RELATIVE DEPRIVATION AND ITS RELATIONSHIP TO PROBLEM GAMBLING

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ABSTRACT

Personal relative deprivation (PRD) is the feeling of resentment one gets from perceived inequality or unfairness. This feeling is argued to be a precursor to risk-taking as well as a causal factor in the development of intensive gambling and problem gambling (PG). However, the evidence supporting the relationship between PG and PRD has been cross-sectional or laboratory based. The present research reinvestigated this relationship using a representative online sample of Canadian gamblers (n = 4,400, which included several hundred problem gamblers) followed over a one-year period (Baseline and Follow-Up). A series of multiple regressions endeavoured to determine PRD's causal relationship to PG, even though PRD was only administered at Follow-Up. The first multiple regression confirmed PRD to be one of the strongest cross-sectional predictors of problem gambling. However, the second cross-sectional multiple regression found no significant relationship between PRD and measures of gambling intensity (i.e., # formats engaged in; gambling frequency), which is theoretically problematic considering that intensive gambling involvement is the immediate antecedent to PG. The final multiple regression found that PG at Baseline was one of the strongest predictors of PRD at Follow-Up. Taken together, the present results suggest that the robust cross-sectional association between PG and PRD is in large part due to PG leading to PRD, rather than PRD leading to PG.

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Introduction

Low socioeconomic status and poverty are positively correlated to a wide variety of negative outcomes such as poor educational attainments, high rates of health problems, increased mortality across all age groups, higher rates of mental health problems, and higher rates of substance use disorder (Adler & Ostrove, 1999; Santiago et al., 2011; Van Oers et al., 1999). To a lesser extent, several researchers have found a correlation between low socioeconomic status and risk-taking behaviours such as homicide and other violent offending, risky sexual behaviour, gambling, and problem gambling (Birken et al., 2009; Lalumière, 2005; Williams et al., 2015). Why would low socioeconomic status be related to increased risk-taking? A simple answer would be that if someone is struggling to meet their basic needs, the potential benefits of risky behaviour (i.e., stealing to provide food and shelter for your family) might outweigh the potential costs (i.e., getting caught and going to jail). A more complex explanation is that absolute poverty (absolute economic deprivation) is not the driver of social problems and risk-taking, rather, it is economic *inequality* and personal *relative* deprivation (PRD) that drive such problems and behaviours (Daly, 2017; Smith et al., 2012).

PRD is the feeling of dissatisfaction or resentment that occurs when people observe others with more status or resources than themselves (for reviews, see Crosby, 1976; Smith, et al., 2012; Smith & Pettigrew, 2014). Smith et al. (2012) assert that there are three main components to PRD:

1. The individual who feels relatively deprived compares themself to someone else.
2. The individual who feels relatively deprived perceives that they are disadvantaged compared to relevant others.

3. The individual who feels relatively deprived believes the observed inequality to be unfair or unjust.

Therefore, PRD is a subjective feeling that is caused by perceived inequality or unfairness. Although objective deprivation within one's material surroundings may trigger these feelings, PRD is not objective deprivation or inequality in and of itself. At first glance it may seem irrational for feelings derived from observed inequality to result in risk-taking and general negative outcomes when the problems associated with poverty such as the inability to meet basic needs seem so much more obvious.

Human beings are social animals. Social comparisons and feelings of fairness and justice are important to people in the real world. Social comparisons are one way that people evaluate their social position, their success in life, and the level of fairness and justice in society and individual outcomes (Festinger, 1954). Fairness and justice are both important concepts that drive behaviour and satisfaction with life. For example, many people calculate their level of material success by comparing their material possessions to others. When they observe someone with many luxury items, they assume that person is more successful than they are (Frank, 2000). When people observe inequalities that they find unfair or unjust between themselves and others, they become dissatisfied or preoccupied with justice indicating that these feelings are natural and ubiquitous (Callan et al., 2008; Kim et al., 2017). Therefore, feelings of resentment derived from perceived disadvantage should affect behaviour. If someone feels unfairly treated or disrespected by their peers when compared to others, they may take risks in an attempt to remedy their situation (Smith et al., 2012).

Although some people will deal with their perceived disadvantage through a healthy avenue such as self-improvement, others suffer from mental or physical health problems and may engage

in self-destructive behaviours (Smith et al., 2012). Feelings of disadvantage can cause psychological stress and mood changes which mediate risk-taking (Mishra & Meadows, 2018). Social problems and risk-taking behaviours such as mental illness, poor health, violent crime, and gambling tend to occur at higher frequencies in populations in which economic inequality is high (Bol et al., 2014; Daly, 2017; Pickett & Wilkinson, 2010; Wilkinson & Pickett, 2006). Furthermore, feelings of personal relative derivation (PRD) are linked to impulsive and risky behaviours such as general antisociality (Mishra & Novakowski, 2016), violence (Daly, 2017), financial risk-taking (Frank, 2000; Mishra, et al., 2015), gambling (Callan et al., 2008), and problem gambling (Callan et al., 2008; Mishra & Novakowski, 2016).

Gambling is a high-risk avenue that people may take to change their disadvantaged situation if low-risk avenues are not perceived to be viable options. Several researchers have demonstrated that gambling and problem gambling are related to economic inequality and feelings of PRD. At the population level, Bol et al. (2014) demonstrated a positive correlation between economic inequality and lottery ticket sales and Canale et al. (2017) showed a relationship between economic inequality and problem gambling. At the individual level, self-reported PRD is positively correlated with gambling involvement (Mishra & Novakowski, 2016) and problem gambling (Callan et al., 2008; Mishra & Novakowski, 2016). Furthermore, manipulations of inequality and PRD in a laboratory setting can increase gambling urges (Callan et al., 2008) and financial risk-taking (Mishra et al., 2014; Mishra et al., 2015). In addition, some key predictors of problem gambling such as depression (Callan et al., 2015a), stress (Mishra & Meadows, 2018), and impulsivity (Callan et al., 2011; Mishra & Novakowski, 2016) have also been shown to be positively related to self-reported PRD.

Although PRD and problem gambling are correlated individually, previous studies do not show how well PRD predicts problem gambling when compared to other common predictors of

problem gambling or how other predictors of problem gambling may be related to PRD. Therefore, we do not know if PRD is a key predictor of problem gambling and if its individual relationship with problem gambling is significant or if PRD is just a proxy for predictors such as low socio-economic status (SES) or impulsivity. All prior studies have only investigated cross-sectional relationships between PRD and problem gambling (Callan et al., 2008; Mishra & Novakowski, 2016). Therefore, it is unknown if PRD precedes and is a cause of heavy gambling and by extension problem gambling, or, alternatively, whether PRD is more of a consequence of problem gambling.

The current research uses data (Baseline and Follow-Up) from the Alberta Gambling Research Institute National Project Online Panel Survey (ANP) which includes measures of PRD as well as problem gambling and all known predictors of problem gambling to address the causal relationship between PRD and problem gambling. PRD was only administered at Follow-Up. There were three research questions:

1. Is personal relative deprivation (PRD) a strong cross-sectional predictor of problem gambling relative to other known predictors? Although PRD is an individual predictor of problem gambling, its contribution to problem gambling in the context of other variables is unknown. How much of the variance in problem gambling can be explained by PRD while controlling for other known predictors of problem gambling?
2. Is PRD a strong cross-sectional predictor of measures of gambling intensity? Intensive gambling involvement is the final common pathway and immediate antecedent to problem gambling. Thus, if PRD is causally related to problem gambling it must also have at least as strong, if not stronger relationship to gambling intensity. If it does, how

much of the variance in gambling intensity can be explained by PRD when controlling for other known predictors of problem gambling?

3. What variables at Baseline predict PRD at Follow-Up? In particular, how strong is Baseline problem gambling in predicting future PRD? No studies have predicted PRD with this multitude of predictors in the same model, nor have any studies predicted PRD with a data set designed with all problem gambling predictors in mind. Therefore, this dataset provides the opportunity to investigate both what predicts PRD and PRD's relationship to problem gambling predictors in particular. If PRD is a causal predictor of problem gambling, there should be overlap between PRD and problem gambling predictors.

Literature Review

"Problem gambling is characterized by difficulties in limiting money and/or time spent on gambling which leads to adverse consequences for the gambler, others, or for the community." (Gambling Research Australia, 2005, p. 125). Problem gamblers experience many problems in their lives. For example, problem gamblers are more likely to have financial problems caused by their gambling such as debt and bankruptcy, experience divorce (Shannon et al., 2017), and suffer from physical and mental health problems (Affifi et al., 2010; Maccallum & Blaszczynski, 2003). Furthermore, they are also likely to suffer from a myriad of both physical and mental health problems. Problem gamblers are more likely to report bronchitis, fibromyalgia, migraines, suicide ideation, severe stress, and anxiety when compared to non-problem gamblers (Affifi et al., 2010).

Problem gambling can also cause problems for communities because a preoccupation with gambling can cause unemployment, lower productivity, and debt which can lead to theft and higher welfare costs (Thompson et al., 2000). Problem gambling and many of its causal factors such as gambling intensity, impulsivity, and mood disorders have been studied frequently in order to discover how to mitigate the consequences of problem gambling (el Guebaly et al., 2015; Williams et al., 2015). However, another potential cause of problem gambling is personal relative deprivation (PRD) which is correlated with problem gambling (Callan et al., 2008) and some of the predictors of problem gambling such as stress (Mishra & Meadows, 2018), and mood disorders (Callan et al., 2015a). Despite the growing body of literature on the relationship between PRD and problem gambling, there have been few attempts to integrate PRD into a causal model of problem gambling. Problem gambling is harmful to the individual, friends, family, and community. Therefore, understanding PRD's role in the etiology of problem

gambling could be helpful in developing better prevention strategies and treatments for problem gamblers.

The Relationship Between Economic Inequality, Relative Deprivation, and Gambling and Problem Gambling

Literature that investigates PRD often uses two kinds of measurements: objective and subjective. Objective measurements cannot measure feelings of resentment or dissatisfaction, but rather they measure inequality or relative disadvantage, a part of the theoretical construct of PRD. These measures include socio-economic measures such as income and education to infer disadvantage or overall economic inequality (Smith et al., 2012). The most common economic inequality measure is the Gini coefficient. The Gini coefficient was designed by Gini (1912) to measure wealth inequality within populations. The Gini coefficient ranges between 0 and 1. Zero indicates total equality and 1 indicates total inequality. So, if the Gini coefficient for a given population is 1, this would indicate that a single person has all of the resources, and the rest of the population has nothing.

The utility of using the Gini coefficient as a measure of PRD is that it allows investigation of population level effects of inequality. The Gini coefficient is used primarily in epidemiological research and is frequently correlated with social problems such as population health (Pickett & Wilkinson, 2010; Wilkinson & Pickett, 2006), and crime (Daly, 2017; Fajnzylber, et al., 2002). For example, countries with more inequality have higher rates of obesity, poorer health, and lower life expectancies (Wilkinson & Pickett, 2006). Violent crime in the form of homicides *per capita* is also strongly positively correlated with income inequality measured by the Gini coefficient (Daly, 2017). Daly (2017) argues that the correlations between economic inequality and social problems are caused by feelings of PRD. However, because the Gini coefficient does

not measure perceptions of inequality or feelings of resentment, it is difficult to confirm that objective inequality has the same effects or is measuring the same construct as feelings of subjective PRD.

Callan et al. (2008) argue that subjective measures of PRD are the best measurements for predicting risk-taking because they measure individual perceptions and feelings. PRD is a subjective feeling. Although unequal wealth distribution, theoretically, contributes to feeling of PRD at the individual level, it is unlikely to be the only contributing factor. Subjective measures of PRD include the Satisfaction with Life Scale (Ravallion & Lokshin, 2010) and the PRD Scale (Callan et al., 2008; 2011). The most commonly used and complete measurement is the PRD Scale. This measurement is particularly important because it measures perceptions of inequality as well as the feelings of resentment stemming from those perceptions which is necessary because not everyone notices inequality or perceives unequal conditions to be unfair (Callan et al., 2008; Ravallion & Lokshin, 2010; Smith et al., 2012).

Population Level Research

The two population studies that have investigated inequality and financial risk-taking have reported a relationship between Gini coefficient and gambling, problem gambling, and overspending. For example, Bol et al. (2014) conducted a study where they looked for relationships between the Gini coefficient and lottery ticket sales in the USA between the years of 1980 and 1997. American states with higher Gini coefficients had an increase in lottery ticket sales when compared to states with a lower Gini Coefficient. Furthermore, Bol et al. (2014) found when the Gini coefficient increased over time within states that lottery ticket sales also increased within those states. In a fixed regression model the Gini coefficient accounted for 83% of the variance in lottery ticket sales when controlling for general gambling trends over time. In a

study by Canale et al. (2017) that investigated the relationship between inequality and problem gambling, a problem gambling survey was administered in classrooms in 21 Italian regions/cities. Canale et al. (2017) found that higher regional Gini coefficients were positively correlated with rates of at-risk and problem gambling on the South Oaks Gambling Screen-Revised for Adolescents. Southern regions of Italy with higher rates of economic inequality, such as Sicily, contained as many as five times the number of at-risk/problem gamblers when compared to more equal regions such as Calle d'Aosta with unequal regions having rates as high as 11% and more equal regions having rates as low as 2%.

Unfortunately, few population studies have investigated gambling, problem gambling and their relationship to economic inequality. Also, all of the population level research is cross-sectional and causality cannot be established. However, experimental research can be used to create equal and unequal conditions in laboratory settings, thus allowing for causal inferences between inequality, PRD and gambling to be made.

Experimental Research

A consistent finding in experimental research is that inequality and disadvantage increase both risky financial decisions and gambling behaviour. However, most of these experiments are limited to studying some form of lottery, or financial choice tasks. Although the financial choice tasks are not gambling formats *per se*, gambling is "Staking money or something of material value on an event having an uncertain outcome in the hope of winning additional money and/or material goods" (Williams et al., 2017, p. 11). Therefore, financial risk-taking tasks that involve low or high-risk betting choices on an uncertain outcome are similar to what might be seen in some gambling formats.

Financial Risk-Taking Experiments. Mishra et al. (2015) conducted an experiment in which participants were given different amounts of cash before being asked to complete a financial risk-taking choice task. Two equal conditions included one in which 2 participants received $10 before completing the task and a second in which both participants received $0. In the unequal condition, one participant received $10, and the other participant received $0 before being asked to complete a choice task. The choice task involved making bets that were either low risk/low reward or high risk/high reward with the low risk guaranteeing $3 and the high risk resulting in the possibility of making more than $3 (or nothing). Participants who were given $0 in the unequal task were on average, more likely to make a risky financial choice (M = 2.95) than those who were given more in the same condition (M = 1.87). Participants who received $0 in the unequal condition also took more risks than those in both equal conditions which differed little.

In a similar study by Mishra et al. (2014) relative disadvantage was manipulated through intelligence scores. Participants were asked to complete a purported intelligence task where they were required to click on an icon on a computer screen while having their response times measured and scored. Participants were randomly assigned to three conditions in which they were told that their scores were above average (the unequal/competitively advantaged condition), below average (the unequal/competitively disadvantaged), and no feedback on their scores (the control condition). Those who were in the relatively disadvantaged state in the unequal condition were on average, almost twice as likely to make a risky choice on a financial choice task (M = 3.13) as compared to those in the advantaged condition (M = 1.56) and the relatively disadvantaged were also more likely to take risks than those in in the equal condition (M = 2.09).

Gambling Experiments. Payne et al. (2017) ran three gambling experiments that were similar to the financial choice tasks used by Mishra and colleagues (Mishra et al., 2014; Mishra et al., 2015). Their first experiment measured gambling through a low-risk/low-reward and high-

risk/high-reward betting task and the second and third experiments measured gambling by giving participants a choice between low-risk or high-risk lottery tickets. Inequality was manipulated by making participants aware of the wins of previous gamblers. In the equal condition previous wins from prior players differed little. In the unequal condition previous wins were scattered with some having won a lot of money and some winning little. Those who observed wins from previous gamblers that were very high on average, were slightly more likely to make high-risk decisions in a gambling task across experiments (M = 51) as compared to those in the low inequality condition (M = 44).

Haisley et al. (2008) investigated whether manipulating economic inequality could cause an increase in lottery ticket purchases. Low-income participants were paid $5 to fill out a survey. The demographics question on yearly income was framed to make participants believe either that their income was below average (making them relatively disadvantaged compared to others) or average when compared to others After completing the survey, participants were given the option to purchase lottery tickets. Those in the relatively disadvantaged condition bought nearly twice as many lottery tickets (M = 1.28) compared to those who were not disadvantaged (M = 0.67).

