

## **Development of an Instrument for Identifying Risk for Problem Gambling among Slot Machine Gamblers in Ontario**

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### **Abstract**

Few gambling assessment tools have been developed to specifically identify gambling risk prior to the onset of problems (e.g., pre-consequence). Given increasing focus on prevention there is a need for new instruments that identify pre-harm indicators of risk, can be self-administered and/or used for general population applications (e.g., surveys), ideally, alerting, educating, and motivating individuals to reduce risk for development of gambling problems. This study refined and tested a new instrument designed to independently identify risk and problem gambling among slot machine gamblers in Ontario and provide insight about the factors contributing to score outcomes. The new instrument, Focal Adult Gambling Screen (FLAGS) was based on a research model previously designed to identify antecedents of problem gambling. A preliminary model was developed and tested in two jurisdictions (Nova Scotia, Canada and Victoria, Australia) and found to be successful in discriminating between risk for problem gambling and the experience of gambling harm (e.g., negative consequences). Opportunities for improving instrument performance were identified related to recent developments in the area of construct design and method bias, as well as new information emerging in the gambling and problem gambling literature including the Problem Gambling framework of the Ontario Problem Gambling Research Centre that outlines a range of risk factors contributing to the onset, reinforcement and maintenance of gambling problems (OPGRC, 2008). A beta version of the FLAGS instrument was formed using 48 of the 132 statements tested. Partial Least Squares (PLS) analysis was used to test the overall model as well as the validity and reliability of each of the ten constructs comprising the new instrument; 5 formative and 5 reflective. The constructs were tested using appropriate criteria specifically related to construct type and a scoring method developed for each. Responses were then summed and used to allocate casino machine gamblers to one of five risk categories: Level I – No Detectable Risk; Level II - Early Risk; Level III - Intermediate Risk; Level IV - Advanced Risk; Level V - Problem Gambling. Resulting classifications were compared to those derived using the Problem Severity Gambling Index (PGSI) of the Canadian Problem Gambling Index (CPGI). There was considerable overlap in classification at the problem gambler level but less so at the risk levels where FLAGS proved superior in classifying pre-harm gambling risk, an important threshold for prevention applications.

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*Prepared by Schellinck, T., Schrans, T., Bliemel M., & Schellinck, H.*

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## **1.0 INTRODUCTION**

A requirement exists for a new gambling measurement instrument that not only provides gamblers with information to help protect them from harm but that also clearly differentiates between the identification of those at risk versus those already experiencing problems with their gambling.

To date, professionals have created a number of screens that could be administered to identify problem gamblers among treatment clientele: examples include the South Oaks Gambling Screen (SOGS) (Lesieur & Blume 1987, 1993) and the DSM-IV (APA, 1980). Following debates surrounding the issue of pathological versus problem gambling and the utility of the existing gambling screens for general population use, (Dickerson, 1993b; Volberg, 1996; Walker and Dickerson, 1996, Lesieur 1994), researchers developed new screens, including the Canadian Problem Gambling Index (CPGI) (Ferris & Wynne, 2001) and the Victorian Gambling Screen (VGS) (Ben-Tovim, Esterman, Tolachard, & Battersby 2001), that could be administered by trained interviewers for prevalence surveys and other non-clinical purposes. These screens also include risk estimates as a component of identifying problem gambling thereby expanding the potential of the instruments for risk identification in general population applications over previous problem gambling screens (e.g., DSM IV & SOGS). However, the risk and problem gambling components of these up-dated instruments continue to be comprised of highly correlated items (e.g., reflective constructs) suggesting that the risk items are measuring the same underlying construct as the harm components, in this case problem gambling.

While identification of problem gambling is useful for allocation of treatment resources, successful prevention and harm reduction is contingent on the ability of gamblers and others to identify impairment before negative outcomes occur. In 1998, researchers at Focal Research Consultants concluded that while existing instruments were able to identify problem gambling, relatively sparse information was produced for detecting those at risk of developing problems. Using structural equation modeling with data gathered during the 1998 Nova Scotia Video Lottery Players Study Schellinck and Schrans (1998) developed a hierarchical model of the antecedents of problem gambling.

In 2005/06, the Victoria Gambling Research Panel (Department of Justice) funded research to develop a preliminary risk assessment screen called the Self Administered Problem Gambling Screen (SAPGS) (Schellinck, 2006). The Victoria study comprised 91 active gamblers and

demonstrated that the screen could be easily administered and that it had high face validity in categorizing active gamblers into three groups: 'No Detectable Risk,' 'at risk but without negative consequences,' and 'those experiencing negative consequences'. The study also highlighted the differences between the SAPGS and other screens; it was a multi-dimensional measure with 6 sub-concepts and 35 items, and, it was designed solely for electronic gambling machine (EGM) players. Finally, further structural equation modeling showed that the data gathered in Australia, for the most part, replicated the findings identified using the model with Nova Scotia data (See Appendix F).

Based on this new information, a risk assessment instrument was designed specifically for machine gambling that included measurable precursors of gambling harm including beliefs, motivations, and behaviours (FocaL Adult Gambling Screen (FLAGS)). Unlike other gambling instruments that measure harm after the fact, a risk assessment instrument could empower gamblers to self-identify and correct their behaviour before experiencing negative consequences and simultaneously screen out those experiencing harm or problem gambling.

As the first step in modifying the FLAGS screen for use with slot machine gamblers, OPGRC funded two Level I projects supporting detailed literature searches of recent developments in the area of construct design and method bias. This information was used to develop an expanded and updated list of items for testing among slot machines gamblers in Ontario. In August 2008, OPGRC awarded Focal Research Consultants Level II Funding to conduct Phase 1 of a two-phase study to develop, test, and refine a prototype risk assessment instrument.

The overall goals of the study were to help Ontario slot machine players:

- Recognize potential consequences of problematic gambling behaviour and motivate behavioural changes to avoid negative consequences;
- Recognize problem behaviours as they occur and regard them as indicators/reminders of a potential problem;
- Recognize erroneous cognitions (i.e., beliefs) that may influence/motivate problem gambling behaviour;

- Recognize occasions where motivations for gambling are problematic which may help players change their behaviour;
- Recognize that the player can take actions to avoid or help reduce problematic behaviours.

Phase 1 of the study commenced with a thorough review of 'at risk' and 'problem gambling' literature, including an examination of research supporting natural recovery and self-motivation to modify problem behaviours (Prochaska & DiClemente, 1992; Prochaska, DiClemente & Norcross, 1992; Hodgins & El-Guebaly, 2000; Hodgins, 2001; Schellinck & Schrans, 2004a). The review also included an assessment of the Ontario Problem Gambling Resource Centre's (OPGRC) model components including risk (risk cognitions, risk behaviours and preoccupation) and problem gambling elements (impaired control, negative consequences, persistence) (Dickerson et al, 1992; Ozga & Brown, 2002; Toneatto & Millar, 2004). The findings indicated that the new gambling risk assessment instrument could be strengthened by including additional behavioural items as well as sub-screens associated with risk (situational and personal factors), and impaired control.

Research in Australia examining on-site identification of problem gamblers (Delfabbro, Osborn, Nevile, Skelt, & McMillen, 2007) built upon original work conducted by Schellinck and Schrans' (2004b) and was used to develop an expanded list of observable behaviours found to be highly correlated with problem gambling among machine gamblers. The additional items provided a wider array of cues to assist the gambler in recognizing problematic behaviours and practices ideally encouraging the gambler to initiate self-change and/or seek assistance. Overall, a total of 190 potential indicators were generated for testing in Phase 1 of the study including risk cognitions (e.g., beliefs, motives) and risk practices (i.e., behaviours) hypothesized to place an individual at increased likelihood of experiencing harm from slot machine gambling.

The next stage of the Phase 1 study took place from August 2008 to February 2009. Qualitative evaluation of a revised risk screen was undertaken with a sample of 63 regular gamblers (i.e., played at least once per month) recruited on-site from the Slots at Western Fair in London Ontario. The goal of the qualitative research was to ensure the items reflected the perceived characteristics of Ontario slot machine gambling and that the screen included indicators of risk and harm appropriate for this particular market and context. The evaluation consisted of three parts: 1)

Completion of an independent pre-session survey gathering individual responses to 190 test statements; 2) An in-session evaluation of a test version of the screen (≈30-35 statements); and, 3) Participation in one of six focus groups to examine comprehension, interpretation, and perceived veracity of each item.

In the final stage of Phase 1, the principal investigators carried out preliminary construct analysis to aid in the selection of appropriate items for further testing of the gambling risk assessment instrument. The analysis included correlations to test for relationships between the items tested and to assess multicollinearity; factor analysis using principal component analysis (PCA) with varimax rotation; and, structural equation modeling (SEM) using partial least squares or path analysis (PLS).

Upon completion of Phase 1 a preliminary risk assessment instrument was produced containing a reduced set of items. The new instrument was comprised of both reflective and formative constructs, thus, providing more complete coverage of the risk factors and consequences associated with slot machine play.

In Phase 2 the up-dated survey was administered to 374 regular monthly slot machine gamblers. This sample size was sufficient for the proposed analysis examining item and construct properties including testing for common method bias (CMB) as well as quantitative validation of the model using structural equation modeling techniques. The results of the research were used to produce a further reduced list of instrument items, comprised of 48 statements that can be used for testing in a general population study (e.g. pilot study) to determine if additional modifications and validation are required before proceeding further.

