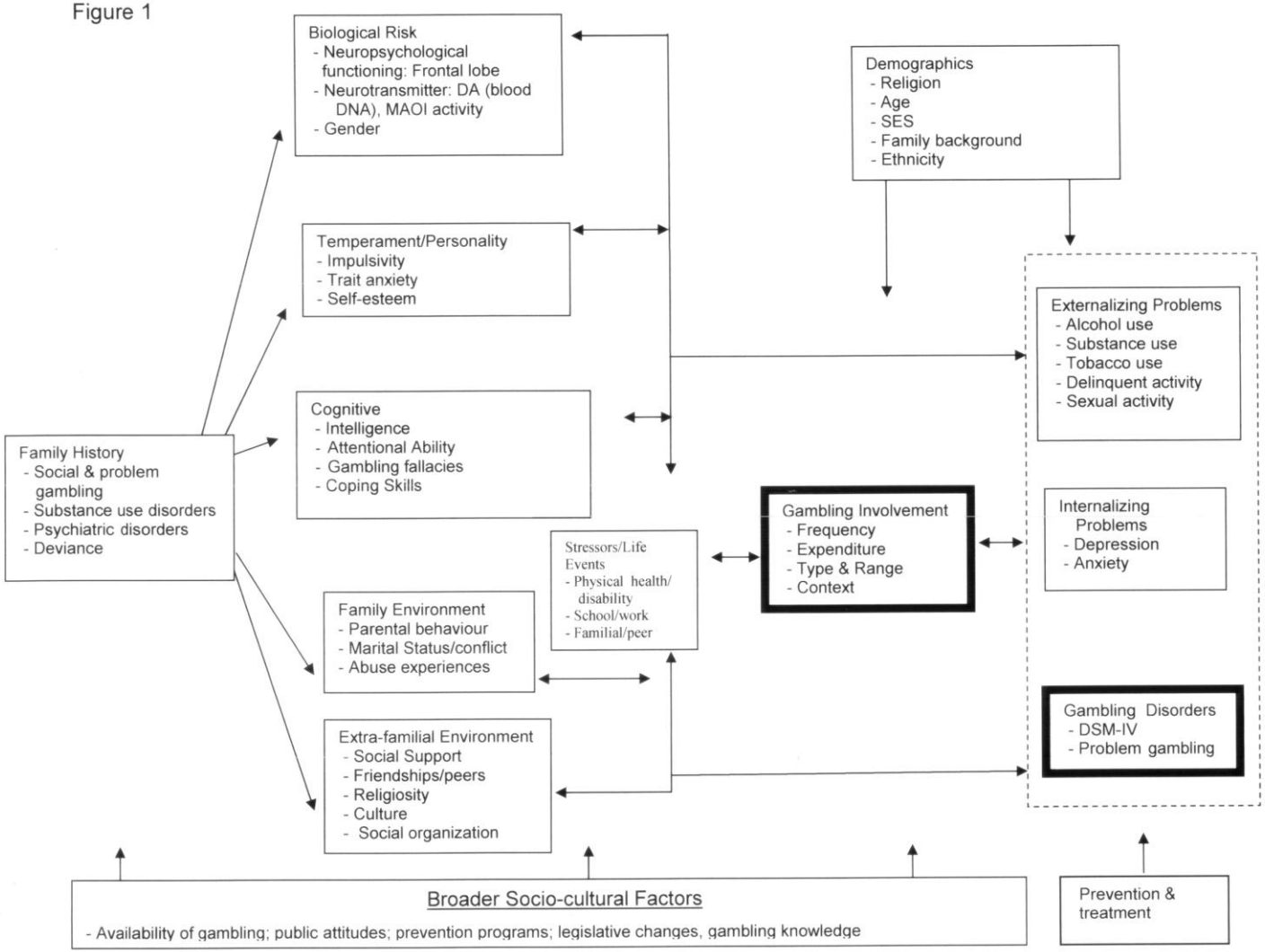
Biological Risk
- Neuropsychological functioning: Frontal lobe
- Neurotransmitter: DA (blood DNA), MAOI activity
- Gender
Demographics
- Religion
- Age
- SES
- Family background
- Ethnicity
Temperament/Personality
- Impulsivity
- Trait anxiety
- Self-esteem
Externalizing Problems
- Alcohol use
- Substance use
- Tobacco use
- Delinquent activity
- Sexual activity
Cognitive
- Intelligence
- Attentional Ability
- Gambling fallacies
- Coping Skills
Family History
- Social & problem gambling
- Substance use disorders
- Psychiatric disorders
- Deviance
Gambling Involvement
- Frequency
- Expenditure
- Type & Range
- Context
Internalizing Problems
- Depression
- Anxiety
Stressors/Life Events
- Physical health/ disability
- School/work
- Familial/peer
Family Environment
- Parental behaviour
- Marital Status/conflict
- Abuse experiences
Gambling Disorders
- DSM-IV
- Problem gambling
Extra-familial Environment
- Social Support
- Friendships/peers
- Religiosity
- Culture
- Social organization
Broader Socio-cultural Factors
- Availability of gambling; public attitudes; prevention programs; legislative changes, gambling knowledge
Prevention & treatment