Manipulating inequality in an experimental setting consistently increases financial risk-taking and gambling across studies. However, most of these studies fail to measure PRD, so it is unknown whether or not it is the subjective feelings of relative deprivation caused by the inequality that is driving behaviour. To test whether subjective relative deprivation influences gambling behaviour, subjective feelings of inequality need to be measured.

Studies Using the Personal Relative Deprivation Measure

Several studies have been run using Callan's PRD measure (Callan et al., 2008; Callan et al., 2011; Mishra & Novakowski, 2016). Using the PRD scale, Callan et al. (2008) ran several

studies on university students. Their first study, a survey administered to university student participants measured feelings of PRD as well as gambling urges and problem gambling tendencies. The PRD scores were positively but weakly correlated to both gambling urges ($r = .22$, $p < .01$) and problem gambling ($r = .24$, $p < .01$). Callan et al. (2008) also ran an experiment to investigate if they could influence feelings of PRD and gambling behaviour through manipulations of inequality. Inequality was manipulated by having participants complete the normative discretionary income index (NDI) which is used to calculate monthly discretionary income. Participants were then asked to compare their NDI to others to make them believe they had more or less than others. Those in the relatively deprived condition who were made to believe they had less than others scored higher on the PRD scale and were more likely to engage in a gambling task when given the choice to gamble or abstain. In the relatively deprived condition, 88% of participants chose to gamble while only 60% of participants in the non-relatively deprived condition chose to gamble.

Problem gambling is associated with trait impulsivity and/or general risk-taking behaviours (Blaszczynski & Nower, 2002; Williams et al., 2015). A couple of studies have argued that feelings of PRD cause people to gain a preference for risk-taking (Callan et al., 2008; Callan et al., 2011), and this preference for risk-taking causes gambling and problem gambling (Callan, et al., 2011; Mishra & Novakowski, 2016). Mishra and Novakowski (2016) have shown that PRD is positively related to trait impulsivity. One of the avenues of studying the preference towards risk-taking and gambling is through delay discounting which can be defined as a preference for short-term rewards over long-term investments/rewards (Callan et al., 2011; Mishra & Novakowski, 2016). People who strongly discount delays (that is, prefer smaller immediate rewards to larger future rewards) are impulsive, do not delay gratification, and are more likely to be problem gamblers (Callan et al., 2011). Callan, et al. (2011) conducted 4 studies

to investigate the relationship between gambling, PRD, and delay discounting. Their first experiment manipulated relative deprivation in a similar manner as Callan et al. (2008) by having students compare their discretionary income to others before filling out a delay discounting questionnaire that asked questions concerning a preference for short-term rewards. In their measure, a smaller score indicates more delay discounting. They found that on average, those in the relatively deprived condition reported a smaller score in delay discounting ($M = 0.5$, $SD = 0.3$) when compared to those in the non-relatively deprived condition ($M = 0.66$, $SD = 0.24$), indicating that the relatively deprived participants preferred immediate gratification. The second and third experiments measured delay discounting among participants before giving them the option to buy lottery tickets. Those who showed a preference for short-term rewards purchased more lottery tickets than those who could better delay gratification. The delay discounting measure and lottery ticket purchases had a moderate negative correlation ($r = -.5$, $p < .001$). In their fourth experiment, a general community sample was surveyed for PRD, delay discounting and gambling urges and a mediation analysis was conducted. Delay discounting mediated feelings of PRD and gambling urges. These studies indicate that PRD can cause a preference for immediate gratification (via delay discounting) as opposed to working for or waiting for delayed rewards and gambling may be one way to seek such immediate rewards.

A survey of a convenience sample by Mishra and Novakowski (2016) reported results from a bivariate correlational study that strengthen the above findings. Self-reports of PRD were individually positively correlated to impulsivity ($r = .30$, $p < .001$), future discounting ($r = .25$, $p < .001$), gambling involvement ($r = .14$, $p < .01$), and problem gambling ($r = .25$, $p < .001$). These studies indicate that when people feel relatively deprived, they may neglect to plan for future rewards and instead turn to gambling to reap immediate rewards.

PRD may be one of the many predictors of problem gambling. Objective measures of disadvantage like the Gini coefficient are positively correlated to increased gambling on lottery tickets and problem gambling. Experimentally manipulating inequality leads to increased risk-taking in financial choice tasks and gambling tasks. Furthermore, subjective feelings of PRD are positively correlated to problem gambling. However, these studies are limited in number and are mostly correlational and laboratory based. Furthermore, the correlations between PRD and problem gambling are not strong (in the .2 range). However, past results are still consistent with the argument that PRD is a causal (although possibly small) factor of problem gambling. However, the importance of PRD when compared to the many well-established predictors of problem gambling is still unknown. To understand the role that PRD plays in problem gambling, it is necessary to be aware of the established predictors of problem gambling and why they drive people to gamble.

Predictors of Problem Gambling

Epidemiological studies show a wealth of information on what causes problem gambling. The literature confirms that problem gamblers frequently have low socio-economic status, suffer from addictions, mental health problems, personality disorders, and are heavy gamblers. Below, the predictors will be discussed individually.

Demographics

The epidemiological literature has studied multiple demographic variables and their relation to problem gambling such as age, gender, and socioeconomic status (SES) indicators. Some predictors such as age (young) and gender (male) are associated with impulsivity. Other predictors, such as education and income, are SES indicators that are indicative of fewer resources, and lower status.

Young age is consistently reported as a correlate of gambling intensity and problem gambling (Williams, Volberg & Stevens, 2012; Williams & Volberg, 2013). A general population survey done in Sweden known as the Sweden Longitudinal Gambling Study (SWELOGS) reported that those within the ages of 15-24 were more than twice as likely to be at risk of becoming lifetime problem gamblers with a 151% higher risk when compared with those who were 25 or older (Volberg et al., 2001). However, young age is not always predictive of problem gambling longitudinally (Welte et al., 2011; Williams et al., 2015). It is likely that young age is related to risk-taking in general and is a proxy of impulsivity (Allami et al., 2021) but alone, does not necessarily result in problem gambling. However, young age could lead to problem gambling through its relationship with gambling intensity because, young people (especially males) tend to be more impulsive and take higher risks when they gamble when compared to older people and may spend more money and time on it (Williams et al., 2015).

Sex and gender are frequently studied as predictors of problem gambling (Abbott, et al., 2018; Blanco et al., 2006; el Guebaly et al., 2015; Merkouris et al., 2016; Williams et al., 2012; Williams et al., 2015) as well as gambling intensity (Williams & Volberg, 2013). Although some mixed results have been reported (Merkouris et al., 2016; Williams et al., 2015), males generally outnumber females as problem gamblers by as much as 2 to 1 (Abbott et al., 2015; Blanco et al., 2006; el Guebaly et al., 2015; Volberg et al., 2012; Williams & Volberg, 2013). The mixed results could be due to males being generally more impulsive than females (Allami et al., 2021) because the relationship between being male and being a problem gambler is consistent with the evidence that males are also more likely to engage in risk-taking activities in general (Brynes, Miller & Schafer, 1999; Daly, 2017; Williams et al., 2015). Although males become problem gamblers more often than females, both may have different pathways to becoming problem gamblers. A review by Merkouris et al. (2016) reported that male problem gamblers tend to be

impulsive and suffer from substance abuse while female problem gamblers tend to suffer from emotional distress and a history of child abuse.

Several researchers have reported that marital status is often related to problem gambling, especially amongst older populations when divorced, separated, or widowed (Afifi et al., 2010; Botterill et al., 2016; Elton-Marshall et al., 2018). Although in the cases of young single problem gamblers, the relationship between being single and a problem gambler could also be a proxy of being young and impulsive (Allami et al., 2021). A general population survey investigating the prevalence of problem gambling in Sweden reported that 53.9% of lifetime problem and pathological gamblers were unmarried compared to around a third (or 32.5%) of non-problem gamblers (Volberg, et al., 2001).

Educational attainment is another common predictor of problem gambling (Williams et al., 2012). Those with lower education levels are more likely to become problem gamblers. (Arge, & Kristjansson, 2015; Volberg et al., 2001; Wu et al., 2014). For example, a study by Volberg et al., 2001) reported that people with a university education are less likely to become problem gamblers than those without a university education with fewer than a fifth or 15.8% of problem gamblers having a university education and over three quarters (84.3%) of problem gamblers not having a university education. Similarly, another population study analysis reported that having a graduate degree was predictive of not being a problem gambler (Williams et al., 2021). Although having low educational attainment could also be representative of being young and therefore, more impulsive (Allami et al., 2021), educational attainment could also be representative of status.

Unemployment is often weakly associated with problem gambling (Allami et al., 2021; Williams et al., 2012). Volberg et al. (2001) reported that, among a general population,

unemployed people were more likely to be problem gamblers than those who were employed. This variable is possibly representative of status and resources.

Those who are economically disadvantaged and receive low incomes are more likely to become problem gamblers (Volberg et al., 2001; Welte et al., 2006). A general population study using Canadian Community Health Survey (CCHS) data conducted by Williams et al. (2021) reported that there was a negative correlation between household income and problem gambling indicating that the lower one's income, the more likely they are to be a problem gambler. The highest rates of problem gambling were in the $40,000-$80,000 and the lowest were in the >$150,000 income range with 2.2% of people in the $40,000-$80,000 range being problem gamblers and only 0.2% of people in the >$150,000 range being problem gamblers.

Several researchers have reported that debt and bankruptcy are correlates of gambling and problem gambling (Grant et al., 2010; Swanton et al., 2019; Swanton & Gainsbury, 2020a; Swanton & Gainsbury, 2020b) with problem gamblers being at least two times more likely to go bankrupt than non-problem gamblers (Allami et al., 2021). This relationship likely exists because problem gambling can cause debt. However, debt may also be a cause of problem gambling in the situations where someone tries to get out of debt by gambling to win money (Allami et al., 2021)

Alcohol and Tobacco Use

The substances that are most frequently associated with problem gambling throughout the literature are alcohol and tobacco. Frequent or disordered alcohol use is often positively related to problem gambling (Grant et al., 2002). One survey reported that problem gamblers are 23 times more likely to have alcohol dependence than non-problem gamblers (Welte et al., 2001). This relationship could be due to alcohol increasing the chances of making risky bets for some

gamblers (Ellery et al., 2005) or because problem gamblers and alcoholics are both vulnerable to addictions (Williams et al., 2015). Tobacco use is often one of the most powerful comorbid variables with problem gambling according to Williams et al. (2015). A meta-analysis by Lorains et al. (2011) discovered that nicotine use was prevalent in over half (60.1%) of problem gamblers.

Mental Health

Problem gamblers frequently suffer from co-morbid mental health disorders such as substance use disorder (SUD), depression, and anxiety. This relationship is found among both treatment seeking and general populations.

Problem gamblers frequently suffer from other addictions as well as gambling and therefore, often engage in substance use at a higher frequency than non-problem gamblers (Williams et al., 2015; Williams et al., 2021; el-Guebaly et al., 2015). Substance use disorders are commonly found among problem gamblers (el-Guebaly et al., 2015; Grant et al., 2002; Lorains et al., 2011; Williams et al., 2015). A meta-analysis by Lorains et al. (2011) reported that over half (57.7%) of problem gamblers have comorbid substance use disorders. The relationship between substance use disorders and problem gambling could be due to both disorders sharing a similar genetic component (Grant et al., 2002).

Depression has been reported to be strongly related to problem gambling in multiple studies, both in general, and in treatment seeking populations. Quigley et al. (2015) studied a sample of 105 problem gamblers from the Leisure, Lifestyle, and Lifecycle Project (LLLP). They found that nearly a third (32.4%) of problem gamblers also suffered from major depression. Recreational gamblers did not have high levels of depression (Quigley et al., 2015). Similar relationships between problem gambling and depression have been found in other studies. For

example, Kessler et al. (2008) reported that depression, anxiety, and panic disorder were predictors of problem gambling with panic disorder being the strongest predictor. However, in the Quinte longitudinal study (a longitudinal survey study conducted in Ontario, Canada designed to study problem gambling and its etiology), depression was the strongest mental health predictor of problem gambling (Williams et al., 2015). Depression has also been reported as one of the strongest mood disorder predictors of problem gambling in treatment seeking samples. A treatment-seeking study by Petry (2005) reported a range of 33.3%-76.0% of problem gamblers having the disorder. A meta-analysis by Lorains et al. (2011) found major depressive disorder in nearly a quarter (23%) of problem gamblers in a general population. Blaszczynski and Nower (2002) have argued that people suffering from depression may turn to gambling in an attempt to escape their emotional problems leading to gambling problems.

Several researchers have reported that anxiety is related to problem gambling (Kessler et al., 2008; Lorains et al., 2011; Petry, 2005). Kessler et al. (2008) reported anxiety to be an even stronger predictor of problem gambling than depression. Petry (2005) conducted a treatment-seeking meta-analysis and found anxiety to be a strong predictor of problem gambling with 7.2%-40.0% of problem gamblers suffering from anxiety. A meta-analysis using studies of a general population by Lorains et al. (2011) discovered that general anxiety disorder was an important comorbid predictor with prevalence in around 1 in 10 problem gamblers (11.1%). People with anxiety may attempt to escape their emotional turmoil by gambling and eventually become problem gamblers (Blaszczynski & Nower, 2002).

Stress and Causes of Stress

High levels of stress are common among problem gamblers (Blaszczynski & Nower, 2002; Ronzitti et al., 2018). Some research has proposed that stress may be both a cause and

consequence of gambling (Buchanan et al., 2020; Russell et al., 2021). Some people turn to gambling to escape feelings of stress and problem gamblers will often experience stress after problem gambling negatively affects their lives. Therefore, the number of stressful life events can increase someone's likelihood of becoming a problem gambler (Turner et al., 2006; Williams et al., 2015) or increasing their gambling behaviours (Reith & Dobbie, 2013). Russell et al. (2021) reported that some of the common stressful life events that precede problem gambling are issues with work, finances, the law, personal relationships, and the death of a loved one. Negative life events can lead people to become problem gamblers by causing stress and emotional problems (especially if the people in question have poor coping abilities (Blaszczynski & Nower, 2002)).

Child abuse is another negative life event that has been a predictor of problem gambling in several studies (Hodgins et al., 2010; Petry & Steinberg, 2005; Williams et al., 2015). History of child abuse is a predictor among general samples (Hodgins et al., 2010) and treatment seeking samples (Petry & Steinberg, 2005). Hodgins et al. (2010) reported a small yet significant relationship with problem gamblers consistently reporting various forms of childhood maltreatment (emotional, physical, sexual) more than those who are not problem gamblers. Negative family backgrounds could also lead to emotional problems that one may try to escape through gambling (Blaszczynski & Nower, 2002).

Personality

Apart from mental disorders, problem gamblers also tend to be impulsive and antisocial. Impulsivity is a consistent and strong predictor of problem gambling (Bagby et al., 2007; Hodgins et al., 2012; Williams et al., 2015; Williams et al., 2022). A large portion of problem gamblers have antisocial personality disorder and tend to live out a generally impulsive and destructive lifestyle. According to a meta-analysis conducted by Lorains et al. (2011) over a

quarter (28.8%) of problem gamblers have antisocial personality disorder compared to the general population (less than 4.0%). This subgroup of gamblers frequently engages in criminal behaviour and drug abuse (Blaszczynski & Nower, 2002). According to Mishra et al. (2011) the relationship between antisociality and problem gambling could be due to a general acceptance and/or preference for risky behaviour.

Environmental Exposure

For someone to become a problem gambler, they first need to be exposed to the activity. Frequent sources of exposure often happen through easy availability of gambling opportunities, and peer influences. Friends or family who gamble can create an environment where gambling is perceived as acceptable. However, this exposure to gambling can lead to a habit that can become problem gambling.

Gambling availability has frequently been studied and reported as a predictor of problem gambling and is usually measured by distance to gambling venues such as casinos (St-Pierre et al., 2014; Welte et al., 2004). Welte et al. (2004) reported that rates of problem and pathological gamblers nearly double with a 90% increase in problem gamblers in geographic locations where there is a casino within ten miles. This relationship could be indicative of gambling opportunities increasing the likelihood of gambling and becoming problem gamblers. However, it is also possible that gambling venues attract people who are already problem gamblers (Welte et al., 2004).