Overall, the FLAGS instrument modified for use with slot machine gamblers was comprised of 10 constructs (5 formative and 5 reflective) including low risk indicators (Risky Cognitions: Beliefs, Risky Cognition Motivations, Preoccupation: Desire), medium risk indicators (Impaired Control: Continue, Risky Practices: Earlier) and high risk indicators (Impaired Control: Begin, Risky Practices: Later, Preoccupation: Obsessed) as well as identifying Problem Gamblers (Negative Consequences + Persistence). Responses to the instrument were used to assign players to one of five risk classifications each associated with different characteristics and implications for support and/or

intervention: Level 1 – No Detectable Risk; Level II – Early Risk; Level III – Intermediate Risk; Level IV - Advanced Risk; Level V – Problem Gambling.

## **1.1 Literature Review**

### **1.1.1 Reflective versus Formative Constructs**

There has been much debate over the conceptualization and measurement of problem gambling during the past twenty years (c.f. Dickerson, 1993b; Lesieur, 1994; Volberg, 1996; Walker & Dickerson 1996; Svetvia & Walker 2008). This led to the development of numerous gambling screens intended for population and in-patient treatment settings. However, all were designed and tested using reflective constructs (c.f. South Oaks Gambling Scale, Leisure and Blume 1987, 1993; the Canadian Problem Gambling Prevalence Index, Ferris and Wynne 2001, and the Victoria Gambling Screen, Ben-Tovim et al. 2001), without the inclusion of formative constructs.

Reflective constructs presuppose that an underlying latent construct causes the observed variation in the measures (Nunnally 1978). That is, there is an assumption that a latent variable exists (e.g., problem gambling) and the direction of causality is from the latent variable to the items measured; for example, because one is a problem gambler he/she will endorse items or exhibit behaviours included in the 'problem gambling' construct. Since items within a reflective construct are indicative of the underlying latent construct, they should be highly correlated and, in theory, a gambler should endorse either all or none of the items. Nevertheless, individuals are often considered to possess the latent characteristics even if endorsing only some of the items; although, the more items endorsed by an individual the greater the probability the gambler will have the characteristic being measured (e.g., problem gambling). As fewer items are endorsed, there is less certainty that the individual is a problem gambler although this does not necessarily mean that the individual is at 'lower risk' for having a problem; the individual who endorses fewer items may still be experiencing gambling problems but we have less confidence that this is the case.

In contrast to a reflective measure, a formative indicator is said to predict the latent variable. For example engaging in certain gambling behaviours and/or practices produces negative gambling outcomes and/or problem gambling. The items comprising formative constructs represent different often uncorrelated dimensions of the latent variable. A formative construct is a linear weighted combination of the observed variables with which it is associated (Bollen and Lennox,

1991; Gefen et al., 2000). Thus, it is unnecessary for correlation among the various items comprising a formative construct. Endorsement is additive such that the more items endorsed the greater the severity of impact. This is a desirable characteristic for an instrument intended to identify levels of risk or harm.

Historically, measures of problem gambling have assumed a reflective construct, and used traditional item analysis, and factor analysis techniques to validate the measures. However, recent research in this area of construct development has focused on the limitations and weakness of such an approach (c.f. Jarvis et al., 2003; Diamantopolous & Winkholfer, 2001; Helme, 2005, McKenzie, Podsakoff & Jarvis 2005). Although there has been much debate as to whether formative or reflective constructs are appropriate for theory development, there is general agreement that formative measures are suitable for prediction of given outcomes (e.g., gambling risk or gambling problems/negative consequences) when used with structured equation modelling (SEM) (Diamantopoulos, Riefler, & Roth 2008; Wilcox, Howell, & Breivik, 2008; Howell, Breivik, & Wilcox 2007a; Howell, Breivik, & Wilcox 2007b; Bollen, 2007; Bagozzi, 2007; Diamontaopoulos & Sigaw, 2006; Freeze & Raschke, 2007). Moreover, Strong, Breen and Lejuez designed a formative measure in 2003 to assess a latent affinity for gambling, and, once refined, concluded it would also benefit treatment providers in identifying those vulnerable to problem gambling who had not yet met the criteria for problem gambling. Strong et al's (2003) methods were similar to those used in Focal's initial assessment of the new gambling risk instrument with analogous results.

The literature and initial research indicated a need to integrate both reflective and formative constructs to separately detect past gambling related harm in addition to risk factors that would predict the probability of harm taking place and the likelihood of developing problem gambling. Such measures not only ensure broader coverage of diverse risk factors (e.g., beliefs, motivations, behaviours) and harm (e.g., financial, personal, relationship, professional) that may differ between individuals (e.g., formative constructs) but also defines and confirms common factors within a certain category (e.g., financial consequences) using multi-item reflective constructs (e.g., debt, losses, inability to pay bills, short of cash) thereby contributing to the opportunity for a more detailed assessment of the factors comprising and influencing the various components (e.g., formative constructs) of problem gambling. The approach is also consistent with the recent model

developed by the Ontario Problem Gambling Research Centre on problem gambling pathways and protective factors (OPGRC, 2008).

The OPGRC adopted a public health model that positions the general population along a continuum of risk and harm. There are two components to the model: gambling risk and problem gambling. Risk refers to the likelihood that problems will occur and consists of three elements comprising direct risks: risk cognitions (i.e., erroneous cognitions, beliefs, and motivations), risk practices (i.e., behaviours) and preoccupation (i.e., thinking about or planning gambling). In contrast, Problem Gambling is characterized by the following three elements: impaired control, negative consequences and persistence. The model posits that under the risk elements erroneous cognitions are the basis for risk practices adopted by gamblers and leads to preoccupation with gambling. Problem gambling occurs when impaired control develops from the presence of the three risk elements producing negative consequences for the gambler in various life areas (e.g., health, financial, social) and is characterized by persistence despite the negative consequences experienced by the individual (Simpson, Goodstadt, Wynne, and Williams, 2008).

In order to develop an instrument to measure these relationships, we had to ensure that the instrument included formative constructs to represent each element. In many cases the construct for each element (e.g., risk cognitions) requires more than one item in order to adequately represent the scope of the element (e.g., beliefs that game outcomes can be influenced, that chances of winning improve with continued play, or that outcomes can be predicted). This means that each risk factor may be comprised of series of statements that may or may not be related to each other. For identification of problem gambling even the elements themselves (e.g., negative consequences) may be comprised of a series of reflective constructs used to form various formative constructs (e.g., health, financial, social).

In other cases, an element may be distinctive and better captured using a single reflective construct. For example, preoccupation is considered to be one of the three direct risk elements in the OPGRC Framework. In order to develop a reflective measure for preoccupation (i.e., preoccupation as the underlying latent construct) it is necessary to include a series of items and/or behaviours that will be endorsed by gamblers experiencing preoccupation with gambling. These items will be highly correlated and the more items endorsed the greater the certainty that the individual is experiencing preoccupation.

### **1.1.2 Method Bias**

A final question that needed to be considered in the design of such an instrument was how to minimize method bias. Method bias occurs when the instruments the researcher uses affect the scores or measures that are being gathered. This is also known as methodological artefact. Researchers have been able to separate the variance in constructs due to what the construct is measuring from the variance attributed to the measurement method (Podsakoff et al 2003). The amount of variance due to method bias in social science applications has been found to be substantial with reported levels ranging from 15.8% in marketing measures to 30.5% in education instruments and as high as 40.7% for attitudinal measures (Cote and Buckley 1988). Similar results have been obtained in the field of psychology (Williams et al 1989). While method bias has not been directly assessed for existing gambling screens the similarity of such measures to other psychometrics tested suggest that the impact of method bias could be substantive. The major sources of method bias in gambling risk constructs can be attributed to the inclusion of items irrelevant to the form of gambling being assessed, poor scale design (e.g., use of inappropriate scales), poor wording, and low thresholds for item response. Specific analysis should also be used to test for and reduce common method bias when constructing measures based on the use of self-reported data (Podsakoff et al, 2003, Bliemel & Hassanein, 2007); such analyses was incorporated into the current study.

### **1.2 Construct Development**

Based on the literature we identified seven primary gambling risk and harm constructs for development and testing including cognitive distortions, motivations, preoccupation, impaired control, risky practices, negative consequences and persistence. There is a long list of correlates that have been identified for problem gambling (Johansson et al 2009; Turner et al 2008) that are not included in FLAGS for purposes of placing people into risk categories. Though these are characteristics that may be possessed by a significantly larger proportion of problem gamblers compared to other populations, the inclusion of general measures in the instrument has the potential to create too many false positives. As well, in order to limit the size of the instrument, it was decided that all constructs would only be gambling related (e.g., impaired

control would only be in the context of an inability to stop gambling). Since most of the items in these constructs relate to gambling this also means the instrument is designed to be administered to active gamblers which are defined as those people who have gambled within the last year. Measures of correlates that are of interest to policy makers can be included in surveys and used to profile the individuals at different risk levels.