Table 1 Comparison of Longitudinal Gambling Studies

Study	Time Span (yr)	# of Waves	Age Category	Gender	Recruitment Technique	Sample Size	Data Gathering Technique	Gambling Measures	Other Constructs Measured
Winters et al., 1993[1]	8	3	**Wave 1** 15-18 **Wave 3** 22-25	Males & Females	RDD	Wave 1 702 Wave 3 305	Telephone interview	SOGS-RA & SOGS Parents gambling	Alcohol/drug use Mental health Delinquency School achievement
Vitaro et al., 1996[2]	3	3	10-13	Males	Unknown	631	Self-reports administered in groups	Gambling freq Type of gambling	Alcohol/drug use Delinquency ADHD Anxiety Impulsivity Parent's occupation
Vitaro et al., 1997[3]	12	10	11-16 16-23	Males	87% of kindergarten boys in 53 schools	903	Face-to-face interview	SOGS-RA & SOGS	Alcohol/drug use Self & Peer Delinquency Impulsivity Delay-of- gratification Anxiety Parental supervision
Cunningham-Williams et al., 1998[4]	Unknown	Unknown	Unknown	Males & Females	Unknown	2954	Face-to-face interviews	Partial Diagnostic Interview Schedule (DIS)	Psychiatric disorders Substance use
Abbott et al., 1999[5]	7	2	18+	Males & Females	RDD	143	Telephone & Face-to-face interviews	SOGS-R	Alcohol Mental Health
Barnes et al., 1999[6]	7	6	**Wave 1** 13-16 **Wave 6** 18-22	Males & Females	RDD	Wave 1 699 Wave 5 522	Face-to-face interview	Gambling freq Type of gambling (Wave 5 & 6 only)	Alcohol/drug use Smoking Impulsivity Moral disengagement Parental monitoring Self & Peer Delinquency
Jacques et al., 2000[7]	5	4	18+	Male & Female	RDD	457 experiment & 423 control	Telephone interview	SOGS French Version	N/A
Shaffer &	2	3	17	Males &	Volunteer	639	Completed at	SOGS	Alcohol

Hall, 2002[8]				Females	workers from 6 casinos		home, no supervision		Smoking Physical health Stress Depression
Slutske et al., 2003[9]	11	4	**Wave 1** 18-19 **Wave 4** 28-29	Males & Females	Freshmen with a relative with alcoholism history	468	Telephone **or** Face-to-face interviews	DSM-III & DSM-IIIR/IV	Alcohol
Wiebe et al., 2003[10]	1	2	18+	Males & Females	Stratified random sample	448	Telephone interview	CPGI	Depression Anxiety Loneliness Life events Social support **Time 2 Only**
DeFuentes-Merillas et al., 2004[11]	2	2	18+	Males& Females	Sample of scratchcard buyers	201	Structured interviews & self-report questionnaires	SOGS	N/A
Hodgins & el-Guebaly, 2004[12]	1	4 or weekly contact	19+	Males & Females	Volunteer participants	101	Face-to-face & telephone interviews	SOGS	Alcohol/Drug Smoking Mood Life events
Vander Bilt et al., 2004[13]	15	6	**Wave 1** 65+ **Wave 4** 71-97	Males & Females	Random & Volunteer participants	Wave 1 1681 Wave 4 1016	Unknown	1 question: Left home to gamble	Cognitive functioning Health Social support
Slutske et al., 2005[14]	3	2	18-21	Males & Females	Births in Dunedin between Apr 1, 72 & Mar 31, 73	939	Face-to-face interview	Modified SOGS	Alcohol Smoking Drug use Personality
Xian et al., 2006[15]	11	2	**Wave 1** M=43 years old **Wave 2** M=54 years old	Males	Twins born between 1939-1955 – both served active military duty	1675	Telephone interview	DSM-III-R	Unavailable
Ladouceur et al., 2007[16]	2	4	**18+**	Males & Females	Individuals who exclude themselves from casinos & agreed to participate in study	161	Telephone interview	SOGS DSM-IV Urge to gamble Motives for exclusion	N/A