Family history of problem gambling is a common predictor of problem gambling (Reith & Dobbie, 2011; Walters, 2001; Williams et al., 2015). This relationship is likely due to both environmental and genetic factors. For example, parents may expose their children to gambling influencing their chances of becoming problem gamblers (Reith & Dobbie, 2011). Also, family

members gambling could be evidence of a genetic component as genetic studies have found relationships between heritability and problem gambling (Slutzke, et al., 2010; Walters, 2001). Slutzke et al. (2010) discovered, through a twin study, that heritability accounted for close to half (49.2%) of the variance in problem gamblers.

Peers who gamble are a potential environmental influencer of problem gambling. Several studies have found relationships between peer gambling and problem gambling or gambling involvement (Delfabbro & Thrupp, 2003; Donati et al., 2013; Yip et al., 2017) Among adolescents, gamblers are more likely to have peers or family who gamble and have a positive attitude towards gambling (Delfabbro & Thrupp, 2003) making this variable important for behaviourally conditioning someone into gambling and problem gambling (Blaszczynski & Nower, 2002).

Problem Gambling Motivations

Problem gamblers often have common motivations to gamble and experience similar cognitive distortions. Some problem gamblers want to win money and believe that gambling can accomplish this goal. Others gamble to escape the stress of their daily lives.

Gambling motivations have been researched in several problem gambling studies with "to escape" being one of the most common motivations (Ledgerwood & Petry, 2006; Nower & Blaszczynski, 2010; Williams et al., 2015). This common motivation indicates that a large portion of gamblers gamble for emotional reasons rather than to make a profit (Blaszczynski & Nower, 2002; Flack & Morris, 2015). However, some problem gamblers do perceive money as important and report that they are trying to increase it (Blaszczynski & Nower, 2010; Nower & Blaszczynski, 2010).

Cognitive distortions such as the hot hand fallacy (i.e., if you won, you will keep winning) are often found among problem gamblers (Goodie & Fortune, 2013). A meta-analysis by Goodie and Fortune (2013) found that problem gamblers often do have fallacious beliefs. Multiple other studies, some being longitudinal, have also reported gambling fallacies to be a predictor of problem gambling (Leonard & Williams, 2016; Leonard et al., 2021; Williams et al., 2015; Yakovenko et al., 2016). However, when other predictors such as impulsivity, and gambling intensity are controlled for, the relationship between gambling fallacies and problem gambling is greatly diminished indicating that fallacies are not a main cause (Leonard & Williams, 2016).

Gambling Intensity

Gambling-related variables indicative of heavy gambling/gambling intensity, such as number of formats engaged in and gambling frequency, are the strongest predictors that precede problem gambling (Blaszczynski & Nower, 2002; Williams et al., 2015; Williams et al., 2022). Multiple studies have reported that number of formats is predictive of problem gambling (Binde, et al., 2017; el-Guebaly et al., 2015; Mazar et al., 2020; Williams et al., 2015). Number of formats and problem gambling have a moderate positive correlation of $r = .39$ ($p < .05$) (Mazar et al., 2020). Number of formats is also positively related to frequency ($r = .40$, $p < .05$) (Mazar et al., 2020). Multiple studies have reported that frequency is a very strong predictor of problem gambling (el-Guebaly et al., 2015; Holtgraves, 2009; Williams & Volberg, 2010; Williams et al., 2015; Williams et al., 2022). A study by Williams and Volberg (2010) reported that gambling frequency has a strong relationship with the problem and pathological gambling measure with a correlation of $r = .707$ ($p < .001$).

Although the variables that cause and are correlated to problem gambling are well known, no one variable is the main cause (Williams et al., 2015). There are, however, a few common themes. For example, many problem gamblers come from a low SES background, as indicated by the demographic predictors. Many problem gamblers are impulsive and engage in other impulsive behaviours such as drug abuse and criminal behaviour. And many problem gamblers suffer from mental disorders and extreme stress.

Personal Relative Deprivation's Relationship with Predictors of Problem Gambling

PRD could be an important causal variable in problem gambling because of its relationship to many of the gambling variables and by extension, their pathways to problem gambling. PRD, inequality, and problem gambling are related to many of the same physical problems associated with stress, such as fibromyalgia, and mental health problems, such as depression, within population studies and surveys (Affifi et al., 2010; Mishra & Carleton et al, 2015).

Health

A literature review by Wilkinson and Pickett (2006) analyzed 128 papers on economic inequality and health and social problems. Only 6% (23) of the articles reviewed did not find evidence supporting the negative societal effects of economic inequality. Therefore, Wilkinson and Pickett (2006) concluded that economic inequality is frequently associated with health problems such as lower life expectancy rates and obesity. However, these studies run into the same problem as the population studies that test for the relationship between economic inequality and gambling. They do not include subjective measurements of PRD that can be used to make strong causal inferences about PRD because population inequality research does not confirm if

actual feelings of PRD are involved in these relationships. Fortunately, some research exists that does investigate the relationship between subjective feelings of PRD and health problems.

The research measuring subjective feelings investigating the link between relative deprivation and health problems is generally accomplished using surveys. For example, Mishra and Carleton (2015) conducted a survey using a convenience sample that measured PRD, general health, and mental health (measured with the Mental Health Inventory (MHI-5)). In multiple regression models that included PRD and SES variables, they reported that PRD was positively related to self-reports of both mental health (accounting for 7% of the variance) and general physical health (accounting for up to 5% of the variance). However, specific physical health problems were not measured.

Beshai et al. (2017) did look for relationships between PRD and specific physical health problems using a general community survey. The survey included PRD, the Depression Anxiety Stress Scale (DASS-21), the Revised Fibromyalgia Impact Questionnaire (FIQR), and the Gastro-Questionnaire. Results reported that PRD was positively correlated to both fibromyalgia ($r = .30$, $p < .001$) and gastrointestinal problems ($r = .19$, $p < .001$).

Some researchers have argued that the cause of many of the physical health problems associated with PRD and economic inequality are the mediating mental health problems because stress and mental illness can result in physical illness (Beshai et al., 2017; Pickett & Wilkinson, 2015).

Mental Health

If PRD plays a role in the formation of problem gambling, there should be a relationship between PRD and many of the same co-morbid mental health predictors of problem gambling such as depression, anxiety, and stress. Population and survey research has reported that PRD and

economic inequality are related to mental health problems. These problems include stress, and mood disorders.

Using data from the World Health Organization (WHO), Pickett and Wilkinson (2010) discovered that even among rich countries, there is a strong positive correlation between income inequality and mental illness ($r = .73$, $p < .01$). Countries with the most economic inequality contained higher rates of mental illnesses such as mood disorders, high impulsivity, and anxiety. The United States had the highest economic inequality and the highest rate of mental disorders with over 1/4 people suffering from mental illness while more economically equal countries such as Japan had the lowest rates with fewer than 1/10 suffering from mental illness.

Research using the subjective measure of PRD has reported a similar pattern with PRD having a positive relationship with mental health problems. Callan et al. (2015a) completed six studies where online surveys were administered via Mechanical Turk measuring subjective PRD, stress, depression, and physical health. PRD was positively correlated to depression ($r = .38$, $p < .01$) and PRD was the best predictor of stress and depression in a multiple regression model even when controlled for by objective measures of socio-economic status such as income and educational attainment.

Subjective measures of PRD are also reported to be related to general anxiety disorder (GAD). Nadler et al. (2020) reported that PRD and GAD were positively correlated across two online surveys. The first study was a secondary analysis of data gathered through Crowdflower for a study by Beshai et al. (2017) that contained measures for PRD and GAD. The relationship between PRD and GAD was confirmed by the second online survey administered through Prolific Academic which found a positive correlation between PRD and GAD ($r = .37$ $p < .001$). Both studies also reported that negative beliefs about worry, and intolerance of uncertainty mediated PRD and GAD indicating that PRD causes negative thoughts that lead to anxiety.

The PRD and health research indicates that feelings of PRD can cause mental health problems that lead to physical health problems. Some problem gamblers gamble to escape their negative feelings stemming from stress and disadvantaged backgrounds (Blaszczynski & Nower, 2002). Therefore, it is possible that their disadvantages cause them to feel relatively deprived. These feelings of PRD could then cause stress, depression, and anxiety.

Antisocial Behaviours

As with problem gamblers, some PRD research has also found a link between PRD, inequality, and antisociality throughout population and survey research. Among the population research, the objective disadvantaged component of PRD is measured with economic inequality (usually using the Gini coefficient) and antisociality is measured with violent crime such as homicides. Survey research on the other hand measures self-reports of PRD, impulsivity, and antisociality.

The link between violent crime and economic inequality has been studied by several researchers (Daly, 2017; Fajnzylber et al., 2002) both within countries (Daly, 2017) and between countries (Fajnzylber et al., 2002). Fajnzylber et al. (2002) found that between countries, economic inequality was correlated with homicide rates among a sample of 37 countries. The same relationship has been reported within countries, usually between states. For example, among American states the Gini coefficient and homicide rates are strongly correlated ($r = .73$, $p < .05$) with the states with the highest rates of economic inequality also having the highest rates of homicides per capita (Daly, 2017). If the same analysis is run replacing the Gini coefficient with average household income the relationship becomes much weaker showing that poverty is not the primary reason for this form of risk-taking. More interesting is the fact that economic inequality is also related to homicide in Canada even though the poorest provinces are the most

economically equal and the richest are the most unequal further indicating that poverty is not the cause of the relationship.

Odgers et al. (2015) used data from the Environmental Risk (E-Risk) Longitudinal survey to investigate the relationship between antisocial behaviours among children and inequality. The survey contained data on child antisocial behaviours such as lying, cheating, and violence gathered from teachers and parents as well as neighborhood data on inequality. They reported that male children from poor families who lived next to wealthy neighbors were more likely to exhibit antisocial behaviours than poor children who lived in poor neighborhoods.

The positive relationship between PRD and antisociality has also been demonstrated in survey research using the subjective measurement of PRD. In a convenience community sample survey by Mishra and Novakowski (2016) data of feelings of PRD, impulsivity, antisocial behaviour (measured with the Self-Report Early Delinquency Instrument), and criminal outcomes (measured with self-reports of arrests, charges, and convictions) were gathered. PRD was reported to be positively correlated to impulsivity ($r = .30$, $p < .001$), and antisocial behaviours ($r = .16$, $p < .01$). Those who reported criminal outcomes were also slightly more likely to report higher scores of PRD. These relationships indicate that impulsive antisocial people also tend to feel relatively deprived.

Demographic Indicators of Status and Personal Relative Deprivation

Many of the demographic predictors of problem gambling such as low levels of education and income are indicators of low SES and status which are important factors in the formation of feelings of PRD; those with low status may be more likely to feel relatively deprived. Some of these demographic predictors of problem gambling have been reported to be related to PRD.

Callan et al. (2015b) investigated the relationship between age and PRD in both a secondary analysis of survey data and a Mechanical Turk survey that they designed to confirm their results that measured PRD, age, and social comparison tendencies. Both studies confirmed that younger people are more likely to compare themselves to others and feel more relatively deprived than older people even when SES variables such as income are controlled for. A mediation analysis found that social comparison tendencies mediated the relationship between age and PRD.

There is also evidence that objective measures of socio-economic status predict PRD. Both Callan et al. (2015a) and Mishra and Meadows (2018) used objective SES measures as control variables in their PRD surveys. Callan et al. (2015a) reported that income and education were negatively correlated with PRD with income correlated at $r = -.32$ ($p < .01$) and education level correlated at $r = -.15$ ($p < .01$) indicating that lower incomes and education levels have a mild relationship with feelings of PRD. Mishra and Meadows (2018) reported that PRD was mildly negatively correlated with age ($r = -.22$, $p < .001$), educational attainment ($r = -.13$, $p < .002$), income ($r = -.25$, $p < .001$), and household income ($r = -.25$, $p < .001$), and that those who were single and unemployed reported higher feelings of PRD indicating that relatively deprived people are more likely to be young, single, low in education, low in income, and unemployed.

Based on PRD's individual correlations to indicators of economic disadvantage and the theory that relative deprivation is caused by observing inequality in status and resources, variables indicative of low SES would likely precede feelings of PRD. These feelings of PRD may, in turn, lead to problem gambling.

Mediators between Personal Relative Deprivation and Problem Gambling

Some researchers have argued that PRD causes actions such as gambling through mediating factors. For example, though not a gambling study, Osborne et al., (2012) conducted a survey on university employees who suffered pay cuts in order to create a model explaining the pathways in which PRD leads to different behaviours. They discovered that relatively deprived employees who felt anger were more likely to voice their concerns while relatively deprived employees who reported feeling sad were more likely to neglect their duties. Essentially their model describes relative deprivation as a feeling that is caused by environmental factors (such as the pay cut). The feelings of PRD then lead to mood changes such as anger or sadness. These mood changes result in different reactions such as voice or neglect.

Mishra and Meadows (2018) conducted a study to investigate stress as a mediator between feelings of PRD and problem gambling. The online survey was administered through Mechanical Turk and measured subjective feelings of PRD, stress, and problem gambling tendencies (PGSI). The reported mediation model did show that stress had a significant mediating effect.

If PRD is resentment from observed inequality, then it would make sense that one may turn to gambling to increase their wealth as a solution to their perceived disadvantage. Tabri et al. (2015) administered an online survey through Mechanical Turk to investigate the relationship between PRD and gambling motivations (the most important being to increase wealth). The survey included gambling motivations, PRD, the PGSI (to measure problem gambling), and a questionnaire on perceived economic mobility. Participants who felt relatively deprived were more likely to be problem gamblers if they perceived their economic mobility to be poor. Tabri et al. (2015) also make the argument that PRD could cause someone to gamble as a way of trying to escape their negative feelings. However, no evidence for this pathway was reported in their study.

PRD likely causes stress, mood, and motivational changes that can lead to problem gambling. Gambling may serve as a distraction in which someone can escape negative moods and stress. However, it is also possible that someone who feels relatively deprived because they lack resources when compared to others may believe that winning money through gambling could raise their resource level.

Hypotheses

PRD is a potential causal factor for both gambling and problem gambling. PRD can cause gambling urges and the desire for immediate rewards (via future discounting) which can lead to gambling and problem gambling. PRD also has a close relationship with many of the predictors that cause problem gambling such as low SES indicators, mood disorders, and some gambling motivations. Based on the evidence provided, PRD may be a key predictor in the etiology of problem gambling.

However, few studies have investigated the strength the contribution that PRD makes as a predictor of problem gambling in the context of other predictors of problem gambling. To investigate the relationship between PRD and problem gambling I constructed 3 hypotheses.

1. PRD has been shown to be a causal factor in stress, mental health problems, and risk-taking; all factors causally associated with problem gambling. Therefore, **it is likely that PRD plays an important and possibly causal role in the formation of problem gambling**. Unfortunately, no studies have investigated the strength of the relationship between PRD and problem gambling categories when PRD is added to a model containing other known predictors of problem gambling. If PRD is a strong predictor of problem gambling, then PRD will remain in the regression model and account for a relatively large proportion of the variance in problem gambling as measured by the

Problem and Pathological Gambling Measure (PPGM).

2. Gambling intensity is a common precursor to problem gambling. People who engage in a high frequency of gambling on multiple formats are more likely to become problem gamblers in the subsequent year (Williams et al., 2015; Welte et al., 2009). Therefore, **If PRD is a causal factor of problem gambling, then it should also be a cause of increased gambling behaviour/intensity.** Unfortunately, no studies have investigated the strength of the relationship between PRD and gambling intensity when PRD is added to a model containing other known predictors of problem gambling. If PRD is a causal predictor of problem gambling, then PRD should also be positively correlated to variables that are predictive of and precede problem gambling. Furthermore, PRD should remain in the regression models and account for a relatively large proportion of the variance in predicting gambling intensity as measured by number of formats and maximum frequency.
3. Many of the predictors of problem gambling are indicators of status such as marital status, household income, and educational attainment (Williams et al., 2015). Both PRD and problem gambling also share relationships with stress and negative moods. **Therefore, PRD could play a causal role in, or be caused by, the factors that lead to problem gambling such as low status and high stress levels.** If PRD is caused by observing status differences and is related to negative moods, then variables that are theoretically indicative of lower status and negative moods should be positively related to PRD. These theoretical relationships would indicate that there is significant overlap between predictors of PRD and problem gambling. Overlap between PRD and common predictors of problem gambling would be a strong indicator that PRD plays an important role in problem gambling and that PRD may be a better measure for predicting problem

gambling than other common predictors. Therefore, predictors of problem gambling should also be predictors of PRD in a multiple regression model.