### **1.2.1 Cognitive Distortions**

Investigations with both gamblers and non-gamblers have suggested that cognitive distortions play a role in gambling behaviour (for reviews see Raylu & Oei, 2003; Miller & Currie, 2008, Johansson et al., 2009; van Holtz et al., 2010). Much of this work originated from the analysis of comments made by gamblers using the “thinking aloud” technique to describe their thoughts while gambling (Walker, 1992; Ladoceur and Walker, 1996). These authors suggested that gamblers have an illusion of control, originally defined by Langer (1975) as the “expectancy of a personal success probability inappropriately higher than the objective probability would warrant”. In other words, gamblers erroneously believe they can use skill to influence the outcomes of games with completely random results. For example, they might think pressing the buttons quickly on a gambling machine would increase their odds of winning. Ladoceur and Walker (1996) also stated that gamblers were superstitious (e.g., they would only win when playing their lucky machines). Finally, they suggested that gamblers mistakenly believed that the opportunity of winning is greater than it actually is (i.e., the gamblers either did not believe or did not understand probability). A number of fallacies fall into the latter category; for example, belief that a number of losses will be followed by a win (i.e., the gambler’s fallacy), belief in near misses, and belief in a winning or losing streak; all appear related to cognitive biases in processing information (Griffiths, 1994).

The arguments advanced by Ladoceur and Walker (1996) and subsequent statements published by Toneatto (1999) provide the backbone for many of the scales developed to investigate the role of erroneous cognition in maintaining problem gambling. The Canadian Problem Gambling Index includes two questions regarding cognitions, one assessing illusion of control and one regarding faulty beliefs (Ferris & Wynne, 2001). The categories of luck/perseverance and illusion of control were used by Steenbergh et al. (2002) on their Gamblers Beliefs Questionnaire to discriminate successfully between pathological and non-pathological gamblers. Similarly, using the Beliefs about

Gambling Questionnaire, Källmén et al. (2008) showed that compared with non-problem gamblers, problem gamblers believed that skill was involved in winning and that they were more likely to win after consecutive losses. Using statements derived from both Toneatto (1999) and Steenbergh et al. (2002), Xian et al., (2007) created a 12 item single factor that when correlated with scores on the National Opinion Research Center DSM – IV Screen for Gambling Problems (NODS) indicated that gambling severity was positively related to the degree of cognitive distortion. This work provided support for that of Joukhador et al., (2003) where problem gamblers showed a significantly higher number of irrational beliefs compared with social gamblers. The 23 item Gambling Related Cognitions Scale developed by Raylu and Oei (2004) included two factors that are based on statements regarding cognitive distortions and one factor associated with illusion of control, all of which were noted to be derived from previous studies such as those of Griffiths (1994) and Toneatto (1999).

Raylu and Oei (2004) have included additional factors in their model related to what they have called “gambling related expectancies”. One factor refers to statements about the value of gambling (e.g., “having a gamble helps reduce tension and stress”); the second is associated with beliefs about the inability to stop playing (e.g. “I can’t function without gambling”). It could be argued that these factors are motivational variables rather than cognitive biases. Indeed, the authors did indicate that their measures demonstrated concurrent validity with the Motivation toward Gambling Scale developed by Chantal and colleagues (Chantal et al., 1995; Chantal & Vallerand, 1996).

## **1.2.2 Motivation**

Motivation is generally defined as internal and external forces that direct behaviour. In the context of gambling, the possibilities could include playing for a feeling of excitement (internal motivation) or to make money (external motivation). The Motivation Towards Gambling Scale (MTGS) incorporated the following motivations: reward seeking; self-imposed pressures (e.g., need for recognition) and goals such as socialization; knowledge; and, accomplishment and stimulation (Chantal et al., 1995). The investigators also found that some gamblers exhibited a non-motivational state, (i.e., playing with no sense of purpose or understanding). Subsequent work confirmed the role of the latter factors (Clarke, 2004, 2005, 2008; Pantaloni et al., 2008). The

motivation “to escape one’s problems” is highly correlated with frequency of gambling and progression toward pathological gambling (Wood & Griffiths, 2007; Clarke, 2008; Nelson et al., 2009; Thomas et al., 2009; Nower & Blaszczynski, 2010). More esoteric motivations such as passion (Ratelle et al., 2004; Rousseau et al., 2002) and craving (Young & Wahl, 2009) have also been identified as related to gambling, with craving a predictor of persistence at play on a virtual slot machine. Lee et al. (2007) added further complexity to the role of motivation by suggesting that motives of excitement or avoidance are mediated solely through the monetary motive.

### **1.2.3 Preoccupation (Desire and Obsession)**

Most researchers include a measure of preoccupation, as described in the DSM-IV, in the development of their gambling screens. Preoccupation which is only one of 10 characteristics of gamblers listed in the DSM-IV is defined as a fixation on gambling such that the individual is constantly reliving past experiences, planning the next outing and thinking about how to get money for such an excursion. Other than the DSM-IV definition, there appears to be little effort to expand upon the concept of preoccupation. Dickerson and O’Conner (2006 pages 93 - 96) described a Gambling Temptation and Restraint Inventory (Collins et al., 1992 ) that included preoccupation with statements regarding attempts to cut down the amount of time and money, intrusive thoughts about frequent gambling and an inability to distract oneself from thinking about gambling.

The DSM-IV criteria for preoccupation have been found to be a reliable and valid predictor of problem gambling (Hodgins et al., 2004; Stinchfield et al., 2005; Lakey et al., 2007; Wickwire et al., 2008; Hong et al. 2009). In particular, Stinchfield (Stinchfield et al. 2005 page 81) noted that “spending a lot of time thinking about gambling” was one of several criteria in the DSM-IV with the greatest discriminatory power between problem gamblers and non-problem gamblers. Most recently, using previously collected data, Toce-Gerstein et al. (2009) determined that the NODS question associated with the DSM-IV criterion “Have there been periods in the last two weeks when you spent a lot of time thinking about your gambling experiences or planning out future gambling ventures or bets” was one of just three questions required to correctly identify both problem and pathological gamblers.

If an individual's degree of preoccupation becomes excessive, the concept of obsession could be applied to his or her problem gambling. Blaszczynski (1999) found that compared with social gamblers, pathological gamblers scored significantly higher on the Padua Inventory, a self-report measure of obsessive-compulsive behaviour. In contrast, Blanco et al. (2009) indicated that the degree of obsessiveness is subsumed by impulsiveness. Vallerand and colleagues (Rousseau et al., 2002; Ratelle et al., 2004) have suggested that "obsessive passion", or the force behind the need to engage in an activity, is characteristic of problem gamblers and related to negative consequences such as negative mood and physical symptoms as well as the time spent playing (Lafreniere et al., 2009).

Many of the obsession factors identified in the literature such as the gambler constantly focusing on how to get money to finance gambling, or making attempts to cut down the amount of time and money, assumes the gambler is having problems due to their gambling or is having troubles controlling their gambling. These factors are associated with obsessed gamblers but are not obsessive elements in themselves. Therefore, if a statement links the experience of obsession to problem gambling or another variable closely aligned to problem gambling (e.g., negative consequences or impaired control) then we cannot use that statement to examine the association between obsession and development of problem gambling; including such statements in a construct for Preoccupation would create a spurious relationship in the PLS model between obsession and negative consequences or obsession and impaired control and, therefore should not be used in a reflective measure of obsession.

Given that the concept of obsession with gambling is obviously important and linked to risk and harm a reflective construct was developed termed Preoccupation: Obsession to represent this component of risk. However, based on past analysis of similar data (Schellinck and Schrans 1998, Schellinck 2004, 2006) a second measure, Preoccupation: Desire, was defined as having a strong desire to gamble frequently or as often as possible (e.g., I would gamble almost every day if I could). Preoccupation: Desire was conceived as being less directly connected to problem gambling behaviour (e.g., it is not unreasonable for many people who enjoy gambling to desire to gamble frequently) and, in a casino gaming environment, it could be a measure of the person's response to marketing activities that are often designed to elicit heightened desire. However, a strong drive state that leads to increased and more extreme gambling activity could be an effective indication of

elevated risk, particularly if it is shown to be a precursor to impaired control and risky practices during the modeling analysis.

### **1.2.4 Impaired Control (Continue and Begin)**

The concept of impaired control has been used to explain excessive gambling (Dickerson and Baron 2000, Dickerson and O'Connor 2003). Two components of impaired control long hypothesised as contributing to problem gambling are an inability to resist opportunities to begin a session, and an inability to cease an activity once engaged (O'Connor and Dickerson (2003b). The latter characteristic would apply primarily to continuous forms of gambling (Dickerson 1993a), and the author argued that the concept of Impaired Control is therefore different depending on the nature of the gambling. Impaired Control for electronic gambling machines may not be the same as impaired control for discontinuous forms of gambling such as lottery tickets.

O'Connor and Dickerson (2003b) defined Impaired Control as “an inability to consistently maintain preferred limits to expenditure of time and money on gambling” and they utilized a shortened version of the Scale of Gambling Choices (Baron, Dickerson & Blaszczynski 1995) to measure this concept. They concluded that the urge to continue after beginning to gamble and an inability to resist starting a session are likely subsets of a unitary dimensional construct of impaired control. Blaszczynski and Nower (2002) define impaired control as a ‘disordered or diseased state that is defined by repeated unsuccessful attempts to resist the urge in the context of genuine desire to cease’. However, this definition does not specify whether one can cease to begin a session or cease to continue a session.