LaBrie et al., 2007[17]	8 months	Unknown	**18+**	Males and Females	Individuals opened account - Internet betting service provider between Feb. 1 to 27, 2005	40,499	Web-based survey	Fixed-odds betting & Live-action betting	N/A
el-Guebaly et al., 2006[18]	5	4	**Wave 1** 13-15, 18-20, 23-25, 43-45, & 63-65	Males & Females	RDD	Wave 1 1808	Telephone & Face-to-face interviews	CPGI, CIDI Fisher DSM-IV-MR-J Attitudes & fallacies	Alcohol/drug use Smoking Psychopathology Health Executive functioning Intelligence Childhood trauma Child behavior Social organization Family support Social support Stressors

1. Winters et al. (1993, 1993, 1995, 2002, 2005);
2. Vitaro, Ladouceur, & Bujold (1996);
3. Vitaro et al. (1997, 1999, 2001, 2004) & Wanner et al (2006);
4. Cunningham-Williams et al. (1998, 2000, 2005) & Cottler et al. (2000);
5. Abbott, Williams, & Volberg (1999, 2004);
6. Barnes et al. (1999, 2002, 2005);
7. Jacques et al., 2000 & Jacques & Ladouceur, 2006
8. Shaffer & Hall (2002);
9. Slutske et al. (2003);
10. Wiebe, Single, & Falkowski-Ham, 2001, 2003 & Wiebe, Cox, Falkowski-Ham, 2003;
11. DeFuentes-Merillas, Koeter, Schippers, & van den Brink (2004);
12. Hodgins & el-Guebaly, 2004 & Hodgins, Peden, & Cassidy, 2005;
13. Vander Bilt et al. (2004);
14. Slutske et al. (2005);
15. Xian et al. (2006);
16. Ladouceur et al. (2007);
17. LaBrie et al. (2007);
18. el-Guebaly et al. (2006)

Table 2 Measures in the LLLP at Wave 1: Adolescent and Adult Participants

Constructs from Figure 1	Construct	Measure	Adolescents	Adults
Family History	History of Substance Abuse	Family History Questions	----	YES
Biological Risk	Demographics	Gender	YES	YES
	Executive Functioning	Wisconsin Card Sorting Task	YES	YES
Temperament/Personality	Temperament/Personality	NEO Personality Inventory	----	YES
Personality	Personality	Personality Assessment Inventory (PAI)	----	YES
Cognitive	Intelligence	Wechsler Abbreviated Scale of Intelligence (WASI)	YES	YES
	Gambling Fallacies	Gambling Fallacies Scale	YES	YES
Family Environment	Marital Status & Conflict	Marital Status & Kansas Marital Satisfaction Scale	----	YES
	Abuse Experiences	Childhood Trauma Questionnaire (CTQ)	YES	YES
	Family Support	Family Environment Scale	YES	YES
Extra-Familial Environment	Social Support	Lubben Social Network Scale (LSNS)	YES	YES
	Religiosity	Rohrbaugh Jessor Religiosity Scale (RJRS)	YES	YES
	Culture	York Ethnicity Scale	----	YES
	Social Organization	Buckner Neighborhood Cohesion Scale (2 questions only)	YES	YES
Stressors/Life Events	Life Events	Life Events Questionnaire	YES	YES
	Physical Health	SF-8 Health Survey or SF-10 Health Survey	YES	YES
	Physical Health	Statistics Canada Questions	YES	YES
Externalizing Problems	Alcohol, Substance, & Tobacco Use	Canadian Community Health Survey (CCHS)	YES	YES
	Delinquent Activity	Child Behavior Checklist (CBC)	YES	----
Internalizing Problems	Depression, Anxiety	Composite International Diagnostic Inventory (CIDI) – SF Personality Assessment Inventory (PAI)	----	YES
Demographics	Demographics	Religion, Age, Education, Occupation, Income, & Ethnicity	YES	YES
Gambling Involvement	Frequency, Expenditure, Type, Range, Context, Motivation, & Knowledge	Canadian Problem Gambling Index (CPGI)	YES	YES
	Type, Motivation, & Knowledge	Sydney & Laval Universities Gambling Screen	----	YES
	Attitude	Gambling Attitude Questionnaire	YES	YES
Gambling Disorders	Problem Gambling	Canadian Problem Gambling Index (CPGI) Composite International Diagnostic Inventory (CIDI)-GM	----	YES
Gambling Disorders	Problem Gambling	Fisher DSM-IV-MR-J	YES	----
Prevention & Treatment	Treatment	National Comorbidity Study Treatment	----	YES