Methods

Survey

The data set for this secondary analysis came from the Alberta Gambling Research Institute National Project Online Panel Survey (ANP Online Panel Survey). The purpose of the project was to collect data on gamblers and problem gamblers in Canada to gain a greater understanding of prevalence rates and problem gambling etiology (Williams et al., 2019). This longitudinal data set contains data from consecutive years. Baseline data were collected from August-October 2018. Follow-Up data were collected from August-September 2019. Baseline contains 10,199 respondents. Follow-Up contains 4,707 respondents. The survey questions were kept consistent across waves with the exception of the PRD scale, which was only administered at Follow-Up, and a few select questions that were only asked at Baseline that did not need to be asked twice such as impulsivity, educational attainment, family history of problem gambling, and history of child abuse.

Sample

Data were collected through an online panel called LegerWeb which consists of around 400,000 members and is Canada's biggest online panel. This study consisted of a subsample of over 10,000 volunteer adults who were screened in favour of gambling at least once a month, across all of Canada. Therefore, there were three to four times more people with gambling problems than the general population (Williams et al., 2022). The sample was gathered by recruiting approximately 1400 participants from each of the ten provinces with the exception of the four Atlantic provinces (Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland and Labrador) in which around 1400 participants were recruited across those four provinces (Williams et al., 2022). The Follow-Up survey only included a sample of around 4700.

However, most who did not do the second-year survey tended to be people who were already part of the largest group. These were people who generally did not suffer from serious problems related to gambling (Williams et al., 2022). The proposal for the ANP Online Panel Survey by Williams et al. (2019) can be found at the following link: https://research.ucalgary.ca/alberta-gambling-research-institute/research/national-gambling-study

Measures

Dependent Variables

Problem Gambling. "Problem gambling is characterized by difficulties in limiting money and/or time spent on gambling which leads to adverse consequences for the gambler, others, or for the community." (Gambling Research Australia, 2005, p. 125). I chose the Problem and Pathological Gambling Measure (PPGM) as my problem gambling measure because it was designed to be used among general populations (Williams & Volberg 2010, 2014) while other popular measurements such as the Problem Gambling Severity Index (PGSI) were designed for treatment-seeking populations (Ferris & Wynne, 2001). According to Williams and Volberg (2014) the PPGM is highly effective in both clinical and general settings and has a higher classification accuracy among general populations than other commonly used measures (Williams & Volberg, 2010). The PPGM also accounts for more gambling harms than other measurements (Williams et al., 2019) and has been validated cross-culturally (Back et al., 2015). The PPGM also has a higher construct validity than most other problem gambling measures because it captures multiple dimensions of problem gambling such as "financial problems," "health and relationship issues," and "difficulty controlling gambling" (Christensen et al., 2019).

This measurement has a good internal consistency with a Cronbach's alpha ranging from .76 to .81 between data sets, and a good one-month test-retest reliability of r = .78 (Williams &

Volberg, 2010, 2014). The classification accuracy is high with a Cohen's k of .96 (Williams & Volberg, 2010). This measure is made up of a 14-item instrument (Williams & Volberg, 2010). The 14 items included 7 items indicative of problems caused by gambling, 4 items indicative of impaired control, and 3 other items. Those who did not report any gambling in the past year were placed in the non-gambler category. Those who reported gambling but scored zero on all problem gambling questions were placed in the recreational gambler category. Those who reported gambling and scored at least a 1 on any problem gambling question were placed in the at-risk category. Those who reported gambling and scored at least 1 in the problems caused by gambling questions and at least a 1 in the impaired control questions were placed in the problem gambling category. Those who scored at least a 1 in both categories and reached a total score of 5 or more were placed in the pathological gambling category.[1] The categories are listed below:

0. = Non-gambler
1. = Recreational gambler
2. = At risk gambler
3. = Problem gambler
4. = Pathological gambler

The Follow-Up administration of this variable was used as the dependent variable for the problem gambling analysis and as an independent variable for the gambling intensity analyses because the PRD variable was only included in the Follow-Up survey. The Baseline administration was used as an independent variable for the PRD analysis because it was being used to predict PRD in the following year. This variable was treated as continuous in all analyses.

Maximum Frequency. This variable is gathered through use of the gambling participation

[1] This ordinal variable was collapsed for all analyses. Further information on why the decision to collapse was made can be found in treatment of variables section.

instrument (GPI) designed by Williams et al. (2017). The GPI as a whole has an overall test-retest reliability coefficient ranging from .46 to .84 and a validity ranging from .60 to .91 (Williams et al., 2019)

Maximum frequency is a continuous variable that is calculated by totalling the frequency of all gambling engagements within the past 12 months for each gambling format and selecting the format that was played most frequently (i.e., the frequency of the *maximally* played format). The frequency of the most played format is then placed in one of seven categories (listed below). The Follow-Up administration of this variable was used as a dependent variable in the gambling intensity analysis. The Follow-Up administration was also used in the problem gambling analysis but as an independent variable. The Baseline administration was used as an independent variable in the PRD analysis.

0. = Never
1. = Less than once a month
2. = Once a month
3. = Two or three times a month
4. = Once a week
5. = Several times a week
6. = Four or more times a week

Number of Formats. This variable, like maximum frequency, is gathered through use of the gambling participation instrument (GPI) designed by Williams et al. (2017). This instrument as a whole has a test-retest reliability coefficient ranging from .46 to .84 and a validity ranging from .60 to .91 across data sets (Williams et al., 2019).

Number of formats is a continuous variable that is calculated by totalling all gambling formats engaged in the past 12 months ranging from 0 to 8 (formats listed below). The Follow-

Up administration of this variable was used as a dependent variable in the gambling intensity analysis. The Follow-Up administration was used as an independent variable in the problem gambling analysis. The Baseline administration was used as an independent variable in the PRD analysis.

1. Lottery or raffle tickets
2. Instant lottery tickets
3. Electronic gaming machines
4. Casino table games
5. Sports betting
6. Bingo
7. Other
8. Speculative financial market activities

Personal Relative Deprivation. PRD is the main variable of interest and is measured by a scale designed by Callan et al. (2008) and revised by Callan et al. (2011). This variable has a good internal consistency with a Cronbach alpha of .78 and has been validated among a multitude of studies (Callan et al., 2008; Callan et al., 2011; Mishra & Meadows, 2018; Mishra & Novakowski, 2016). This continuous variable is calculated by taking the total of five 7-point Likert scale questions ranging from "strongly disagree" (coded as 1) to "strongly agree," (coded as 7). The five statements are listed below.

1. I feel deprived when I think about what I have compared to what other people like me have
2. I feel privileged compared to other people like me (reverse coded)
3. I feel resentful when I see how prosperous other people like me seem to be
4. When I compare what I have with what others like me have, I realize that I am quite well

off (reverse coded)

5. I feel dissatisfied with what I have compared to what other people like me have

This variable was only included at Follow-Up. Therefore, PRD's Follow-Up administration was used for all analyses. In the problem gambling and gambling intensity analysis PRD was used as the independent variable. In the PRD analysis this variable was used as the dependent variable.

Predictor Variables

Although the problem gambling, maximum frequency, number of formats, and PRD variables were used as dependent variables for some analyses, they were also used as predictor variables in the analyses where they were not the dependent variables. All other variables in this section were used as predictors in all analyses. Information on what variables were used in each analysis can also be found in the table in the appendix. This table summarizes what wave each variable came from as well as whether or not changes were made to each variable.

Demographic Variables

Age. Age is a continuous variable found only at Baseline with a minimum age of 18 and a maximum of 97.

Sex. Sex was a categorical variable found only at Baseline containing male (coded as 1), female (coded as 2), and other (coded as 3) as its categories. With other coded as missing, it was treated as a binary independent variable.

Marital Status. The main importance of this variable is its possible relationship to PRD. Being single can be a sign that one is of too low a status to be successful in the dating market (Daly, 2017). Being single has also been linked to feelings of PRD (Mishra & Meadows, 2018). Therefore, marital status (especially being single) could be a proxy for the PRD measure.

This variable was initially a categorical variable with five categories: Each category was dummy coded into a binary variable so they could all be used in a multiple regression. Baseline was missing 41 cases and Follow-Up was missing 40 (in the form of "prefer not to answer").

1. = Single
2. = Married
3. = Separated
4. = Divorced
5. = Widowed

Educational Attainment. Educational attainment could be a proxy for status. Some research has already reported a relationship between low educational attainment and PRD (Callan et al., 2015a; Mishra & Meadows, 2018). Therefore, PRD should be closely related to educational attainment and could be a stronger predictor of problem gambling.

This ordinal variable is only contained at Baseline because educational attainment is unlikely to change much between the two waves. This ordinal variable contains 10 categories. Any missing data for this variable were already imputed with the series mean before I obtained this data set. This variable was treated as a continuous variable.

1. = Primary level
2. = Some secondary schooling
3. = Completed secondary schooling
4. = Some vocational training
5. = Completion of vocational training
6. = Some post-secondary schooling
7. = A post-secondary certificate
8. = Bachelor's degree

9. = Professional degree
10. = Masters or doctorate degree

Employment Situation. Being unemployed is an indication of lower status or resources and therefore could be a proxy for feeling relatively deprived. Furthermore, Mishra and Meadows (2018) found that unemployment was related to personal relative deprivation.

This variable is categorical and contains 7 categories. Each variable was dummy coded into a binary variable so they could be used in a multiple regression. Baseline was missing 69 variables and Follow-Up was missing 68 (in the form of "I prefer not to answer").

1. = Employed full time
2. = Part time
3. = Sick leave
4. = Homemaker
5. = Unemployed
6. = Student
7. = Retired

Household Income. This demographic variable was mainly chosen because of its possible relationship to PRD. One study reported a relationship between reported household income and PRD (Tabri et al., 2015). PRD has also been reported to be a better measure than some economic measures. For example, Callan et al. (2015a) reported that PRD was more strongly related to depression and health problems than SES measures such as income and education. Therefore, PRD may be a stronger predictor than household income in the problem gambling analysis. Income is also a signal of status (Daly, 2017; Frank, 2000). Therefore, low household income

could also be a predictor of PRD.[2]

This ordinal variable contained in both waves is a Likert scale with 8 categories (Listed below). This variable was treated as a continuous variable.

1. = Less than $20,000
2. = $20,000-$39,000
3. = $40,000-$59,000
4. = $60,000-$79,000
5. = $80,000-$99,000
6. = $100,000-$119,000
7. = $120,000-$139,000
8. = Over $140,000

Substance Use

Alcohol Use. Alcohol use is an ordinal variable that was measured by asking respondents "during the past 12 months how often did you drink alcoholic beverages," ranging on an 8-point Likert scale from "not at all," (coded as 0) to "every day," (coded as 7). Alcohol use was treated as continuous.

0. = Not at all
1. = Less than once a month
2. = Once a month

[2] The related variable, household debt, was also considered because of its theoretical relationship to financial risk-taking and PRD. However, I did not use this variable because it contained mortgage debt (which is common among most home buyers and therefore may not cause feelings of PRD). Also, a big mortgage could indicate wealth or a good job. A better variable to measure the relationship between debt and PRD would be a variable that excludes mortgages that could be subtracted from household income (such a measure was not included in the data set).

3. = 2 to 3 times a month
4. = Once a week
5. = 2 to 3 times a week
6. = 4 to 6 times a week
7. = Every day

Tobacco Use. Tobacco use is an ordinal variable that was measured and treated the same as the alcohol use variable.

Cannabis Use. Although cannabis use has not been studied as frequently as tobacco, alcohol, and substance use disorder, Hammond et al. (2020) have reported a relationship between cannabis use and problem gambling. Cannabis was used to compare to alcohol and tobacco use.

Cannabis use is an ordinal variable that was measured and treated the same as the alcohol use variable.

Other Drugs. Although other illicit drugs are not as prominent in the literature as alcohol, tobacco, and substance use disorder, Ferentzy et al. (2013) have reported a relationship between problem gambling and illicit drugs. The variable "Other drugs" was used to compare to alcohol and tobacco.

Other drugs are measured with the yes = 1 or no = 0 question "During the past 12 months have you used cocaine, amphetamines, hallucinogens (such as LSD, mushrooms, or PCP), heroin, opium, fentanyl, or any other drugs not intended for medical use?"

Mental Health

Substance Use Disorder. Substance use disorder (SUD) is an ordinal variable contained in both waves. Substance use disorder was calculated by totalling responses from 11 Diagnostic and Statistical Manual of Mental Disorders (DSM) criteria for the disorder and placing them into categories (listed below).

0. = No SUDisorder (0-1 items checked)
1. = Mild SUDisorder (2-3)
2. = Moderate SUDisorder (4-5)
3. = Severe SUDisorder (6+)

Depression. This variable may be of importance for the PRD analysis because multiple studies have reported a positive relationship between feelings of PRD and higher levels of depression, negative moods, and stress (Callan et al., 2015a; Mishra & Meadows, 2018; Osborne et al., 2012).

Depression is assessed by the DSM-V criteria for major depressive disorder (American Psychiatric Association, 2013) and has an interrater reliability of a kappa statistic of .28 (Freedman et al., 2013). Depression is a binary variable ("yes," = (1) "no," = (0)) contained in both waves and is measured by two questions on the survey. The first question (C13a) is a screening question and asks the yes or no question "In the past 12 months, was there ever a period of 2 weeks or longer where you had a depressed mood most of the day nearly every day and/or a loss of interest or pleasure in most activities?" The participants who answered yes to the first question moved on to the second question. The second question (C13b) is a check list of 8 items (including none of the above), each item being a DSM symptom of depression. If the participant selected over 3 items, they were considered to have depression.

Anxiety. The anxiety measure was taken from the DSM-V criteria for generalized anxiety disorder (American Psychiatric Association, 2013). Anxiety has an interrater reliability of a kappa statistic of .20 (Freedman et al., 2013). Anxiety is a binary variable contained in both waves that is measured similarly to depression with three questions (C14a, b, and c). The first two questions (C14a and b) are screening questions. C14a is a yes or no question that asks "would you describe yourself as chronically anxious? C14b is a yes or no question that asks

"does this anxiety cause significant distress or impairment in your social functioning, employment, or other areas? If participants answered yes to both questions, they were moved on to the third question (C14c). C14c is a checklist with 7 items (including none of the above). Participants were considered to have anxiety if they checked over 2 items off the checklist.

PTSD. Post-traumatic stress disorder does not seem to be as closely related to problem gambling as depression and anxiety. For example, the variable was used as a possible predictor of first onset problem gambling in the Quinte study (Williams et al., 2015) and was not significant (also reported in the LLLP study (el-Guebaly et al. 2015). PTSD was also not a predictor of problem gambling in the Kessler et al. (2008) study, though problem gambling could predict PTSD. However, PTSD will be used as a predictor for this study in order to compare it to the other mood disorders.

The PTSD measure was taken from the DSM-V criteria (American Psychiatric Association, 2013). PTSD has an interrater reliability kappa statistic of .67 (Freedman et al., 2013). PTSD is a binary variable contained in both waves that is measured similarly to depression except it is measured by 4 different checklists (C11a, C11b, C11c, and C11. A participant was considered to suffer from PTSD if they scored over 0 in both C11a and C11b, and over 1 in both C11c and C11d.

Panic. Panic is also not as prominent of a predictor as depression and anxiety throughout the literature. However, it was related to problem gambling in the Kessler et al. (2008) study. This variable is mainly being used to compare to depression and anxiety.

The panic measure was taken from the DSM-V criteria for panic disorder (American Psychiatric Association, 2013). Panic disorder is a binary variable contained in both waves that is measured similarly to depression with two yes or no questions (C15a, b). C15a asks the yes or no question "in the past 12 months have you had recurrent unexpected panic attacks during which 4

or more of the following symptoms occur: (lists 15 items). C15b asks the yes or no question "Have these attacks been followed by either a persistent worry about having additional attacks and/or avoidance of activities or unfamiliar places?" Participants were considered to have panic disorder if they answered yes to both questions.

Stress and Causes of Stress

Stress. Stress is related to both problem gambling (Blaszczynski & Nower, 2002; Ronzitti et al., 2018) and PRD (Mishra & Meadows, 2018). There is also evidence that stress mediates PRD and problem gambling (Mishra & Meadows, 2018). Therefore, this variable should be related to problem gambling and PRD in the problem gambling and PRD analyses.

This ordinal variable was modeled after the question GEN_Q020 from the Canadian Community Health Survey (CCHS) and was assessed by a 5-point Likert scale that measured responses from the question "Thinking about the amount of stress in your life, would you say that in the past 12 months most of your days are…?" (scale listed below). This variable was treated as continuous.

1. = Not at all stressful
2. = Not very stressful
3. = A bit stressful
4. = Quite a bit stressful
5. = Extremely stressful

Stressful Life Events. Stress and negative moods are related to PRD (Mishra & Meadows, 2018; Callan et al., 2015a) and many of the stressful life events could be indicators of status (or lack thereof) such as divorce, illness, financial difficulties, and jail time. Therefore, there may be overlap with this variable and PRD.