Impaired control can be considered both an etiological factor (Ladouceur et al 2007) and a result of problem gambling, which holds implications for modeling and the nature of items in a scale. When constructing a structural equation model to examine etiological structures the issue is whether to place the impaired control component before problematic gambling or harms, or after. In measurement terms, a person must have experienced impaired control while gambling to indicate they have experienced Impaired Control. The use of a general impaired control measure seems an unsuitable alternative since it is unknown whether impaired control applies to all excessive behaviours a person engages in. We assume it must be gambling specific, and, presumably based on a gambler’s experience; they must have experienced impaired control before we can detect it.

This leads to another problem noted by Dickerson and O'Connor (2003) who suggest that gamblers might attempt to justify their losses by attributing it to a lack control. They identify this as a "perception of impaired control" which might be correlated with problem gambling and harms but not etiologically tied to problem gambling. To overcome this issue they recommend that measures focus on the "decision process" that happens during gambling; the moment of truth when the gambler becomes short of money (or knowingly has reached a pre-set limit) and continues to gamble (it may or may not have to be against their better judgment to continue). The issue may still remain unresolved if these gamblers use impaired control to justify their behaviour in these crucial moments (e.g., many At Risk and Problem Gamblers state they are addicted to gambling, meaning they lack control, despite a lack of evidence that they have impaired control).

If gamblers recognize they have moments where their behaviour runs contrary to their intentions or better judgment, and they are not using it to rationalize their actions, then it may be a good indicator of risk or problem gambling regardless of whether it is perceived or actual impairment. Indeed, if the gambler recognizes it as occurring frequently, but have not yet suffered significant harms, it could be an excellent indicator of risk. We utilized and modified several statements from the Scale of Gambling Choices (Baron, Dickerson & Blaszczynski, 1995) and revisit below the question of whether impaired control is a one or two dimensional construct with respect to the continuation of a gambling session and the commencement of gambling sessions.

### **1.2.5 Risky Practices**

As gambling activities become more problematic, gamblers often engage in a wide range of risky practices ranging from theft to attempted suicide. The DSM-IV includes statements on chasing losses, lying about the extent of gambling, and participating in illegal activities to finance gambling (APA, 1980). Many investigations confirm these behaviours among individuals with severe gambling problems (Beaudoin & Cox, 1999; Martins et al., 2004; Sumitra & Miller, 2005; Hong et al., 2009). Chasing losses, defined by O'Connor and Dickerson as "the attempt to recover gambling losses by continuing to gamble (1993)" has been most frequently investigated (Linnet et al., 2006; Cusak et al., 1993; Campbell-Meiklejohn et al., 2008). Risky practices can also occur during play; for example, an individual may attempt to borrow money from another player.

## **1.2.6 Negative Consequences**

Questions about the negative behavioural consequences of gambling are typically included in assessments of gambling activities. Moreover, the absence of negative consequences is considered an indicator of recovery from problematic gambling (Nower & Blaszczynski, 2008). A comprehensive list of the consequences of gambling behaviour as described by Thomas et al., (2009) include negative impacts on work; housing and living arrangements; financial well-being borrowing money from others; criticisms about gambling; interpersonal relationships ; criminal and deceptive behaviour; and health problems. Gambling screens such as the SOGS (Lesieur & Blume 1987); CPGI (Ferris & Wynne 2001), and the NODS (Toce-Gerstein et al., 2009) contain several questions regarding harmful outcomes. While most screening items identify the potential effect of the gambler's relationships with others, they fail to consider negative impacts on the individual's sense of self-worth, and evidence exists to suggest that a loss of self-respect may be harmful. Suurvali et al. (2009) have suggested that feelings of shame, embarrassment, and stigma are one of the major barriers to seeking help.

## **1.2.7 Persistence**

Although the term 'persistence' is frequently found in the gambling literature, it has not been consistently conceptualized or defined. The term is sometimes used as a reference to persistence in a play session when losing (Dickerson 1991, Dickerson 1993a, Breen & Zuckerman 1999, Dickerson & Adcock 1987, Kassinove 1999). It has also been used as an indicator of the number of trials at play (Kassinove 1999) or sessions per month (Ladouceur & Sevigny 2005), excessive play (Corless & Dickerson 1989), in addition to chasing losses between sessions (Breen & Zuckerman 1999). Some of these uses of the term coincide with constructs we have already created such as Risky Practices for chasing, and Impaired Control: Continue and Impaired Control: Begin. What is missing is continued gambling over an extended period of time in such a manner that leads to harms. That is, the gambler persists in gambling and engaging in risky practices that lead to negative consequences. We have therefore defined persistence as referring to the situation when a gambler continues to engage in risky practices over an extended period of time that lead to negative consequences.

## **2.0 Method**

In March 2008, Focal Research designed a two-phase study to develop, test, and refine a prototype risk assessment instrument.

- Phase 1: Qualitative evaluation to develop an up-dated FLAGS measure modified for use with slot machine gamblers in Ontario;
- Phase 2: Quantitative evaluation of the revised instrument in identifying and classifying gambling risk among slot machine gamblers in Ontario.

Once the materials for the project were designed the study was subject to an independent ethics review by the Ontario Institutional Review Board (ON IRB). Final protocol approval was obtained and valid for the study period of July 2008 to August 2009.

### **2.1 Phase 1: Qualitative Evaluation**

The Phase 1 Qualitative Evaluation was initiated in August 2008. Based on a comprehensive literature review a total of 190 potential indicators of risk cognitions (e.g., beliefs, motives) and risk practices (i.e., behaviours) were identified that were hypothesized to place individuals at risk for harm from slot machine gambling (See Appendix D).

The second stage of the Phase 1 study, Qualitative Evaluation, took place from August 2008 to February 2009. Trained staff from Focal went on-site at the Slots at Western Fair in London Ontario, operated by the Ontario Lottery and Gaming Corporation (OLGC) and recruited approximately 679 regular slot machine players (i.e. played slot machines at least once per month or more) to participate in an ongoing research panel. From these panel members, 72 players were screened and invited to take part in a qualitative evaluation of the revised risk screen of which 63 participated. The evaluation consisted of three components: completion of an independent pre-session version of the survey to test responses to the full 190 statements; an in-session evaluation of a reduced test version of the screen ( $\approx$ 30-35 statements) varied by group; and, participation in one of six in-depth discussion groups (focus groups) to examine comprehension, interpretation, and perceived veracity of each item comprising the test versions of the screen.

The groups took place from September 18 to 20, 2008 including 29 men and 34 women.

Participants were recruited to represent both younger and older slot players (<35 years; n=19; 35-

55; n=21; 55 years+; n=23), new (< 2 years; n=28) and long-time players (2+ years of regular slot play; n=35), and were comprised of those scoring at different levels of risk using the Problem Gambling Severity Index of the Canadian Problem Gambling Index (Low/No Risk: n=22; Moderate Risk n=21; Problem: n=20).

### **2.1.1. Phase 1: Analysis**

The goal of the discussion groups was to ensure the items reflected the perceived characteristics of Ontario slot machine gambling and that the screen provided 'good' indicators of risk and harm suitable for use in this context and market. The discussion centered around conceptual perception and clarity of the items, suggestions for improvement, perceived utility and value of the screen, circumstances or situations where it might be used, possible threatening aspects of the screen, and actions that might arise from its use.

In the final stage of Phase 1, the principal investigators, Focal Research, carried out preliminary construct analysis to aid in the selection of appropriate items for further testing of the gambling risk assessment instrument. The analysis included correlations to test for relationships between the items tested and to assess multicollinearity; factor analysis using principal component analysis (PCA) with varimax rotation; and, structural equation modeling (SEM) using partial least squares or path analysis (PLS).

### **2.1.2. Phase 1: Key Findings**

Phase 1 permitted Focal Research Consultants to generate an initial risk assessment instrument that contained a reduced set of items comprised of both reflective and formative constructs providing more complete coverage of the risk factors and consequences associated with slot machine play. However, the results also indicated that the revised instrument required further modifications and pilot testing before validation with a random population sample. The participants responded positively to the concept and most of the items tested, but a number of opportunities for improvement were identified. For example, terms such as 'near misses,' 'chasing losses,' 'hot machines,' 'stop buttons' and 'pay-outs' were found confusing, especially among older gamblers (55 year or older).

Using an iterative approach the improved items consistently identified in early focus groups were assessed by later participants/focus groups. Items flagged as confusing or unclear were revised or

replaced. Principal Component Analysis (PCA) was used to assess and adjust the various constructs (represented by groups of items) comprising the harm and risk components of the screen. Items representing the same construct were grouped and, when possible, any items found to be confusing, unclear, or misunderstood during the focus group discussions were deleted. Those with preferred wording, clarity, and understanding, or that elicited more uniform understanding were retained for further testing.

Principal Component Analysis (PCA) was conducted on the 190 statements in Phase I of the FLAGS project. If most of the statements in the components and the component's factor scores were not significantly correlated with the PGSI score then the items were excluded as candidates for inclusion in FLAGS and dropped from the list of statements tested in Phase II.