Table 3 Measures in the LLLP at Wave 1: Source, Number of Items, and Subscales Used

Measure	Source	Number of Items & Subscales Used
Wisconsin Card Sorting Task (WCST)	Kongs et al., 2000	64-card computerized version
NEO Personality Inventory NEO-FFI & NEO PI-R	Costa & McCrae, 1992	140-items Neuroticism and Extraversion
Personality Assessment Inventory (PAI)	Morey, 1991	296-items Selected subscales
Wechsler Abbreviated Scale of Intelligence (WASI)	PsychCorp, 1999	Vocabulary & Matrix Reasoning subtests
Gambling Fallacies Scale	Williams, 2003; Williams et al., 2006	10-items
Marital Status & Kansas Marital Satisfaction Scale	Schumm et al., 1986	3-items
Childhood Trauma Questionnaire (CTQ)	Bernstein et al., 1997; Bernstein & Fink, 1998	28-items All 6 subscales included
Family Environment Scale (FES)	Moos & Moos, 2002	90-items, all l 3 subscales included
Lubben Social Network Scale (LSNS)	Lubben, 1988	10-items
Rohrbaugh Jessor Religiosity Scale (RJRS)	Rohrbaugh & Jessor, 1975	8-items
York Ethnicity Scale	Cameron, 2004	16-items 3 factor scale
Buckner Neighborhood Cohesion Scale	Buckner, 1988	Only 2 of original 18-items
Life Events Questionnaire	Vuchinich, Tucker, & Harllee, 1986	84-items for Adults 66-items for Adolescents
SF-8 Health Survey	Ware et al., 2001	8-item short form
SF-10 Health Survey	Ware et al., 2001	10-item short form
Statistics Canada Health Questions	Statistics Canada, 2002	2-items
Canadian Problem Gambling Index (CPGI)	Ferris & Wynne, 2001	Multiple items
Sydney & Laval Universities Gambling Screen	Blaszczynski, Ladouceur, & Moodie (in press)	23-items
Gambling Attitude Questionnaire	Azmier, 2000; Williams, 2003; Williams et al., 2006; ACCORD Research, 2000	16-items, 12-items, & 3-items
Religion, Age, Education, Occupation, Income, & Ethnicity	Statistics Canada, 2001	Multiple items
Canadian Community Health Survey (CCHS)	Statistics Canada, 2002	Smoking, substance, and alcohol use
Child Behavior Checklist (CBC)	Achenbach & Rescorla, 2001	Full questionnaire
Composite International Diagnostic Inventory (CIDI) – SF	Kessler, et al., 1998, WHO, 1997	Multiple items
Composite International Diagnostic Inventory (CIDI)-GM	CIDI-DSM-IV; APA, 1994	12-items
Fisher DSM-IV-MR-J	Fisher, 2000	9-items
National Comorbidity Study Treatment & Family History	Kessler et al., 1994	13-items

Table 4 The LLLP: Demographics

	Total Population Completes (N=1808)	
	N	%
Age		
13-15 Year Olds	436	24.1
18-20	315	17.4
23-25	341	18.9
43-45	403	22.3
63-65	313	17.3
Gender		
Male	837	46.3
Female	971	53.7
Location		
Calgary	754	41.7
Edmonton	536	29.6
Grande Prairie	224	12.4
Lethbridge	294	16.3
Marital Status (Adults Only)		
Single, Never Married	571	41.7
Married	516	37.7
Common-law	127	9.3
Divorced or Separated	123	9.0
Widowed	33	2.4
Level of Education		
Less than High School	549	30.4
Completed High School	279	15.4
Some Technical/College	203	11.2
Completed Tech/College	225	12.5
Some University	236	13.1
Bachelor's Degree	225	12.5
Master's or Professional Degree	90	5.0
Current Employment Status		
Not Currently Employed	746	41.3
Employed Part-Time	430	23.8
Employed Full-Time	631	34.9

Table 5 The LLLP: Problem Gambling Status (Age 18+)

	General Population				At-Risk Population	
	Not At-Risk (High Frequency)		At-Risk		At-Risk	
	Count	Col %	Count	Col %	Count	Col %
Non Gambler	265	38.4%	22	6.7%	23	6.5%
Non-Problem Gambler	348	50.4%	181	55.0%	199	56.1%
Low-Risk Gambler	63	9.1%	90	27.4%	78	22.0%
Moderate-Risk **or** Problem Gambler	14	2.0%	36	10.9%	55	15.5%