According to Williams et al. (2019), the stressful life events checklist is adapted from the

life events questionnaire designed by Vuchinich et al. (1986). Stressful life events is a continuous variable contained in both waves. This variable was made up by totalling a checklist of 39 negative life events (out of 50 general life events) after participants are asked the question "Check off any events that have happened to you in the past 12 months."

History of Child Abuse. History of child abuse is a binary variable contained only at Baseline because this variable would remain unchanged a year later. This variable was assessed through a yes = (1) or no = (0) question. The question being: "Did you experience significant physical, sexual, or emotional abuse or neglect as a child?"

Personality

Impulsivity. Impulsivity is positively correlated to PRD (Mishra & Novakowski, 2016) and is one of the main predictors of problem gambling (Blaszcynski & Nower, 2002; Williams et al., 2015). Therefore, impulsivity may be an important predictor of both problem gambling and feelings of PRD.

The impulsivity scale is a subsection of the neuroticism measure from the NEO Personality Inventory – Revised (NEO PI-R), which is the main measure for assessing the big five personality traits. The NEO has an internal reliability ranging from .86 to .92 and its individual facets have an internal reliability ranging from .58 to .82. This scale also has good concurrent and discriminant validity and is frequently used to assess personality in both general and clinical populations (Costa & McCrae, 1992).

Impulsivity is considered to be a stable trait (Niv et al., 2012) and is therefore only assessed at Baseline. This variable is continuous and is calculated by summing the responses from 8 questions. Each question is scored on a 5-point Likert scale ranging from 0 ("strongly disagree") to 4. ("strongly agree"). Higher scores indicate higher levels of impulsivity. Below are the questions:

1. “I have little difficulty resisting temptations,” (reverse coded)
2. “I rarely overindulge in anything,” (reverse coded)
3. “When I am having my favourite foods, I tend to eat too much,”
4. “I seldom give in to my impulses,” (reverse coded)
5. “I sometimes eat myself sick,”
6. “I have trouble resisting my cravings,”
7. “Sometimes I do things on impulse that I later regret,”
8. “I am always able to keep my feelings under control.” (reverse coded)

Environmental Exposure

Family History of Problem Gambling. This binary variable contained at Baseline is assessed by “yes,” = (1) or “no,” = (0) responses to the question “Have you or anyone in your immediate family ever had a gambling problem? (not including self)” This variable was used as an independent variable in all analyses.

Peers Who Gamble. This ordinal variable contained in both waves was assessed by responses to the question: “In the past 12 months, how many of the people that you regularly spend time with have been regular gamblers?” With the responses being a 5-point Likert scale (responses listed below).

0. = None
1. = One
2. = A few of them
3. = Many of them
4. = All of them

Problem Gambling Motivations

Perception of Money. Some gamblers do perceive the money as important and report that

they are trying to increase it (Blaszcynski & Nower, 2010; Nower & Blaszcynski, 2010). PRD is caused by feelings of resentment from low status or a lack of resources (Callan et al., 2008). Therefore, a gambler who perceives money to be important may be more likely to feel relatively deprived if they believe they have less than others.

This ordinal variable contained in both waves is a Likert scale that was assessed by participants answer to the question "How important is money to you?" Participants could reply with 4 answers:

0. = Not at all important
1. = Somewhat important
2. = Quite important
3. = Very important

Gambling Motivations. Gamblers sometimes have different motivations to gamble. Some of these motivations could be caused by PRD. PRD is caused by feelings of resentment from low status or a lack of resources (Callan et al., 2008). These feelings can lead to stress and/or risk-taking (Mishra & Meadows, 2018; Osborne et al., 2012). Gambling may be a way of coping with stress caused by feelings of PRD (Tabri et al., 2015). PRD has also been reported as being positively related to the gambling motivation "to win money," (Tabri et al., 2015). Therefore, motivations such as "to escape" (to relieve stress) should be related as well as motivations such as "to win money," and possibly "to compete," because, someone who feels they are low in status may see gambling as an avenue for obtaining status or resources.

These variables, contained in both waves, were originally a categorical variable but were dummy coded to binary variables before I attained the data set. The 8 motivations were assessed with the question "What would you say are the main reasons that you gamble? (check all that apply)." The 8 gambling motivations are listed below.

1. Excitement
2. To win money
3. To develop skills
4. To compete or for the challenge
5. To socialize
6. To support worthy cause
7. To escape
8. It makes me feel good about myself

Resistance to Gambling Fallacies. This gambling fallacies measure designed by Leonard et al. (2015) has an internal consistency with a hierarchical omega coefficient of .61 and a good one-month test-retest reliability of .70 (Williams et al., 2019).

This continuous variable contained in both waves is calculated by totalling the responses of 10 different questions regarding beliefs related to gambling fallacies. A high score indicates more resistance to fallacious gambling beliefs.

Analyses

The three hypotheses were tested with 3 different sets of analyses. The problem gambling analyses were used to test for the relationship between the problem gambling categories and PRD. The gambling intensity analyses were used to test the relationship between gambling intensity and PRD. The PRD analysis was used the test for the relationship between PRD and other common predictors of problem gambling. The multiple regression method was used for all analyses (the problem gambling, gambling intensity, and PRD analyses).

1. The purpose of the problem gambling analysis was to test for the strength of the relationship between PRD and problem gambling alongside other predictors of problem

gambling (see variable table in appendix for list of variables). This analysis was cross-sectional using variables from the AGRI National Project Online Panel (ANP) data set which contains two waves of data collected from two consecutive years. Data from Follow-Up were used for the problem gambling analysis because PRD was only included at Follow-Up. Problem gambling, measured by the Problem and Pathological Gambling Measure (PPGM categories), was the dependent variable. PRD and the variables listed in the table were the independent variables. Should PRD be a significant contributor, the same analysis would be run again without PRD to assess if the addition of PRD strengthened or changed the model and the predictors within it. For example, I was able to observe if the inclusion of PRD removed significance from any variables in the model. These analyses were done with a simultaneous regression because stepwise regressions are more commonly used for exploratory analyses (Williams, 2019) and I was not conducting exploratory analyses. Each predictor variable was chosen because of its known relationship to problem gambling and/or gambling intensity. I was most interested in discovering the strength of the relationship between PRD and problem gambling when all variables are included in the model.

2. The purpose of the gambling intensity analysis was to test for the relationship between PRD and variables indicative of gambling intensity. Two multiple regressions were run; one with max frequencies as the dependent variable and the other with number of formats as the dependent variable. These analyses were also cross-sectional. Should PRD be a significant contributor, the same analysis would be run again without PRD to assess if the addition of PRD strengthened or changed the model and the predictors within it. These analyses were done with a simultaneous regression because each predictor variable was chosen to construct a model where I could investigate the strength of the relationship

between PRD and gambling intensity when all variables are included in the model.

3. The purpose of the PRD analysis was to test for possible predictors of PRD that may precede PRD (Baseline predictors). Therefore, this analysis was time lagged by one year. This analysis was the only one that could be time lagged (where the analyses predicting problem gambling and gambling intensity were cross-sectional) because PRD was only included at Follow-Up in the data set (See table in appendix). This analysis was conducted with a stepwise regression because discovering which of the predictors best predicts PRD is exploratory and a stepwise analysis can be used to identify the strongest predictors for the best possible model (Williams, 2019).

Treatment of Variables

Problem Gambling. For the PPGM categories variable all responses from participants who were in the non-gambler category were removed because non-gamblers were not supposed to be in the survey as it was designed exclusively for gamblers. Data gathered by participants who did the survey when instructed otherwise may be untrustworthy. The removal of this category resulted in the loss of 31 cases at Baseline and 125 at Follow-Up. The problem and pathological categories were combined into one category called the problem/pathological category. Because both problem and pathological gambling are forms of problem gambling (pathological being more extreme), combining the two categories does not violate the ordering of the PPGM measure and creates a larger sample size in the combined category. The original cell sizes were as follows: Recreational (3591) At-Risk (617) Problem (165) Pathological (303) at Baseline and Recreational (3545) At-Risk (506) problem (206) pathological (325) at Follow-Up. It is worth noting that with this variable collapsed, a positive relationship with the collapsed PPGM and another variable would indicate a relationship with the problem gambling category in

a regression even when treated as continuous.

Sex. This variable was a categorical variable with three categories (male, female, and other). Other was removed because this category only contained 5 cases, which are not enough to analyze, leaving only male and female (binary variable).

Age. This continuous variable was initially missing 120 cases. The missing data were imputed with the mean. Although age was only collected for the Baseline survey it was not adjusted for the problem gambling, and gambling intensity multiple regression analyses (in which most variables came from the Follow-Up survey) because results would not differ[3].

Substance Use Disorder. This ordinal variable was initially missing 1,447 cases in its Follow-Up iteration. The missing cases were due to respondents who had low prior substance use being left out. The missing data were dealt with by placing the missing data into the no substance use disorder category. The Baseline administration of this variable was not missing any data.

Peers Who Gamble. The "Unsure," responses were recoded as "none," leaving a five-point Likert scale. This variable was used as an independent variable for all three analyses.

Household Income. This variable was initially missing 588 cases at Baseline and 521 at Follow-Up. The mean was imputed for the variable in both waves.

Marital Status. This variable was initially a categorical variable with five categories (single, married, separated, divorced, and widowed). Each category was dummy coded into a binary variable so they could all be used in a multiple regression. Baseline was missing 41 cases and Follow-Up was missing 40. The Follow-Up iteration of this variable was imputed with the mode which was the married category. The Baseline iteration was not imputed because the PRD analysis was not missing as much data.

[3] Adding a constant to a variable will not change the results of a correlational analysis (Vokey & Allen, 2007).

Employment. This variable was categorical and contained 7 categories (employed full time, part time, sick leave, homemaker, unemployed, student, and retired). Each variable was dummy coded into a binary variable so they could be used in a multiple regression. Baseline was missing 69 cases and Follow-Up was missing 68. The Follow-Up iteration of this variable was imputed with the mode which was the full-time category. The Baseline iteration was not imputed because the PRD analysis was not missing as many cases.

Gambling Motivation Other. The Baseline iteration of this variable was missing 90 cases which lowered the case load of the PRD analysis. Therefore, these missing cases were imputed with the mode "not other." The Follow-Up iteration was not missing any data and therefore was not imputed.

Results

Descriptive Statistics

Table 1 includes all the variables being used in the problem gambling and gambling intensity analyses displayed by problem gambling category. All variables contain 4,400 cases. All variables are from Follow-Up of the ANP Online Panel survey data set with the exception of Baseline variables that remain relatively consistent across time including sex, age, impulsivity, educational attainment, history of child abuse, and family history of problem gambling. The table is broken up into 6 sections (labeled a-f) and contains categorical, ordinal, and continuous variables. Categorical and ordinal variables have their counts displayed by problem gambling categories in each column. Numbers in brackets are the percentage of the category total. The total column displays the number and percentage of each variable collapsed across categories. Continuous variables have their mean and standard deviation displayed by problem gambling category and the overall mean and standard deviations across categories displayed in the total column. The bolded variables are used as dependent variables in at least one analysis.

Variables and General Trends

All demographic variables can be seen in section a. of Table 1. The general sample contains slightly more females than males with an average age in the mid 50's. Most members of the sample were married and worked full time. Problem gamblers are more likely to be males, people who were below the average age, educational attainment, and household income. Problem gamblers were also more likely to be unmarried and unemployed when comparing the problem gambling and recreational gambling categories.

All gambling related variables can be seen in section b. of Table 1. Most of the sample were recreational gamblers, and generally gambled to win money or for enjoyment. Most

problem gamblers engaged in a higher number of gambling formats (number of formats) more frequently (maximum frequency) than non-problem gamblers within the past year. Problem gamblers were also more likely to know peers who gambled, have a family history of gambling, and have less resistance to gambling fallacies.

All substance use variables can be seen in section c. of Table 1. Of the general sample, the majority of participants engaged in at least one kind of substance use with most drinking alcohol within the past 12 months and the least engaging in the use of "other drugs (not intended for medical use)." Problem gamblers engaged in more frequent substance use than non-problem gamblers. Problem gamblers were also much more likely to engage in the use of "other drugs" than non-problem gamblers.

Mental health, stress, and individual difference related variables can be seen in sections d, e, and f, respectively, of Table 1. As can be seen in section d., most participants did not have mental health problems. However, the most common mental health problem was depression. Problem gamblers tended to have the highest rates of all mental health problem. As can be seen in section e., over half of the general sample experienced at least "a bit of stress." However, problem gamblers were more likely to experience extreme stress. More problem gamblers also experienced more stressful events, and child abuse when compared to non-problem gamblers. As can be seen in section f., problem gamblers scored higher on average on trait impulsivity and on the PRD scale.

Table 1. *Descriptive Statistics for all variables included in the Problem Gambling and Gambling Intensity Analyses displayed by Problem Gambling category (dependent variables are bolded).*

a. Demographic Variables									
Problem Gambling PPGM		Recreational (N=3439)		At-Risk (N=475)		Problem/ Pathological (N=486)		Total (%) N=4400	
Sex N (%)	Male=1	1633	(47.5)	258	(54.3)	256	(52.7)	2147	(48.8)
	Female=2	1806	(52.5)	217	(45.7)	230	(47.3)	2253	(51.2)
Age Range (18-93)	M	56.25		53.56		47.33		54.98	
	SD	13.61		14.66		14.07		14.06	
Marital Status N (%)	Single	599	(17.4)	112	(23.6)	138	(28.4)	849	(19.3)
	Married	2296	(66.8)	276	(58.1)	260	(53.5)	2832	(64.4)
	Separated	92	(2.7)	13	(2.7)	22	(4.5)	127	(2.9)
	Divorced	260	(7.6)	50	(10.5)	50	(10.3)	360	(8.2)
	Widowed	192	(5.6)	24	(5.1)	16	(3.3)	232	(5.3)
Employment N (%)	Full Time	1436	(41.8)	216	(45.5)	280	(57.6)	1932	(43.9)
	Part Time	377	(11.0)	56	(11.8)	57	(11.7)	490	(11.1)
	Sick Leave	100	(2.9)	12	(2.5)	25	(5.1)	137	(3.1)
	Homemaker	118	(3.4)	12	(2.5)	14	(2.9)	144	(3.3)
	Unemployed	77	(2.2)	20	(4.2)	29	(6.0)	126	(2.9)
	Student	11	(0.3)	5	(1.1)	5	(1.0)	21	(0.5)
	Retired	1320	(38.4)	154	(32.4)	76	(15.6)	1550	(35.2)
Educational Attainment	M	6.06		5.99		5.94		6.04	
	SD	2.27		2.35		2.31		2.28	
Household Income	M	4.28		4.15		3.88		4.22	
	SD	1.87		1.94		1.89		1.89	

b. Gambling Variables					
Problem Gambling PPGM		Recreational (N=3439)	At-Risk (N=475)	Problem/ Pathological (N=486)	Total (%) N=4400
Number of Formats Range (1-8)	**M**	**2.20**	**3.13**	**4.43**	**2.55**
	SD	**1.10**	**1.38**	**2.17**	**1.48**
Maximum Frequency Range (1-6)	**M**	**3.19**	**3.88**	**4.28**	**3.39**
	SD	**1.36**	**1.16**	**1.31**	**1.39**
Family History of Problem Gambling N (%)		245 (7.1)	59 (12.4)	106 (21.8)	410 (9.3)
Peers Who Gamble N (%)	None	2360 (68.6)	217 (45.7)	150 (30.9)	2727 (62.0)
	One	431 (12.5)	77 (16.2)	77 (15.8)	585 (13.3)
	A few	594 (17.3)	157 (33.1)	167 (34.4)	918 (20.9)
	Many	39 (1.1)	19 (4.0)	72 (14.8)	130 (3.0)
	All	15 (0.4)	5 (1.1)	20 (4.1)	40 (0.9)
Gambling Motivations	Enjoyment	1517 (44.1)	284 (59.8)	262 (53.9)	2063 (46.9)
	Win	2266 (65.9)	317 (66.7)	350 (72.0)	2933 (66.7)
	Skills	39 (1.1)	21 (4.4)	51 (10.5)	111 (2.5)
	Compete	137 (4.0)	48 (10.1)	74 (15.2)	259 (5.9)
	Socialize	345 (10.0)	97 (20.4)	80 (16.5)	522 (11.9)
	Support Cause	567 (16.5)	45 (9.5)	33 (6.8)	645 (14.7)
	Escape	463 (13.5)	148 (31.2)	181 (37.2)	792 (18.0)
	Feels good	100 (2.9)	27 (5.7)	42 (8.6)	169 (3.8)
	Other	216 (6.3)	15 (3.2)	14 (2.9)	245 (5.6)
Resistance to Gambling Fallacies Range (0-10)	M	7.00	6.33	5.45	6.75
	SD	1.38	1.89	2.32	1.65