Based on this process 34 statements forming ten multi-item components as well as five single item play behaviours were removed. The following components were found to have weak associations with problem gambling and dropped from the instrument and further testing in Phase 2 of the study (See Appendix E for a detailed list of correlations for statements and constructs dropped using this approach):

- Resources – has sources of cash, can gain gambling knowledge from others and has easy access to a casino;
- Superstitions – has lucky charms and rituals;
- Motives – others want to socialize with them at the casino, the friends they like also like to gamble, the casino is the centre of their social life, they gamble with friends and relatives;
- Play Behaviours – use of the stop feature, drinking alcohol before gambling, spending all their time at the slots while at the casino, covering all lines on the machines, not talking to others when gambling and playing more than one machine at a time.

There were 34 preliminary groupings, comprised of 132 statements emerging from the Phase 1 analysis for further testing including: 11 potential constructs measuring consequences including persistence; 10 measuring risk cognitions (e.g., motivations and beliefs); 7 measuring risk behaviours; 3 measuring resources; 2 measuring impaired control; and, 1 measuring persistence.

## **2.2 Phase 2: Quantitative Evaluation**

A new survey was designed using the reduced set of items identified in Phase 1 of the study comprised of 132 statements. The survey was administered by telephone, using a cross-sectional approach, to 374 regular slot machine gamblers recruited to the player research panel in Phase 1 of the study. Participants completed the gambling risk assessment instrument and the data was analyzed using principal component analysis, correlation analysis, and, structural equation modeling. Cross-sectional surveys are recommended for gathering attitudinal data and for exploratory research. Accordingly, this design was most appropriate since the goal was to quantitatively evaluate the items retained for the risk assessment measures developed in Phase 1 and decide whether further revision will increase the instrument's efficacy. In addition, many of the disadvantages of cross-sectional survey designs are not applicable for the current Phase 2; there is no requirement to establish causality or measure change across time. Furthermore, estimations of sampling power were not relevant since the investigators are not attempting to determine effect changes or to test hypotheses.

### **2.2.1. Phase 2 Method**

A telephone survey was undertaken from April 22 to May 22 2009 administering the revised instrument to the pre-selected sample of Ontario slot gamblers who had consented to re-contact in Phase 1 of the study. Overall, there were 610 potential respondents available from the original sample frame of 679 recruited in August 2008 with 10% (n=69) lost due to attrition (e.g., moved, changed phone number, deceased). Of the 610 potential panel members 131 could not be reached after 7+ attempts (21.5%). Among the remaining 479 re-contacted 11.9% (n=57) refused to take part with 422 successfully screened for participation. An overall survey response rate of 69.2% was obtained with 374 completed surveys and 48 disqualified due to respondent selection criteria (e.g., play slots less than once per month, excluded occupations; n=422/610).

The Phase 2 final survey sample size was appropriate for the research objectives. Structural Equation Modeling analysis using Partial Least Squares Path Analysis (PLS) was used in the data analysis phase to assess the ability of the constructs to discriminate between risk (i.e., pre-consequence) versus harm (i.e., post-consequence) and to identify problem gambling (i.e., impaired control, negative consequences, and persistence). The required sample size for using PLS analysis is either 10 times the number of items comprising the most complex construct or 10 times the

largest number of independent variables (e.g., formative and reflective constructs) impacting a dependent variable (e.g., gambling risk or harm) (Chin & Newsted, 1999; Chin 1998). In this case, a number of complex constructs were considered with 34 preliminary groupings identified for testing. Therefore, 374 respondents were considered sufficient to meet the analysis requirements for Phase 2 of the study.

The Phase 2 gambling risk survey instrument was comprised of the updated items/constructs identified during Phase 1 of the study. A reduced set of 132 dichotomous statements was used in order to test different versions of wording and item improvement emerging from the Phase 1 study. The statements were randomized for each participant to reduce the risk of common method bias (Bliemel & Hassanein, 2007). The survey also gathered demographic information and general gambling behaviour and playing patterns typically included in Canadian prevalence studies (Wiebe, Single & Falkowski, 2002; Smith & Wynne, 2002; Volberg, R.A. & Ipsos-Reid, 2003; Wynne, 2002; Schrans, Schellinck & Focal Research Consultants, 2001, 2003, 2007). This information was used to assess any demographic or gambling sensitivities or differences in findings and taken into consideration when selecting the final instrument items:

- Gender, year of birth, current marital status, and highest level of education completed.
- Frequency and amount of money spent on slot machines and other forms of gambling, including lottery tickets, bingo, horse racing and Internet gambling.

The survey took approximately 20-46 minutes to administer with an average duration of 26 minutes and was conducted by trained professional interviewers from Focal's secure data collection facility located in Halifax Nova Scotia. The surveys were 100% edited and entered into a fully labelled SPSS files for analysis. A 10-15% random quality control check was performed on all completed surveys and data entry to verify the information gathered

Informed consent was again obtained from potential respondents on the panel before initiating any data collection. This included full disclosure of privacy and confidentiality of the survey data; the voluntary nature of participation and right to withdraw consent at any time throughout the process; survey length; contact information for Focal Research; and, contact information for authorized client project personnel (e.g. toll-free number (1-888-454-8856), email, Project

Manager). Participants who were currently receiving treatment or services for substance use, gambling, or a mental health issue were excluded from taking part, as were those who indicated they worked for the media, a political or lobby group, Addiction Services, Ontario Lottery Gaming, or an affiliate. Referral information for assistance and/or information regarding gambling and gambling problems were provided to all individuals during the interview. Follow-up contact was undertaken specifically with three respondents expressing personal concern with their slot machine gambling during the survey process to ensure they had obtained additional support services or the information requested.

An identification number was assigned for analysis and tracking purposes without any links to other data that may identify the respondent. As an incentive, those taking part in the survey and who gave consent had their name entered into a draw for one of four \$100 grocery gift certificates (with no cash value) at a retail grocer of their choice. The draw was held upon completion of data collection for the study and winning respondents were notified by phone and receive their gift certificate in the mail (via Canada Post). Data records were entered without participant names or contact information.

### **2.2.2. Phase 2 Data Analysis**

In the analysis stage tracking numbers and any other identifiers were removed in order to comply with all necessary confidentiality requirements. The data from the Phase 2 survey was first examined for Common Method Bias (CMB) using the methodology recommended by Podsakoff and his colleagues (2003) for Harmon's one-factor test. Principal Component Analysis (PCA) was undertaken using unrotated and rotated varimax solutions to ensure that the variables did not load on a single factor (indicative of method bias) (See Appendix B). Correlation analysis was used to examine relationships between the statements and test for multicollinearity, and response frequencies were examined for each item to assess endorsement thresholds (e.g., the number of players responding to each item). Structural equation modeling (SEM) using path analysis (Partial Least Squares (PLS)) was used to examine relationships between the various constructs comprising the new instrument and the latent factors (i.e., risk, harm problem gambling measures). Analysis for validity and reliability was conducted to assess the constructs and a comparison was performed between results obtained for the new instrument and those for the Problem Gambling Severity Index (PGSI) of the Canadian Problem Gambling Index (Ferris and Wynne, 2001).

### **3.0 LIMITATIONS AND FUTURE WORK**

The study was quantitative in nature and comprised of a large sample of regular slot machine gamblers that is suitable for refining instrument design and development. However, the sample is not a true random sample and estimates associated with use of the new instrument (i.e., estimates of problem gambling, gambling harm and risk) cannot be generalized to the population of slot machine gamblers at-large. Moreover in the current study the sample was used to develop the new instrument for slot machine application and, therefore, cannot be used for statistical testing to assess instrument performance. Additional research is required to assess screen performance for those in the general population both within and outside of Ontario.

### **4.0 INSTRUMENT DEVELOPMENT**

Development of the new instrument was comprised of seven separate steps:

- **Step 1** - Test for the presence of method bias.
- **Step 2** - Create key constructs (10) by selecting appropriate items from the 132 statements utilized in the survey. The constructs were then scored as part of the **FLAGS** instrument and, therefore, had to have certain characteristics appropriate for the construct type (reflective versus formative) and its' hypothesised position in the development of problem gambling (e.g., hierarchy rank). There were six criteria used for selecting the statements comprising each construct (outlined in 4.2 below).
- **Step 3** - Determine the final set of indicators for each construct tested in the PLS analysis.
- **Step 4** - Test each of the final constructs, both formative and reflective, for validity and reliability.
- **Step 5** - Identify the risk levels associated with each construct based on hierarchy scores and PLS analysis
- **Step 6** - Assess the proposed method of assigning people to specific risk categories (i.e., instrument scoring and classification). The characteristics of those assigned to the various categories were produced to see if this resulting profile was reasonable.
- **Step 7** - Compare the results for FLAGS to those obtained using the PGSI.