c. Substance Use Variables									
Problem Gambling PPGM		Recreational (N=3439)		At-Risk (N=475)		Problem/ Pathological (N=486)		Total (%) N=4400	
Alcohol Use N (%)	Not at all	407	(11.8)	46	(9.7)	40	(8.2)	493	(11.2)
	Less than once a month	554	(16.1)	75	(15.8)	55	(11.3)	684	(15.5)
	Once a month	263	(7.6)	35	(7.4)	55	(11.3)	353	(8.0)
	2 to 3 times a month	525	(15.3)	76	(16.0)	72	(14.8)	673	(15.3)
	Once a week	437	(12.7)	54	(11.4)	57	(11.7)	548	(12.5)
	2 to 3 times a week	677	(19.7)	99	(20.8)	107	(22.0)	883	(20.1)
	4 to 6 times a week	385	(11.2)	63	(13.3)	63	(13.3)	511	(11.6)
	Every day	191	(5.6)	27	(5.7)	37	(7.6)	255	(5.8)
Tobacco Use N (%)	Not at all	2508	(72.9)	286	(60.2)	163	(33.5)	2957	(67.2)
	Less than once a month	110	(3.2)	18	(3.8)	24	(4.9)	152	(3.5)
	Once a month	30	(0.9)	15	(3.2)	25	(5.1)	70	(1.6)
	2 to 3 times a month	51	(1.5)	10	(2.1)	26	(5.3)	87	(2.0)
	Once a week	18	(0.5)	11	(2.3)	26	(5.3)	55	(1.3)
	2 to 3 times a week	57	(1.7)	17	(3.6)	26	(5.3)	100	(2.3)
	4 to 6 times a week	76	(2.2)	9	(1.9)	34	(7.0)	119	(2.7)
	Every day	589	(17.1)	109	(22.9)	162	(33.3)	860	(19.5)
Cannabis Use N (%)	Not at all	2614	(76.0)	309	(65.1)	202	(41.6)	3125	(71.0)
	Less than once a month	257	(7.5)	52	(10.9)	43	(8.8)	352	(8.0)
	Once a month	77	(2.2)	27	(5.7)	39	(8.0)	143	(3.3)
	2 to 3 times a month	87	(2.5)	19	(4.0)	34	(7.0)	140	(3.2)
	Once a week	78	(2.3)	13	(2.7)	42	(8.6)	133	(3.0)
	2 to 3 times a week	83	(2.4)	30	(6.3)	44	(9.1)	157	(3.6)
	4 to 6 times a week	73	(2.1)	7	(1.5)	32	(6.6)	112	(2.5)
	Every day	170	(4.9)	18	(3.8)	50	(10.3)	238	(5.4)
Other Drugs N (%)		75	(2.2)	18	(3.8)	98	(20.2)	191	(4.3)

d. Mental Health Variables									
Problem Gambling PPGM		Recreational (N=3439)		At-Risk (N=475)		Problem/ Pathological (N=486)		Total (%) N=4400	
Substance Use Disorder (SUD) N (%)	No SUD	3306	(96.1)	428	(90.1)	353	(72.6)	4087	(92.9)
	Mild SUD	100	(2.9)	35	(7.4)	86	(17.7)	221	(5.0)
	Moderate SUD	20	(0.6)	9	(1.9)	32	(6.6)	61	(1.4)
	Severe SUD	13	(0.4)	3	(0.6)	15	(3.1)	31	(0.7)
Depression N (%)		326	(9.5)	68	(12.2)	106	(21.8)	490	(11.1)
Anxiety N (%)		258	(7.5)	48	(10.1)	92	(18.9)	398	(9.0)
PTSD N (%)		108	(3.1)	26	(5.5)	70	(14.4)	204	(4.6)
Panic N (%)		257	(7.5)	48	(10.1)	133	(27.4)	438	(10.0)
e. Stress Related Variables									
Stress N (%)	Not at all stressful	349	(10.1)	30	(6.3)	19	(3.9)	398	(9.0)
	Not very stressful	1041	(30.3)	106	(22.3)	65	(13.4)	1212	(27.5)
	A bit stressful	1365	(39.7)	213	(44.8)	213	(43.8)	1791	(40.7)
	Quite a bit stressful	569	(16.5)	106	(22.3)	132	(27.2)	807	(18.3)
	Extremely stressful	115	(3.3)	20	(4.2)	57	(11.7)	192	(4.4)
Negative Life Events Range (0-23)	M	1.11		1.40		2.48		1.29	
	SD	1.49		1.79		2.96		1.79	
History of Child Abuse N (%)		505	(14.7)	102	(21.5)	147	(30.2)	754	(17.1)
f. Individual Differences Variables									
Impulsivity Range (0-32)	M	13.57		15.10		17.09		14.13	
	SD	4.84		4.74		4.39		4.91	
PRD Range (5-35)	**M**	**15.35**		**17.38**		**20.67**		**16.15**	
	SD	**5.79**		**6.09**		**5.74**		**6.06**	
Importance of Money N (%)	Not at all important	99	(2.9)	20	(4.2)	21	(4.3)	140	(3.2)
	Somewhat important	1235	(35.9)	141	(29.7)	142	(29.2)	1518	(34.5)
	Quite important	1307	(38.0)	176	(37.1)	160	(32.9)	1643	(37.3)
	Very important	798	(23.2)	138	(29.1)	163	(33.5)	1099	(25.0)

Problem Gambling Analyses

The first research question was, "Is personal relative deprivation (PRD) a strong cross-sectional predictor of problem gambling relative to other known predictors? If so, how much of the variance in problem gambling can be explained by PRD while controlling for other known predictors of problem gambling?" Prior research has reported that problem gambling and PRD are positively related (Callan et al., 2008; Mishra & Novakowski, 2016). However, I was more interested in investigating the strength of this relationship when included with other problem gambling predictors. To answer this question, I conducted two multiple regressions. The first was a simultaneous multiple regression where I carefully chose known predictors of problem gambling/gambling intensity to be the predictor variables alongside PRD in our model. The dependent variable was the PPGM categories variable. I hypothesised that if PRD is important in the formation of problem gambling, there should be a strong positive and significant relationship between PRD and problem gambling within the model.

I also ran a complimentary analysis excluding PRD. The purpose of the second analysis was to investigate if PRD added or removed the significance of any predictors from the analysis. Other variables becoming insignificant upon entry of PRD could indicate that PRD is a better measure for predicting problem gambling than some other common predictors. For example, many of the demographic predictors of problem gambling are indicative of disadvantage (of which PRD measures subjective perceptions). Therefore, I believed that PRD may remove some demographic variables.

Both models significantly predicted PPGM category. The model including PRD was significant with $F(43,4356) = 65.516$, $p<.001$ with an adj. R^2 of .387 indicating that the variables included in the model account for close to 40% of the variance of problem gambling. The model

excluding PRD was significant with F(42,4357) = 64.119, p<.001 with an adj. R^2 of .376 indicating that this model was slightly weaker than the model that included PRD. Nonetheless, the model excluding PRD also accounted for just under 40% of the variance of problem gambling.

Results for both problem gambling analyses (including/excluding PRD), using the PPGM categories variable as the dependent variable, can be seen in Table 2. Within the problem gambling analysis excluding PRD, variables are ordered by their standardized betas with the exception of PRD which is placed in its ordinal position from the analysis in which it is included. Shown in Table 2 are the unstandardized betas, standard errors, standardized betas, t statistics, and squared semi-partial correlations (the unique variance that would be removed from the model if the independent variable was not there (Williams, 2019)). Significance is reported with the standardized betas (see notes at the bottom of table 2).

Table 2. *Results for Problem Gambling Multiple Regressions Predicting Problem Gambling Cross-Sectionally Including and Excluding PRD*

	Excluding PRD					Including PRD				
Variable	B	SE	β	t	sr_i^2	B	SE	β	t	sr_i^2
Number of Formats	.123	.007	.274***	17.895	.045	.121	.007	.270***	17.764	.044
Maximum Frequency	.078	.006	.163***	12.639	.023	.076	.006	.159***	12.450	.022
Personal Relative Deprivation	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	.013	.002	.123***	8.783	.011
Resistance to Gambling Fallacies	-.050	.005	-.125***	-9.499	-.013	-.046	.005	-.114***	-8.632	-.010
Peers who gamble	.071	.009	.103***	7.684	.008	.071	.009	.103***	7.736	.008
Impulsivity	.013	.002	.095***	7.254	.007	.011	.002	.083***	6.310	.005
Gambling to Escape	.133	.022	.077***	5.918	.005	.129	.022	.075***	5.819	.005
Gambling to Support Cause	-.129	.023	-.069***	-5.639	-.004	-.120	.023	-.064***	-5.254	-.004
Family History of Prob. Gambling	.142	.028	.062***	5.056	.004	.142	.028	.062***	5.082	.004
Substance Use Disorder	.102	.023	.061***	4.477	.003	.096	.023	.058***	4.224	.003
Tobacco Use	.013	.003	.057***	4.228	.003	.012	.003	.053***	3.930	.002
Other Drugs	.166	.044	.051***	3.741	.002	.158	.044	.049***	3.602	.002
Sex (female)	-.054	.017	-.041**	-3.129	-.001	-.042	.017	-.031*	-2.445	-.001
Divorced	.100	.031	.041**	3.242	.002	.101	.031	.042***	3.298	.002
Unemployed	.143	.050	.036**	2.874	.001	.121	.050	.030*	2.444	.001
Gambling to Compete	.097	.036	.034**	2.709	.001	.100	.036	.035**	2.819	.001
Alcohol Use	-.011	.004	-.034**	-2.670	-.001	-.009	.004	-.030*	-2.345	-.001
Household Income	-.012	.005	-.034*	-2.282	-.001	-.004	.005	(-.011)	-.755	-.000
Depression	.062	.030	.029*	2.035	.001	.050	.030	(.024)	1.668	.000
PTSD	.093	.043	.029*	2.185	.001	.088	.042	.028*	2.090	.001
Importance of Money	-.015	.010	(-.019)	-1.563	-.000	-.027	.010	-.033**	-2.709	-.001
Gambling to Improve Skills	.092	.055	(.022)	1.688	.000	.117	.054	.028*	2.154	.001

Notes: N/A=Not Applicable, B=Unstandardized beta, SE=Standard Error, β=Standardized beta, t=t statistic, sr_i^2=Squared semi partial correlation, ***=p<.001, **=p<.01, *=p<.05, ( )=Nonsignificant

Variables commonly associated with problem gambling in other analyses are also strong predictors in these analyses. The gambling intensity variables (number of formats and maximum frequency) are commonly some of the strongest predictors of problem gambling (Mazar et al., 2020; Williams et al., 2015). In both problem gambling analyses, number of formats and maximum frequency were the strongest predictors of problem gambling (see Table 2). Number of formats was the strongest predictor of problem gambling categories indicating that those who gambled on a larger variety of formats within the previous 12 months were more likely to be problem gamblers. Maximum frequency was the second strongest predictor in both models indicating that those who gamble more frequently are more likely to be problem gamblers.

In answer to our research question concerning the strength of the relationship between PRD and problem gambling categories, PRD was significant and positively related to the problem gambling categories variable within this comprehensive model predicting problem gambling. Out of the 20 significant predictors, PRD had the third strongest relationship ($\beta = .123$, $t = 8.783$, $p<.001$) indicating that feelings of PRD are high among problem gamblers.

Our analysis also replicated the important relationship between problem gambling and several other commonly strong predictor variables such as resistance to gambling fallacies, peers who gamble, and impulsivity. These variables are strong predictors of problem gambling even when PRD is included in the model. Gambling fallacies are commonly associated with being a problem gambler across studies (Goodie & Fortune, 2013; Williams et al., 2015). Resistance to gambling fallacies was the fourth strongest predictor of problem gambling. This strong negative relationship indicates that problem gamblers show less resistance to gambling fallacies and therefore, are more likely to hold fallacious beliefs. Knowing peers who gamble is also a common (yet usually smaller) predictor of problem gambling (Delfabbro & Thrupp, 2003; Donati

et al., 2013; Yip et al., 2017). In our analysis, peers who gamble was stronger than expected, being the fifth strongest predictor. Impulsivity is the most common personality predictor of problem gambling across studies (Bagby et al., 2007; Hodgins et al., 2012; Williams et al., 2015). Therefore, it is unsurprising that impulsivity is the sixth strongest predictor indicating that problem gamblers tend to be impulsive. A full listing of each significant independent variable is displayed in Table 2.

Differences Between Problem Gambling Analyses

Although differences between the two models are generally small there are some changes to variable strength and statistical significance in the models depending on the inclusion or exclusion of PRD. When PRD is added, the majority of predictor variable dropped slightly in their β scores indicating that PRD accounts for some of the variance in the model and may be related to a wide variety of predictor variables.

The addition of PRD into the model resulted in two variables becoming nonsignificant and two becoming significant. Household income, and depression became nonsignificant with the addition of PRD indicating that both variables are closely related to PRD. Household income changed the most in not just significance but also in its β scores which dropped more than most other variables (β = -.034 with PRD excluded and β = -.011 with PRD included). PRD taking variance from household income is not surprising because Callan et al. (2015a) and Mishra and Meadows (2018) have reported negative correlations between income and PRD. The change in depression is smaller than the change with household income. However, Callan et al. (2015a) reported a positive relationship between depression and PRD making the current results unsurprising.

The two variables that were added to the model with the addition of PRD were

"importance of money," and the gambling motivation "to improve skills," indicating that PRD does not have a strong relationship with these variables. These two variables were some of the weakest in both models in terms of β, and sr_i^2 scores. Therefore, little can be stated about their addition with any confidence. There was likely overlap and shared variance between many of the variables because many of the variables are correlated. One variable that overlaps with others can take away or add variance based on its inclusion or exclusion in a model. Furthermore, some variables that are very close to reaching (or barely reaching) significance can lose or gain significance if minor changes are made to the model. Therefore, particularly for variables whose variance accounted for is near the cutoff for significance, adding or removing variables can cause them to become significant or nonsignificant. It's likely that when PRD took away variance from most variables, weaker variables were able to become significant.

A few variables that did not become significant or nonsignificant experienced changes in β more than others. Two variables that had the largest changes when PRD was added were the positive relationship between problem gambling and impulsivity and a negative relationship between problem gambling and sex (being female). Both variables became weaker predictors indicating that PRD has a relationship with being impulsive and being male. Prior studies have reported that PRD is positively related to impulsivity and impulsive behaviour (Callan et al., 2011; Mishra & Novakowski, 2016). Daly (2017) has argued that being male is possibly related to feelings of PRD (although, this has not been confirmed with the PRD scale) which may account for the reduction in the relationship with problem gambling, independent of impulsivity, when PRD entered the model.

Results from the problem gambling analysis including PRD, show that PRD and higher problem gambling categories have a strong positive relationship. The model including PRD

revealed that PRD was within the top three predictors of problem gambling even when included in a model containing a large number of predictors that have been significant in prior studies.

Gambling Intensity Analyses

The gambling intensity analyses used the same 45 variables, and 4,400 ANP Online Panel Survey respondents as the problem gambling analyses except number of formats and maximum frequency were used as the dependent variables instead of the problem gambling categories variable. Table 1 includes all variables used.

The problem gambling analyses discovered that PRD is strongly positively related to problem gambling when included in a model containing many of the common predictors of problem gambling cross-sectionally. However, the relationship did not indicate cause and as a second wave variable, PRD cannot be used in a longitudinal analysis with our current data. Instead, I constructed an analysis where I could infer causality by investigating the relationship between gambling intensity (the strongest predictor of problem gambling) and PRD to answer the second research question which was, Is PRD positively related to gambling intensity? If so, how much of the variance does PRD explain in gambling intensity? PRD being related to the strongest predictors of problem gambling could indicate that PRD is important in the formation of problem gambling. Within the ANP Online Panel data set are two variables that are indicative of gambling intensity. These variables are Number of formats (number of different types of formats played in the past 12 months) and maximum frequency (maximum number of times played on most frequently played gambling format in the past 12 months). Therefore, I ran two multiple regressions.

Gambling Number of Formats Regression Results

The gambling number of formats model was significant $F(43,4356) = 78.297$, $p < .001$ with an adj. R^2 of .430 indicating that the predictors in the model accounted for over 40% of the variance for gambling formats.