## **4.1 Common Method Bias (Step 1)**

Method bias is the variance in data that is attributable to the method by which the data is collected and can account for a substantial proportion of the total variance (Bagozzi et al., 1991; Campbell and Fiske 1967). The method bias found in single source, self-reported data is called common method bias and is of particular concern as it can threaten the validity of the study (Podsakoff et al., 2003). Podsakoff et al. (2003) suggest several procedural techniques for minimizing common method bias such as using different scales for endogenous and exogenous variables, separating the assessment of predictor and criterion variables, and randomizing the questions. In the current study the questions were randomized but due to other design considerations impacting scaling for the items we were unable to utilize the remaining techniques to reduce the possibility of method bias due to self reporting. Therefore, it was important to assess the potential impact of method bias for study findings.

We used Harmon's one-factor method of assessing method bias as outlined by Podsakoff and colleagues (Podsakoff and Organ 1986, Podsakoff et al. 1984). PCA was performed on all 48 indicators eventually chosen for inclusion in the constructs and the unrotated solution was assessed to determine the number of components with an eigenvalue greater than one. Strong method bias exists if the analysis produces a single component; less exists when more components are produced. In the current analysis eleven components emerged with eigenvalues greater than one with the first component accounting for 33.6% of the variance and collectively the 11 components accounting for 66.3% of the original variance. The results supported the conclusion that the findings were unlikely to be influenced by method bias; that is the amount of variance due to common method bias was not sufficient to explain the findings in this study.

## **4.2 Statement Selection Process (Step 2)**

Overall, there were 132 statements included in the final survey for testing in Phase 2 of the study. The statements had been selected and modified from a larger list tested and refined in Phase I of the research. Each statement was included specifically for use in generating the various reflective and formative constructs previously hypothesized and/or identified as being predictive of risk, harm, or problem gambling.

In order to select the most appropriate statements for each construct we established and used the following process:

- 1) The full set of statements (i.e., items) included to measure each specific construct were analysed separately using principal component analysis (PCA). The output from the PCA was used differently depending on whether the particular construct was formative or reflective in nature. For formative constructs at least one statement was selected from each component identified in order to ensure the full range of different elements would be captured by the construct. However, under certain conditions we also included selected statements that loaded minimally on the component under the assumption it was measuring a different aspect of the construct and thus may make a unique contribution to the formative construct. In contrast, for reflective constructs all the indicators were required to load highly on a single component.

The data entered into the PCA analysis is binary and it has been suggested that the creation of components could be an artefact of the attenuated distributions associated with binary data. Despite these possible shortcomings we see three main arguments for using the process described above to arrive at a set of statements for a formative construct. First, the components formed had considerable face validity, with hypothesised items grouping together as predicted. Second the items in the components tended to have very similar profiles in terms of frequency of response, their sequential ranking and their correlation with the PGSI which makes it reasonable to conclude that they are very similar on the dimensions of interest and that picking one as representative will not exclude items that may be less correlated than indicated in the PCA results. Third, the PCA was only one step in the item selection process. For example, the items in the proposed formative construct were then tested using the variance inflation factor to ensure there was not too much overlap in responses.

- 2) Frequency of response is also an important consideration in selection of statements for reflective constructs; each item selected in a reflective construct should have a similar rate of endorsement by gamblers if it is measuring the same underlying latent variable. Therefore, both the absolute value of the frequency (i.e., number of players responding) and frequency ranking (i.e., sequential order of item endorsement) were taken into

account during the statement selection process. Those statements that evoked responses from a similar number of players were retained while those that differed from the majority of statements found to comprise the construct in terms of frequency of endorsement were rejected.

- 3) Another consideration in the statement selection process was the hierarchy score (see a description of the hierarchy score below). In brief, the hierarchy score indicates “at what point” along the risk harm continuum certain constructs are positioned. To be useful as an indicator of risk at a particular point on the path to problem gambling we ensured that the hierarchy score for the reflective indicators were relatively consistent within the construct; meaning that each of the items comprising the construct occurred at a similar point in the temporal sequence of events and/or items leading to risk, harm or problem gambling. It was expected that the formative constructs would have a wider range of hierarchy scores than the reflective constructs due to the nature of the measure and lack of correlation required between items. However, for certain constructs such as Risky Practices the range of hierarchy scores was substantial. Examination of the statements and the respective hierarchy scores and rankings indicated that two indicators would be more appropriate for capturing risk; one for early risk practices (Risky Practices: Earlier) and one representing behaviour relevant later in the model (Risky Practices: Later). In other cases we did not select a particular statement for inclusion in a formative construct if its hierarchy score was substantially different from the rest of the indicators comprising the construct. Both the hierarchy score and the ranking were used when assessing individual items for inclusion in the construct.
- 4) A rule of thumb suggested by Diamantopoulos and Sigauw (2006) is that all indicators in a formative construct should have a variance inflation factor (VIF) less than 3.3. Others have suggested a cut-off of 5 to 10 is acceptable (Henseler et al., 2009; Kleinbaum et al., 1988; Stevens, 1996). However, for the purpose of this study we preferred to adopt a more conservative standard. Each set of indicators were tested against the 3.3 criterion and statements contributing to high levels of multicollinearity were removed until all VIFs fell below the specified criterion keeping in mind the need to have representative indicators from the various components from the PCA analysis in order to maintain content validity.

- 5) A further criterion adopted was more pragmatic; generally we aimed to select three to five indicators for each reflective construct which would permit testing of reliability yet minimize the number of questions needed. We were aware that there could be as many as ten constructs in the instrument overall and that formative constructs, in order to ensure coverage, tend to be larger. Therefore, we sought to meet the criteria as efficiently as possible by reducing the number of statements in the instrument to the minimum requirement.
- 6) In order to increase the probability that the statements and, therefore the constructs were relevant and associated with problem gambling we also selected indicators that were significantly correlated with the overall PGSI score from the Canadian Problem Gambling Index.

#### **4.2.1 Development of a Hierarchy Measure**

A critical goal of the instrument design was to enable identification of where particular gamblers fall in terms of risk potential for problem gambling (e.g., pre-harm risk, harm, problem) in order to support prevention prior to the development of negative consequences or problems. We used two approaches to establish the path structure and inform instrument scoring and the classification process:

- a) A Hierarchy Measure; and,
- b) Partial Least Squares (PLS) Path Analysis

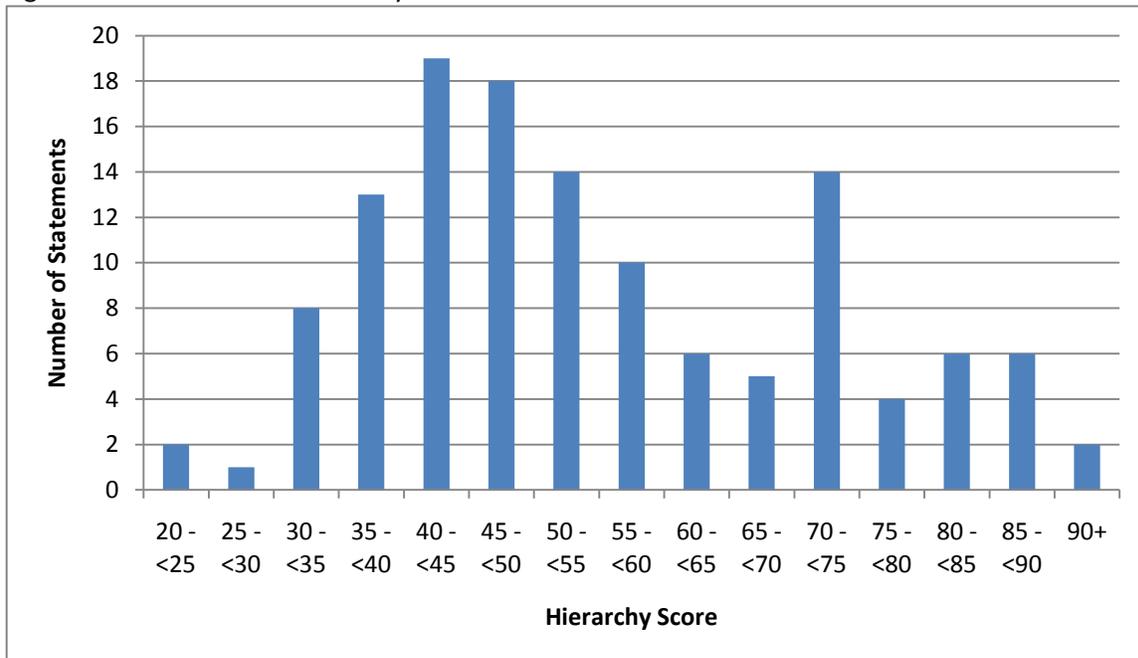
The hierarchy measure, a more simplistic approach, identified statements gamblers endorse (i.e., respond positively to) before becoming problem gamblers. For example, Toce-Gerstein, et al. (2003) formed a hierarchy of gambling disorders based upon an average number of criteria met by gamblers. Those who chased losses generally met one or two criteria; those who triggered on three to four displayed elevated rates of preoccupation; five to seven criteria was associated with loss of control and tolerance. The number of criteria met establishes an individual's placement in the hierarchy such that those gamblers who triggered on more criteria were rated higher in the hierarchy for disordered gambling whereas those triggering on few criteria fall lower in the hierarchy.