Results for the gambling intensity analyses, using the number of formats variable as the dependent variable, can be seen in Table 3. Only the results of the analysis including PRD are shown because PRD had no influence on the model. The variables are ordered by their standardized betas (with the exception of PRD which is placed at the top of the table for emphasis). Shown are the unstandardized betas, standard errors, standardized betas, t statistics, and squared semi-partial correlations. Significance is reported with the standardized betas (see notes at the bottom of table 3).

Table 3. *Results for Gambling Intensity Multiple Regression Predicting Number of Formats Gambled Cross-Sectionally*

Variable	B	SE	β	t	sr_i^2
Personal Relative Deprivation	-.001	.003	(-.004)	-.266	-.000
Problem Gambling	.557	.031	.250***	17.764	.041
Peers who Gamble	.229	.020	.149***	11.683	.018
Resistance to Gambling Fallacies	-.131	.011	-.147***	-11.654	-.018
Age	-.015	.002	-.140***	-7.997	-.008
Gambling for Excitement	.296	.037	.100***	8.079	.008
Maximum Frequency	.101	.013	.095***	7.616	.008
Gambling to improve Skills	.798	.116	.085***	6.902	.006
Other Drugs	.555	.094	.076***	5.900	.004
Gambling to Socialize	.316	.056	.069***	5.654	.004
Depression	-.325	.065	-.069***	-5.034	-.003
Gambling to Win	-.207	.039	-.066***	-5.262	-.004
Gambling to Compete	.399	.076	.063***	5.247	.004
Cannabis Use	.043	.010	.060***	4.466	.003
Gambling to Escape	.208	.048	.054***	4.357	.003
Panic	.259	.065	.052***	3.962	.002
Stressful Life Events	.039	.012	.048**	3.264	.001
Anxiety	-.188	.071	-.036**	-2.630	-.001
Stress	-.052	.021	-.035*	-2.442	-.001
Alcohol Use	.020	.009	.029*	2.392	.001
Gambling for Other Reasons	-.189	.079	-.029*	-2.406	-.001
Unemployed	-.245	.106	-.028*	-2.302	-.001
Household Income	.022	.011	.028*	1.982	.001
Gambling to Feel Good	-.189	.091	-.025*	-2.065	-.001

B=Unstandardized beta, SE=Standard Error, β=Standardized beta, t=t statistic, sr_i^2=Squared semi partial correlation, ***=p<.001, **=p<.01, *=p<.05, ()=Nonsignificant

Our analysis replicated the important relationship between number of formats and several other predictor variables such as problem gambling, peers who gamble, and maximum frequency. number of formats is a strong predictor of problem gambling in both our problem gambling analyses and in other literature on problem gambling (Binde, et al., 2017; el-Guebaly et al., 2015; Mazar et al., 2020; Williams et al., 2015). Therefore, it is unsurprising that in the number of formats analysis, problem gambling was the strongest predictor of number of formats. People who gamble heavily or are problem gamblers are more likely to have peers who gamble who may

influence their behaviour (Blaszcynski & Nower, 2002; Delfabbro & Thrupp, 2003) and our problem gambling analyses also found a strong relationship between problem gambling and peers who gamble. Peers who gamble was positively related to number of formats and was the second strongest predictor in the model. Both variables, number of formats and maximum frequency are indicators of gambling intensity (Williams et al., 2015) and both are strongly positively correlated with each other (Mazar et al., 2020). Maximum frequency was also positively related as the sixth strongest predictor of number of formats in our model. A full listing of each significant independent variable is displayed in Table 3.

If PRD is a causal predictor of problem gambling then, like the predictors listed above, PRD should influence gambling intensity which should lead to problem gambling. As can be seen in Table 3, PRD was not a significant predictor of the number of formats variable (β = -.004, t = -0.266, p > .05) and added no contribution to the model (sr_i^2 = -.000).

Maximum Frequency Regression Results

The gambling maximum frequency model was significant F(43,4356) = 21.819, p < .001 with an adj. R^2 of .169 indicating that the predictors in the model accounted for over 16% of the variance for gambling frequency.

Results for the gambling intensity analyses, using the maximum frequency variable as the dependent variable, can be seen in Table 4. Only the results of the analysis including PRD are shown because PRD had no influence on the model. The variables are ordered by their standardized betas (with the exception of PRD which is placed at the top of the table for emphasis). Shown are the unstandardized betas, standard errors, standardized betas, t statistics, and squared semi-partial correlations. Significance is reported with the standardized betas (see notes at the bottom of table 4).

Table 4. *Results for Gambling Intensity Multiple Regression Predicting Maximum Frequency of Gambling Cross-Sectionally*

Variable	B	SE	β	t	sr_i^2
Personal Relative Deprivation	.002	.004	(.009)	.526	.000
Age	.022	.002	.228***	10.800	.022
Problem Gambling	.451	.036	.216***	12.450	.029
Number of Formats	.130	.017	.138***	7.616	.011
Gambling to Win	.339	.044	.115***	7.610	.011
Sex (female)	-.226	.041	-.082***	5.465	-.006
Gambling to Escape	.288	.054	.080***	5.327	.005
Alcohol Use	.050	.010	.076***	5.196	.005
Educational Attainment	-.035	.009	-.058***	-3.891	-.003
Stress	.078	.024	.055**	3.209	.002
Anxiety	-.227	.081	-.047**	-2.809	-.002
Gambling to Socialize	-.190	.063	-.044**	-2.996	-.002
Household Income	.030	.013	.041*	2.346	.001
Peers who Gamble	.059	.023	.041**	2.623	.001
Single	.130	.056	.037*	2.326	.001
Tobacco Use	.016	.008	.034*	2.155	.001
Unemployed	-.273	.120	-.033*	-2.268	-.001
Impulsivity	-.009	.004	-.031*	-2.039	-.001

B=Unstandardized beta, SE=Standard Error, β=Standardized beta, t=t statistic, sr_i^2=Squared semi partial correlation, ***=p<.001, **=p<.01, *=p<.05, ()=Nonsignificant

Our analysis replicated the important relationship between maximum frequency and other independent variables such as problem gambling, and number of formats. Problem gamblers generally gamble at a high frequency (el-Guebaly et al., 2015; Holtgraves, 2009; Williams & Volberg, 2010; Williams et al., 2015). The analyses predicting problem gambling also reported a strong positive relationship between problem gambling and maximum frequency. Therefore, it is no surprise that problem gambling was the second strongest predictor of maximum frequency in this analysis. Number of formats is positively correlated with frequency of gambling behaviour (Mazar et al., 2020). The analysis predicting number of formats found a strong positive relationship between the two variables. Therefore, it is unsurprising that number of formats was the third strongest predictor in this analysis. A full listing of each significant independent variable

is displayed in Table 4.

The strongest predictor of maximum frequency was older age which was less expected because usually younger age is correlated with gambling problems (Williams, et al., 2012; Williams & Volberg, 2013). However, most problem gamblers gamble frequently but most gamblers who gamble at a high frequency are not problem gamblers. Therefore, this analysis probably captured much of the older population that gambled as a frequent activity but did not necessarily have problems. This model was also weaker than the problem gambling and number of formats models as can be seen by its lower adj. R^2 of .169 when compared to the other models that had adj. R^2 scores over .3. This lower adj. R^2 indicates that the selected independent variables are better predictors of problem gambling than maximum frequency which is not surprising because these variables were chosen with problem gambling being foremost in mind. Nonetheless, this model still accomplished replicating expected relationships between maximum frequency and problem gambling, and number of formats.

To answer the research question, surprisingly, like the number of formats analysis, PRD was nonsignificant in this analysis ($\beta = .009$, $t = 0.526$, $p > .05$), and added no contribution to the model ($sr_i^2 = .000$).

Personal Relative Deprivation Analysis

Descriptive Statistics

Table 5 includes all variables being used in the PRD analysis. The variables in this table are the same variables displayed in Table 1, with the only difference being that all administrations of these variables are from Baseline of the ANP Online Panel survey data set with the exception of the PRD variable. All variables contain 4,406 cases. The total of each categorical and ordinal variable is in the total column with total counts on the left and percentages of total responses in

the brackets on the right. The means and standard deviations of the continuous variables are also located in the total column. Variables are broken up into 6 sections labeled a-f.

Description of Sample

Overall, the sample used in the PRD analysis is nearly identical to the sample used in the problem gambling and gambling intensity analyses and consequently the descriptive statistics are also nearly identical. As can be seen in section a. of Table 1., most participants in the sample were female (by a small margin). The average age of the sample was in the mid 50's. Most participants were also married and had full time employment. For gambling variables (see section b.) most of the sample was composed of recreational gamblers, close to half of the sample knew peers who gambled, and the most selected motivation to gamble was to win money. For substance use variables (see section c.) most drank alcohol, and the fewest engaged in the use of "other drugs." For mental health variables (see section d.) the most common mood disorder was depression and the least common was PTSD. Most of the sample also reported feeling some stress within the past 12 months (see section e.).

The purpose of the PRD analysis was to answer the third research question, What variables predict PRD? Although some studies have found correlations between PRD and other variables (Callan et al., 2011; Mishra & Novakowski, 2016), few if any have done an exploratory analysis with the same large number of problem gambling independent variables to investigate which variables are the strongest. This analysis allows us to investigate what predicts PRD, and the overlap between variables that predict problem gambling and PRD. This analysis is exploratory. Therefore, a stepwise multiple regression was used to create the best model possible for predicting PRD with the available variables (Williams, 2019).

Table 5. *Descriptive Statistics for all Variables Included in Personal Relative Deprivation Analysis*

Variable		Total
a. Demographic Variables		
Sex	Male	2156 (48.9)
	Female	2250 (51.1)
Age	M	54.89
	SD	14.19
Marital Status	Single	868 (19.7)
	Married	2840 (64.5)
	Separated	121 (2.7)
	Divorced	362 (8.2)
	Widowed	215 (4.9)
Employment Situation	Full Time	1899 (43.1)
	Part Time	472 (10.7)
	Sick Leave	150 (3.4)
	Homemaker	178 (4.0)
	Unemployed	161 (3.7)
	Student	36 (0.8)
	Retired	1510 (34.3)
Household Income	M	4.16
	SD	1.88
Educational Attainment	M	6.06
	SD	2.28

b. Gambling Variables		
Problem Gambling	Recreational	3423 (77.7)
	At-Risk	567 (12.9)
	Problem/Pathological	416 (9.4)
Number of Formats	M	2.68
	SD	1.51
Maximum Frequency	M	3.52
	SD	1.21
Family History of Problem Gambling		415 (9.4)
Peers Who Gamble	None	2347 (53.3)
	One	737 (16.7)
	A few	1180 (26.8)
	Many	111 (2.5)
	All	31 (0.7)
Gambling Motivations	Excitement	2141 (48.6)
	Win	3038 (69.0)
	Skills	111 (2.5)
	Compete	254 (5.8)
	Socialize	573 (13.0)
	Cause	674 (15.3)
	Escape	832 (18.9)
	Feels good	138 (3.1)
	Other	137 (3.1)
Resistance to Gambling Fallacies	M	6.57
	SD	1.71

c. Substance Use Variables		
Alcohol Use	Not at all	469 (10.6)
	Less than once a month	711 (16.1)
	Once a month	367 (8.3)
	2 to 3 times a month	629 (14.3)
	Once a week	591 (13.4)
	2 to 3 times a week	883 (20.0)
	4 to 6 times a week	502 (11.4)
	Every day	254 (5.8)
Tobacco Use	Not at all	3020 (68.5)
	Less than once a month	157 (3.6)
	Once a month	72 (1.6)
	2 to 3 times a month	85 (1.9)
	Once a week	53 (1.2)
	2 to 3 times a week	103 (2.3)
	4 to 6 times a week	110 (2.5)
	Every day	806 (18.3)
Cannabis Use	Not at all	3457 (78.5)
	Less than once a month	309 (7.0)
	Once a month	96 (2.2)
	2 to 3 times a month	103 (2.3)
	Once a week	69 (1.6)
	2 to 3 times a week	105 (2.4)
	4 to 6 times a week	76 (1.7)
	Every day	191 (4.3)
Other Drugs		174 (3.9)

d. Mental Health Variables		
Substance Use Disorder (SUD)	No SUD	4142 (94)
	Mild SUD	196 (4.4)
	Moderate SUD	43 (1.0)
	Extreme SUD	25 (0.6)
Depression		505 (11.5)
Anxiety		309 (8.8)
PTSD		156 (3.5)
Panic		386 (8.8)
e. Stress Related Variables		
Stress	Not at all stressful	429 (9.7)
	Not very stressful	1243 (28.2)
	A bit stressful	1760 (39.9)
	Quite a bit stressful	772 (17.5)
	Extremely stressful	202 (4.6)
Negative Life Events	M	1.31
	SD	1.97
History of Child Abuse		760 (17.2)
f. Individual Differences Variables		
Impulsivity	M	14.12
	SD	4.92
Personal Relative Deprivation	**M**	**16.16**
	SD	**6.08**
Importance of Money	Not important	138 (3.1)
	Somewhat important	1507 (34.2)
	Quite important	1629 (37.0)
	Very important	1132 (25.7)

Notes: All variables are from Baseline with the exception of PRD, N=4406

Personal Relative Deprivation Regression Results

The multiple regression model was significant $F(20,4385) = 71.011$, $p < .001$ with an adj. R^2 of .241 indicating that the independent variables in the model accounted for nearly 25% of the variance in PRD.

Results for the stepwise multiple regression with PRD as the dependent variable are displayed in Table 6. Variables are ordered by their standardized betas. Shown are the unstandardized betas, standard errors, standardized betas, t statistics, adj. R^2, and steps. adj. R^2

which is the cumulative strength of the model when each variable enters the regression, and step is the step at which each variable was added to the model.

Table 6. *Results for Stepwise Multiple Regression Predicting Personal Relative Deprivation Using Variables from the Previous Year.*

Variable	B	SE	β	t	adj. R^2	Step
Household Income	-.591	.048	-.183***	-12.350	.166	3
Stress	.766	.095	.125***	8.042	.089	1
Problem Gambling	1.195	.140	.125***	8.546	.130	2
Impulsivity	.141	.018	.114***	7.750	.211	5
Retired	-1.465	.247	-.114***	-5.935	.217	6
Age	-.044	.008	-.104***	-5.401	.198	4
Importance of Money	.565	.098	.078***	5.766	.224	7
Sex (Female)	-.780	.167	-.064***	4.671	.227	8
Gambling for Excitement	-.737	.164	-.061***	-4.495	.230	9
Cannabis Use	-.185	.048	-.056***	-3.851	.236	12
Resistance to Gambling Fallacies	-.172	.051	-.048***	-3.407	.234	11
Anxiety	1.001	.326	.047**	3.078	.233	10
Tobacco Use	.082	.031	.038**	2.645	.237	13
Depression	.684	.291	.036*	2.353	.239	15
Single	.451	.224	.030*	2.015	.239	16
Gambling to Improve Skills	-1.171	.533	-.030*	-2.199	.240	18
Unemployed	.951	.446	.029*	2.130	.238	14
Employed Part Time	-.544	.277	-.028*	-1.967	.240	17
Gambling for Other Reasons	-.877	.466	(-.025)	-1.882	.241	19
Gambling to Feel Good	.794	.471	(.023)	1.684	.241	20

Notes: This is the final model (model 20) from the stepwise analysis, B=Unstandardized beta, SE=Standard Error, β=Standardized beta, t=t statistic, adj. R^2=Adjusted R Squared of each step, Step=Step at which variable was added to model, ***=p<.001, **=p<.01, *=p<.05, ()=Nonsignificant

The PRD analysis results replicated relationships found in prior correlational studies including PRD's relationship with income, stress, problem gambling, impulsivity, and age. Callan et al (2015a) and Mishra and Meadows (2018) have reported that low household income or SES are related to feelings of PRD. The problem gambling analyses removed household income from the model when PRD was added indicating a relationship between the two variables. In the PRD analysis, household income was the strongest predictor of PRD. The relationship was negative, indicating that those with lower incomes experience stronger feelings of PRD. Mishra and

Meadows (2018) demonstrated stress as being positively related to feelings of PRD. In this analysis stress was the second strongest predictor of PRD.

Problem gambling is a correlate to PRD in some studies (Callan et al., 2008; Mishra & Novakowski, 2016). The problem gambling analysis (including PRD) found a strong positive relationship between PRD and problem gambling. Therefore, it is unsurprising that problem gambling category was the third strongest predictor of PRD. It is worth noting that like the gambling intensity analyses, PRD was not significantly related to number of formats or maximum frequency further indicating that PRD is related to problem gambling but not gambling intensity.