A similar approach and logic was used to place statements rather than gamblers in a hierarchy. It is assumed that those players falling further along the gambling disorder hierarchy will meet more of the criteria and thus will respond positively to more of the questions. Therefore, we say that a statement is associated with elevated levels of risk if it is a criterion selected by those who meet a larger number of criteria. Conversely, a statement that is answered by those who meet relatively few criteria is low in the hierarchy. Thus, to define an “early indicator” of risk we assumed that those who answered ‘yes’ to only a few statements were early on in their path to problem gambling. This approach assumes an ordinal relationship between the number of indicators and degree of risk for problem gambling.

Of the 132 statements ranked and administered to 374 regular gamblers, the highest frequency response to any single statement was 253 (67.7%). The number of positive responses to statements by gamblers ranged from 0 (i.e., they did not respond positively to any statements) to 108 (i.e., the respondent said yes to 108 of the 132 statements). Those statements that were endorsed by less than five respondents were excluded from the hierarchy analysis. The hierarchy indicator was then calculated as the average number of positive responses among those who responded to the statement. For example, if two people responded positively to a statement with one endorsing a total of six statements and the second endorsing four, the hierarchy score for that statement would be five, an average of the total statements answered by all those responding positively to the statement in question.

We present the distribution of the hierarchy scores below. The mean is 53.3 and the SD is 15.7, with a range of 23 to 97. The majority of statements fall in the 35 – 55 range as most are risk indicators placing them lower in the hierarchy. The Spearman rank order correlation between the hierarchy score and frequency of response is  $-0.736$  ( $p < 0.000$ ) indicating a strong inverse relationship between the number of people agreeing with a particular statement and its position in the hierarchy of effects for problem gambling.

Figure 1: Distribution of Hierarchy Scores for 132 Statements



It was expected that statements used in the formative constructs would have a wider range of hierarchy scores than would those used in the reflective constructs. Due to the inherent characteristics of a reflective construct (e.g., Persistence) statements comprising this construct should have similar response frequencies and hierarchy scores as the selected statements should be measuring the same thing (e.g., the underlying latent variable 'Persistence'). However, a formative construct such as Risky Practices could entail risky behaviours that occur early on in a gamblers progression (e.g., betting max bet), while others manifest/occur later and are more likely associated with extreme behaviours (e.g., borrowing money from others in order to continue to gamble). Thus, the range of the hierarchy scores and frequencies was expected to be larger for formative constructs. This also means that statements found to be falling further up the hierarchy scale for a particular formative construct are less useful for identifying risk prior to the development of consequences (e.g., first, it would be redundant as those likely to endorse items with high hierarchy scores would be identified by other items in the same construct with lower scores and that occur earlier in the hierarchy sequence; second, the more closely an item is positioned relative to problem gambling the less opportunity for identifying risks before harm has accrued). In such cases we examined potential for breaking the original construct into more

homogeneous units in order to better position certain construct items (e.g., earlier versus later risk indicators) and, thus, utilize the higher ranked statements more appropriately.

Our second approach was to model the constructs using PLS path analysis to develop a more detailed picture of the path structure and the possible causal factors leading to problem gambling. We used both approaches to design the scoring system by determining the order of the constructs and early warning indicators that had the greatest impact, and, therefore, are the more important indicators of problem gambling.

### **4.3 Results for Statement Selection (Step 3)**

Tables presented under section 4.3 (i.e., Tables 1a to 6) contain the results of several analyses performed on the statements to determine the final set of indicators for each construct tested in the PLS analysis.

**Figure 2: Example of Table Headings for each Analysis Presented in Tables 1a-6 in Section 4.3**

<b>Construct and Statements</b>	<b>Component</b>	<b>Comp loading</b>	<b>Frequency</b>	<b>Freq. Rank</b>	<b>Hierarchy Score</b>	<b>Hier. Rank</b>	<b>Diff. Rank</b>	<b>Correlation with PGSI</b>	<b>VIF</b>
<b>Risky Cognitions: Beliefs</b>									
S174 I feel the machines are fixed sometimes so that you can't win on them.	6	0.81	67.6%	1	49.8	2	1	0.39	1.03

Principal components analysis with varimax rotation was first conducted on the statements. For each statement the resulting component and factor loadings were reported in the second and third columns. Although this was not confirmatory factor analysis, the structure helped identify indicators for inclusion in the constructs.

For formative constructs the goal was to select statements that captured a wide range of factors so we chose at least one to two statements that loaded highly on each component. However, in some cases a third statement was included if it had a low loading on the component as it was not necessarily highly correlated with the other statements and thus represented a different aspect of

the construct. For reflective constructs one expects the statements will load highly on one component. Nevertheless, Preoccupation and Impaired Control were both reflective constructs found to load on two components each, indicating that there were two distinctive sub-groups within each of these main construct categories. The frequency and hierarchy analyses of the four constructs confirmed these findings.

The third and fourth columns of tables as presented in Figure 1 present the frequency of responses and the ranking of these frequencies (i.e., frequency ranking). As noted previously under the Statement Selection Process (Section 4.2) frequencies for statements comprising reflective constructs should be relatively equivalent in size with a wider range of frequencies for statements in the formative constructs. To compare the two measures, we created rank order columns for both the frequency of gambler endorsement and the hierarchy score. The hierarchy score is presented in column six, its rank-order in column seven and the difference between the frequency and hierarchy ranking is calculated in column eight. A negative difference means that the frequency rank is higher and a positive difference means the hierarchy score is higher.

The ninth column presents the correlation between the statement and the PGSI score. All correlations presented were significant at the  $p < .05$  level. We were not expecting nor looking for high correlations with the PGSI but rather selected statements that were significantly correlated with the PGSI score ( $p < .05$ ) in order to establish some degree of association with problem gambling and ideally improving the predictive validity of the final construct.

A tenth column was included for formative constructs only (e.g., Risky Cognitions, Risky Practices and Negative Consequences) that provides the variance inflation factor (VIF) measuring the association between the individual statements comprising the construct. VIF scores above 3.3 signal evidence of too much multicollinearity among the statements indicating that one or more of the statements should be removed (Diamantopoulos and Siguaw 2006). We have presented t-scores for the individual weights in Table 11. In some cases, we retained a few non-significant indicators (i.e., six statements) in order to maintain content validity as suggested by Bollen and Lennox (1991) as well as Henseler, Ringle, and Sinkovics (2009).

### **4.3.1 Risky Cognitions Beliefs/Motives Formative Constructs (Tables 1a & 1b)**

Nine statements were selected for the Risky Cognitions formative construct (see Tables 1a & 1b below). These statements collectively loaded on six components potentially representing six different aspects of risky cognitions. The goal with formative constructs is to include an exhaustive list of statements keeping in mind the other criteria for statement selection such as number of questions and construct validity. Therefore, in some cases, we chose more than one statement from a single component; while the items loaded on the same component, they captured different aspects of the component that were useful to measure in terms of finding solutions for the gambler and/or for policy decisions. However, inclusion of multiple statements from a particular component could potentially weight that component more highly within the construct. To optimize the coverage and number of statements included in the formative constructs the variance inflation factor (VIF) was examined for multicollinearity and highly correlated statements were tested and dropped until the VIF fell under the 3.3 conservative standard recommended by Diamantopoulos and Siguaw (2006).

Based on the results of this analysis we divided Risky Cognitions into two constructs: 1) Risky Cognitions: Beliefs; and, 2) Risky Cognitions: Motives.

#### **4.3.1.1 Risky Cognitions: Beliefs (Formative) (Table 1a)**

The statements selected for inclusion in the Beliefs indicator each came from a different component in the PCA analysis including: association of near misses with improved odds of winning; beliefs that the games are 'fixed' by the operator; beliefs in using a system or strategy for beating the machines; perception one can win in the long run while playing the machines; and, the belief one is more likely to win after a string of losses (i.e., gambler's fallacy). Belief statements concerning the use of a strategy or system and trusting they can win in the long run had low hierarchy rankings but high frequency rankings (differences of -60 and -54 between the frequency and hierarchy rankings respectively). This discrepancy stemmed from the fact that while relatively few people believe that a strategy works or that they can win in the long run, these beliefs tend to be positioned early in the hierarchy relative to problem gambling making both statements good candidates for inclusion in an indicator of risk. It also illustrates the value of the hierarchy measure as a criterion for placing statements in a particular construct.

Believing the machines ‘are fixed’ to prevent wins had the highest rate of player endorsement (67.6%) (i.e., frequency rank =1) and is ranked 2 in the hierarchy score suggesting a weak relationship with risk for problem development. However, it was retained in the construct at this time because it is significantly correlated with PGSI scores (0.39,  $p < .05$ ) and thus, may be a good indicator of very early risk.