PRD is correlated with impulsivity (Mishra & Novakowski, 2016), and young age (Callan et al., 2015b). Impulsivity was positively related to PRD and was the fourth strongest predictor in this analysis indicating that impulsive people tend to experience stronger feelings of PRD. Age was negatively related to PRD and was the sixth strongest predictor indicating that young people are more likely to experience stronger feelings of PRD.

This analysis is the most comprehensive analysis to date on PRD and its relationship to problem gambling predictors. Results from the PRD analysis confirm that PRD is independently related to household income, stress, problem gambling, and impulsivity replicating results of less comprehensive studies. Results of this analysis also confirm some of the relationships between PRD, problem gambling, and problem gambling predictors found in the problem gambling analyses. Implications of these results will be discussed in the discussion section.

Discussion

Previous studies have consistently demonstrated that there is a strong relationship between feelings of personal relative deprivation (PRD) and problem gambling. This relationship is interpreted as evidence that PRD has a causal effect on the development of disordered gambling, however, these results are based on cross sectional data and rarely included other well-established predictors of problem gambling. The current study expands on existing literature by investigating the strength of the relationship between PRD and problem gambling when other common predictors and potential mediating factors such as stress (Mishra & Meadows, 2018), negative mood and low income[4] (Callan et al., 2015a) are included in the analysis. Furthermore, I used both cross-sectional and longitudinal data to help identify the causal direction of the relationship between PRD and problem gambling. Results indicate that even though PRD has a strong relationship with problem gambling, PRD is likely caused by problem gambling rather than the reverse.

To investigate the relationship between PRD and problem gambling and PRD's relationship to other problem gambling predictors I ran two multiple regressions that predicted problem gambling cross-sectionally. The first multiple regression was a replication of previous research and contained all of the common predictors of problem gambling found in prior large-scale analyses investigating the causes and predictors of problem gambling (el-Guebaly et al., 2015; Williams et al., 2015). Results were consistent with previous findings such as strong relationships between problem gambling and predictors like gambling intensity, gambling fallacies, and trait impulsivity. The second multiple regression was the same as the first with the

[4] Negative mood and low income are both independently correlated with PRD (Callan et al., 2015a) and Mishra and Meadows (2018) demonstrated that stress mediated the relationship between PRD and problem gambling in a mediation analysis.

exception of adding PRD to the model, allowing us to determine PRD's relative predictive power and impact on other variables in the model.

PRD was the third strongest predictor of problem gambling with a standardized beta of .123. The only variables that had greater predictive power were number of formats (β = .270), and maximum frequency (β = .159). A particularly important finding is that PRD had a stronger relationship with problem gambling than several variables that are moderate predictors of problem gambling. For example, resistance to gambling fallacies (β = -.114), peers who gamble (β = .103), and impulsivity (β = .083). Furthermore, the inclusion of PRD in the second multiple regression dropped standardized beta values from β = .095 to β = .083 for impulsivity; and from β = -.410 to β = -.031 for being female; and, income and depression became non-significant indicating that there is likely shared variance between PRD and these variables. The overall adjusted r squared values changed very little between the two models predicting problem gambling with the addition of PRD changing the adjusted r squared from .376 to .387. Therefore, the addition of PRD adds little power to the analysis and mainly contributes by accounting for variance among other predictors of problem gambling.

These results are unsurprising given that PRD is associated with risk-related individual differences, including personality traits such as impulsivity and performance on delayed discounting tasks (Callan et al., 2011; Mishra & Novakowshi, 2016). Lyu and Sun (2020) demonstrated that being male and having a lower income is positively correlated with increased feeling of PRD (though not measured with the Callan PRD scale) (Lyu & Sun, 2020). Callan et al. (2015a) demonstrated that depression is positively related to both problem gambling and PRD, and Osborne et al. (2012) argued that depression may be a possible mediating factor between PRD and changes in behaviour. However, what was surprising was that PRD appeared to have

very little effect on variables that are the best predictors of subsequent year problem gambling. Standardized beta values for number of formats dropped from $\beta = .274$ to $\beta = .270$ and maximum frequency dropped from $\beta = .163$ to $\beta = .159$. These minor changes indicate that PRD is not related to gambling intensity. If PRD has a causal influence in the development of problem gambling, then we would expect to see a relationship between PRD and these variables.

In the two multiple regression models that predicted gambling intensity cross-sectionally using number of formats and maximum frequency as dependent variables, PRD did not significantly predict either variable. Again, this is surprising because previous cross-sectional studies have consistently found a relationship between PRD and problem gambling. Authors have argued for a causal pathway that assumes PRD leads to the choice to gamble (Callan et al., 2008), which leads to increased gambling intensity (Callan et al., 2011), which leads to problem gambling. Supporting this assertion is that the best statistical predictors of future problem gambling are variables that measure gambling intensity which generally immediately precedes becoming a problem gambler (Williams et al., 2015). If PRD is a causal factor in problem gambling, we would expect to see a strong relationship with PRD predicting gambling intensity just as well or better than problem gambling indicating that PRD influences increased gambling behaviour leading to problem gambling. Our results do not show any relationship between PRD and gambling intensity when included in a model containing many predictors of problem gambling. Therefore, a better interpretation of the relationship between PRD and problem gambling is that PRD is a psychological consequence of problem gambling rather than a cause of problem gambling. This interpretation of the relationship between PRD and problem gambling makes sense because problem gambling is defined by a lack of self-control in limiting one's gambling behaviour resulting in adverse consequences or disadvantages (Gambling Research

Australia, 2005) such as debt, bankruptcy, and divorce (Shannon et al., 2017). Gambling heavily does not necessitate a lack of self-control or adverse outcomes. Therefore, if losing money due to gambling causes PRD, gambling heavily by itself may not be sufficient to cause these feelings without the addition of the disadvantages inherent to gambling problems.

To help elucidate the relationship between problem gambling, PRD, and other predictors of problem gambling I ran a multiple regression predicting PRD score. For this final analysis all independent variables were from the Baseline survey or year preceding the measurement of PRD which was only included in the Follow-Up survey. Predicting future PRD allowed me to not only investigate a multitude of possible causes of PRD but more importantly allowed me to investigate the relationship between past year problem gambling and future feelings of PRD. The results are consistent with previous research. The strongest predictor of PRD was household income which had a negative relationship with PRD ($\beta = -.183$); stress and problem gambling were the second and third strongest predictors with an equal standardized beta ($\beta = .125$); and the fourth strongest predictor of PRD was impulsivity ($\beta = .114$). The finding that past year problem gambling is one of the strongest predictors of future PRD is consistent with my assertion that PRD follows problem gambling. However, without longitudinal data I cannot confirm that problem gambling preceded the formation of feelings of PRD.

When considering that PRD does not cross-sectionally predict gambling intensity (the strongest predictor that directly precedes problem gambling) and that problem gambling from the previous year (Baseline survey) is one of the strongest predictors of PRD, I can infer the possibility that the strong cross-sectional relationship between PRD and problem gambling could be due to PRD being a consequence of problem gambling rather than a cause. If PRD is a consequence of problem gambling, then we need to understand PRD's relationship to other

overlapping variables and consider the possibility that feelings of PRD could be another form of gambling related harm. Social comparisons are an important part of understanding our place in the world relative to others and such comparisons can in turn affect our cognitions, affect, and behaviour. Those who are relatively deprived are more likely to think negatively about the world and future, feel negative emotions, and behave in more risky ways (Smith et al., 2012).

Congruent with other research on PRD, the current study also shows that the best predictor of PRD is income. Low socioeconomic status is also a low to moderate predictor of problem gambling. When PRD is included as an independent variable in our analysis predicting problem gambling, income is no longer significant. Similarly, a mediation analysis by Mishra and Meadows (2018) found stress to be a mediator between PRD and problem gambling and Callan et al. (2015a) found that economic disadvantage predicts PRD. Therefore, it is possible that economic disadvantage causes feelings of PRD, and these feelings result in stress. The current study adds support for this line of thought. Taken together, results seem to indicate there is a complex relationship between PRD, income, stress, and problem gambling and that PRD is unlikely to have a direct causal influence on the development of problem gambling.

Strengths and Limitations

The primary strength of the current study is that I was able to look at the effects of PRD on problem gambling in conjunction with other well-established predictors of problem gambling. However, because PRD was not included in the Baseline wave of the ANP Online Panel Survey, I was limited to using cross-sectional data for the multiple regressions predicting problem gambling and gambling intensity. A more robust approach would have been to use longitudinal data for these analyses. It is also worth noting that data and the variables used in the current analysis were gathered for the purpose of studying problem gambling. The sample was over representative of people who gamble and have gambling problems and the variables were

selected based on their relationships to gambling and problem gambling (Williams et al., 2022). Although this data set may be ideal for studying problem gambling (Williams et al., 2022), it was not designed to study PRD. Therefore, a representative general population sample including non-gamblers and other variables may create a more accurate model predicting PRD.

Very few of the studies that investigate the effects of economic inequality on gambling behaviour use subjective measures of inequality (i.e., PRD). Most population studies only use objective measures of disadvantage, such as the Gini coefficient, meaning that one cannot confirm if feelings of PRD are present amongst the population (Bol et al., 2014; Canale et al., 2017). Similarly, most of the experimental studies use only objective disadvantage and many do not use actual gambling behaviour as the dependant measure; rather, they measure financial choice tasks or simple lottery ticket tasks (Haisley et al., 2008; Mishra et al., 2014; Mishra et al., 2015; Payne et al., 2017). The implication is that the results might be exclusive to simple choice tasks and not generalizable to gambling behaviour. The data set used in the current study provided an opportunity to investigate the relationship between subjective disadvantage and problem gambling at a population level using the more fine-grained, and arguably better, measure of disadvantage, PRD.

Future Research

My preferred hypothesis, in light of this study, is that problem gambling causes feelings of PRD rather than feelings of PRD causing problem gambling. I argue that economic losses associated with problem gambling lead to economic disadvantages that in turn cause feelings of PRD. Unfortunately, I was only able to use longitudinal data for the analysis predicting PRD and the conclusions are based on primarily a series of cross-sectional analyses. Future research should aim to replicate the current results using longitudinal data and validated subjective measures of PRD and objective inequality.

Future studies could also include multiple measures of disadvantage. At the individual level, inequality could be measured using the technique used by Odgers et al. (2015). Odgers et al. (2015) used multiple SES variables to indicate the general SES of neighborhoods within a 0.5 mile radius. SES of individuals was assessed through indicators such as household income and government benefits. Therefore, Odgers et al. were able to pinpoint individuals living in objectively unequal conditions by comparing the SES of individuals to that of their overall community. Another useful measure of economic disadvantage would be household debt (excluding mortgage debt) because debt may play an integral part as a cause or consequence of feelings of PRD (Frank, 2000) and problem gambling (Allami et al., 2021). For example: Frank (2000) reported a population level trend of increased luxury spending coinciding with increased levels of debt. He postulated that feelings of PRD may be responsible for this relationship.

Finally, stress and negative moods are often positively related to feelings of PRD in both the literature (Callan et al., 2015a; Mishra & Meadows, 2018) and the current study. It has been theorized that feelings of PRD cause changes in mood (Mishra & Meadows, 2018). However, cause cannot be determined cross-sectionally. Therefore, future research on PRD should attempt to determine if feelings of PRD precede stress and mood changes longitudinally.

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Appendix

The following tables, the first for Baseline variables and the second for Follow-Up variables, contain all the variables used in the analysis. The variable column contains the variable. The variable name column contains the code name so that the variable can be found in the code book and, more importantly, the actual data set. The missing data columns contain the amount of missing data before and after changes were made. The Change column indicates if there was a change or not. None indicates no changes made. The analysis column indicates the analyses in which the variables are used (PRD, PG, and GI). PRD indicates that the variable was used for the personal relative deprivation analysis. PG indicates that the variable was used in the problem gambling analysis. GI indicates that the variable was used in the gambling intensity analysis.

Out of 10,199 participants, 4,707 completed both waves. Therefore, those who did not take part in the Follow-Up survey are excluded and any missing data here are from participants who took part in the Follow-Up survey but either did not fill out all of the questions or answered with unsure or prefer not to answer.

After variables with missing data were changed, I was left with 4,400 cases for the problem gambling and gambling intensity analyses and 4,406 for the PRD analysis.

Tables

Table 1: *Baseline Variables*

Variable	Variable Code Name	Type	Missing Data Before Change	Missing Data After Change	Change	Analysis
Problem gambling	b_PPGMCATEGORIES	ordinal	0	31	Removed non-gamblers	PRD
Age	b_d2a	continuous	120	0	imputed mean	PRD, PG, GI
Sex	b_d1	categorical	0	5	removed other	PRD, PG, GI
Marital Status	b_d3	categorical	41	41	dummy coded	PRD
Educational Attainment	b_d6_1	ordinal	0	0	none. Mean already imputed	PRD, PG, GI
Employment Situation	b_d7a	categorical	69	69	dummy coded	PRD
Household Income	b_d8	ordinal	588	0	imputed mean	PRD
Alcohol Use	b_c2a	ordinal	0	0	none	PRD
Tobacco Use	b_c1a	ordinal	0	0	none	PRD
Cannabis Use	b_c4a	ordinal	0	0	none	PRD
Other Drugs	b_c5a	binary	0	0	none	PRD
SUD	b_SUD	ordinal	0	0	none	PRD
Depression	b_DEPRESSION	binary categorical	0	0	none	PRD
Anxiety	b_GANXIETY	binary categorical	0	0	none	PRD
PTSD	b_PTSD	binary categorical	0	0	none	PRD
Panic	b_PANIC	binary categorical	0	0	none	PRD
Stress	b_c8	binary categorical	0	0	none	PRD

Stressful Life Events	b_C10NegTOTAL	continuous	0	0	none	PRD
History of Child Abuse	b_c9	binary categorical	0	0	none	PRD, PG, GI
Impulsivity	b_NEO_N_I_TOTAL	continuous	0	0	none	PRD, PG, GI
Family History of Problem Gambling	b_gfh1a	binary categorical	184	184	none	PRD, PG, GI
Peers Who Gamble	b_ge2	ordinal	470	0	changed category	PRD
Perception of Money	b_gm3	ordinal	0	0	none	PRD
9 Gambling Motivations	b_gm1a_1-9	binary categorical	31	31	Other imputed with mode, already dummy coded	PRD
Gambling Fallacies	b_GFTOTAL	continuous	0	0	none	PRD
Gambling Formats	b_GTYPES	continuous	0	0	none	PRD
Max Frequencies	b_GMAXFREQ	continuous	0	0	none	PRD

Table 2: *Follow-Up Variables*

Variables	Variable Code Name	Type	Missing Data Before Change	Missing Data After Change	Change	Analysis
PRD	F_RDTOTAL	continuous	0	0	none	PRD, PG, GI
Problem Gambling	F_PPGMCATEGORIES	categorical	0	125	Removed non-gamblers	PG, GI
Marital Status	F_d3	categorical	40	0	Imputed mode, dummy coded	PG, GI
Employment Situation	F_d7a	categorical	68	0	Imputed mode, dummy coded	PG, GI
Household Income	F_d8	ordinal	521	0	imputed mean	PG, GI
Alcohol Use	F_c2a	ordinal	0	0	none	PG, GI
Tobacco Use	F_c1a	ordinal	0	0	none	PG, GI
Cannabis Use	F_c4a	ordinal	0	0	none	PG, GI
Other Drugs	F_c5a	binary	0	0	none	PG, GI
SUD	F_SUD	ordinal	1447	0	Added non sud	PG, GI
Depression	F_DEPRESSION	binary categorical	0	0	none	PG, GI
Anxiety	F_GANXIETY	binary categorical	0	0	none	PG, GI
PTSD	F_PTSD	binary categorical	0	0	none	PG, GI
Panic	F_PANIC	binary categorical	0	0	none	PG, GI
Stress	F_c8	binary categorical	0	0	none	PG, GI
Stressful Life Events	F_CNegTOTAL	continuous	0	0	none	PG, GI
Peers Who Gamble	F_ge2	ordinal	691	0	changed category	PG, GI
Perception of Money	F_gm3	ordinal	0	0	none	PG, GI

9 Gambling Motivations	F_gm1a_1-9	binary	124	124	none, already dummy coded	PG, GI
Gambling Fallacies	F_GFTOTAL	continuous	0	0	none	PG, GI
Gambling Formats	F_GTYPES	continuous	0	0	none	PG, GI
Max Frequencies	F_GMAXFREQ	continuous	0	0	none	PG, GI