**Table 1a: Criteria for Selection of Items in the Risky Cognitions: Beliefs Construct**

<b>Construct and Statements</b>	<b>Component</b>	<b>Comp loading</b>	<b>Frequency</b>	<b>Freq. Rank</b>	<b>Hierarchy Score</b>	<b>Hier. Rank</b>	<b>Diff. Rank</b>	<b>Correlation with PGSI</b>	<b>VIF</b>
<b>Risky Cognitions: Beliefs</b>									
s182 You can sometimes tell when the machine is about to pay out big because the symbols start getting closer to lining up on the pay line (e.g., almost winning).	1	0.53	6.4%	92	55.4	79	-13	0.41	1.10
S174 I feel the machines are fixed sometimes so that you can't win on them.	6	0.81	67.6%	1	49.8	2	1	0.39	1.03
s183 It is important for me to use a system or a strategy when I play the machines.	4	0.80	9.9%	74	38.4	20	-54	0.26	1.06
s8 I believe that in the long run I can win playing slots at the casino.	3	0.68	5.9%	97	44.0	37	-60	0.44	1.04
s88 If a slot machine hasn't had a big pay out in a long time, it is more likely to do so soon.	5	0.75	25.4%	25	33.2	5	-18	0.41	1.11

**4.3.1.2 Risky Cognitions: Motives (Formative) (Table 1b)**

There were four statements used to comprise the Risky Cognitions: Motives construct primarily falling under two components: playing to make money when needed or pay off debts; and, playing when depressed or to escape worries and problems. The statements in the two motive components tend to have higher hierarchy scores (three are above 46) than the erroneous beliefs

statements (the highest is 37) suggesting that erroneous beliefs tend to precede the manifestation of inappropriate motives and in fact may be influencing the development of such motives.

All the statements were significantly correlated with PGSI scores and the highest VIF score for beliefs and motives statements were 1.11 and 1.32 respectively indicating a very low degree of multicollinearity among the statements within either the Risky Cognitions: Beliefs or Motives construct.

**Table 1b: Criteria for Selection of Items in the Risky Cognitions: Motives Constructs**

<b>Construct and Statements</b>	<b>Component</b>	<b>Component Loading</b>	<b>Frequency.</b>	<b>Freq. Rank</b>	<b>Hierarchy Score</b>	<b>Hier. Rank</b>	<b>Diff. Rank</b>	<b>Correlation with PGSI</b>	<b>VIF</b>
<b>Risky Cognitions: Motives</b>									
s2 I sometimes play the slots in hopes of paying off my debts/bills.	1	0.65	11.0%	69	55.6	80	11	0.53	1.29
S47 Gambling on the slots is a way I can try to get some money when I need it.	1	0.74	6.1%	95	59.0	87	-8	0.36	1.25
s74 I sometimes play the slots when I'm feeling down or depressed.	2	0.72	19.0%	44	46.3	47	3	0.36	1.32
s35 I can escape by playing the slots whenever I am worried or under stress	2	0.67	27.0%	18	36.7	14	-4	0.34	1.23

#### **4.3.2 Preoccupation: Desire/Obsession (Reflective Constructs) (Tables 2a & 2b)**

The results of the exploratory PCA in Tables 2a and 2b identified two distinctive components suggesting there are two reflective constructs related to Preoccupation that fall in different locations in the hierarchy for problem gambling: 1) Preoccupation: Desire; and, 2) Preoccupation: Obsession.

**4.3.2.1 Preoccupation: Desire (Reflective) (Table 2a)**

The first component Preoccupation: Desire was made up of statements that reflect a ‘desire’ to gamble more often. As would be expected for a reflective construct the frequencies and hierarchy scores each fell into a narrow range of 20.3% to 29.1% and 36.8 to 44.6 respectively. The hierarchy rankings were relatively low, ranging from 16 to 41 out of the possible 132 which means that gamblers scored on this construct early relative to the development of problem gambling. The correlations with PGSI score ranged from 0.30 to 0.49 which was relatively high suggesting a strong relationship with problem gambling.

**Table 2a: Criteria for Selection of Items in the Preoccupation Desire Construct (Table 2a)**

Construct and Statements	Component	Comp. Loading	Frequency	Freq. Rank	Hierarchy Score	Hier. Rank	Diff. Rank	Corr with PGSI
<b>Preoccupation: Desire</b>								
s29 If I could play the machines all the time I would.	1	0.83	26.2%	22	43.1	31	9	0.45
s9 I wish I could gamble on the slots more often.	1	0.80	28.9%	17	36.8	16	-1	0.39
s55 I would like to play the slots almost every day.	1	0.74	20.3%	41	44.6	41	0	0.49
s3 I like to play the slot machines every chance I get.	1	0.77	29.1%	16	40.2	25	9	0.45

**4.3.2.2 Preoccupation: Obsessed (Reflective) (Table 2b)**

The second component, Preoccupation: Obsessed, captured those who were substantially further along the hierarchy towards problem gambling (rankings of 73 and 97) and were more fixated and/or obsessed with gambling. Players endorsing these statements were preoccupied with gambling, dreaming or thinking about playing the slots when not engaged in active play. The frequency of responses and hierarchy measures were relatively consistent between the two statements at 8.0% - 9.4% and 53.2 – 65.7 respectively. Both statements were correlated with the PGSI.

The evidence suggests that this new construct may benefit from the inclusion of additional statements to better represent the category as a separate construct. We recommend adding statements to this construct in the next phase of the research in order to arrive at three to five items that will permit testing for internal consistency.

**Table 2b: Criteria for Selection of Items in the Preoccupation: Obsession Construct**

<b>Construct and Statements</b>	<b>Component</b>	<b>Comp. Loading</b>	<b>Frequency</b>	<b>Freq. Rank</b>	<b>Hierarchy Score</b>	<b>Hier. Rank</b>	<b>Diff. Rank</b>	<b>Corr with PGSI</b>
<b>Preoccupation: Obsessed</b>								
s140b I sometimes dream about playing the slot machines.	2	0.78	8.0%	83	53.2	73	-10	0.28
s51 I spend more time than I used to thinking about playing the slots.	2	0.70	9.4%	76	65.7	97	21	0.42

### **4.3.3 Risky Practices (Formative Constructs) (Tables 3a & 3b)**

Six components were identified for Risky Practices using PCA (Table 3a & b). The hierarchy ranks for the statements ranged widely from a low of 6 to a high of 117 suggesting that it was appropriate to create two separate constructs, each capturing risky practices at different stages along the risk, harm problem gambling continuum. Behaviours can act as effective cues for gamblers in signalling risk; they are typically observable and/or accessible to the gambler to use as an alert and are relevant with high face-validity for harm reduction purposes; if players wish to reduce their risk it is logical to focus on changing the behaviours shown to be associated with elevated risk levels. Therefore, in order to include as many salient yet distinctive risky behaviours as possible in the FLAGS instrument we divided the Risky Practices statements into two groups; those with hierarchy rankings of 53 and below (Risk Practices: Earlier), and those with rankings of 81 and above (Risky Practices: Later). The resulting constructs made sense in terms of reflecting early high-risk gambling behaviours versus those we would expect to see more closely associated with problem gambling.

#### **4.3.3.1 Risky Practices: Earlier (Formative) (Table 3a)**

The first construct labelled Risky Practices: Earlier contained six statements taken from five of the six PCA components identified. The two statements from component 1 have higher VIF scores (1.52 and 1.58) and were obviously related in that those who exceeded the amount of money they intended to spend could be expected to frequently obtain more money from ATMs using their debit cards in order to keep playing. However these gamblers may not yet be going into debt or borrowing from non-commercial sources in order to finance their gambling. The four remaining statements in this construct each come from a separate component and have a maximum VIF of 1.34. These statements, playing max bet, playing after large wins, playing as fast as they can, and gambling for more than six hours straight represent more extreme slot machine gambling behaviours. However, the frequency range for these behaviours among the regular slot gamblers taking part in the study was relatively high ranging from 15.0% to 34.8% suggesting some 'risky practices' are engaged in by a significant proportion of regular casino slot gamblers.

**Table 3a: Criteria for Selection of Items in the Risky Practices: Earlier Construct**

<b>Construct and Statements</b>	<b>Component</b>	<b>Comp. Loading</b>	<b>Frequency</b>	<b>Freq. Rank</b>	<b>Hierarchy Score</b>	<b>Hier. Rank</b>	<b>Diff. Rank</b>	<b>Correlation with PGSI</b>	<b>VIF</b>
<b>Risky Practices: Earlier</b>									
s32 I sometimes exceed the amount of money I intended to spend in order to win back money I have lost.	1	0.77	29.7%	14	44.6	40	26	0.71	1.52
s36a When gambling on the slots I usually use my bank or debit card to get more money so I can keep playing.	1	0.65	19.8%	42	47.4	53	11	0.53	1.58
s25 I play max bet if I'm on a winning streak.	3	0.76	29.7%	15	33.2	6	-9	0.28	1.15
s165 If I win big I am likely to put the money back into a machine and keep playing.	4	0.78	17.6%	50	46.7	51	1	0.40	1.34
s93 When gambling on a slot machine I usually play as fast as I can.	5	0.76	15.0%	57	44.4	39	-18	0.36	1.17
s129 I have sometimes gambled for more than six hours straight when I was playing the slots.	6	.63	34.8	11	34.7	11	0	0.41	1.24

**4.3.3.2 Risk Practices: Later (Formative) (Table 3b)**

The second construct, Risky Practices: Later contains six statements that captured various aspects of three basic high-risk gambling behaviours, chasing, borrowing and staying to gamble alone. The hierarchy rankings were considerably higher than those observed for Risky Practices: Earlier, ranging from 81 to 117 and the proportion of gamblers exhibiting these characteristics were considerably lower, ranging from 4.0% to 14.7% among participating regular slot gamblers. The hierarchy rankings of the three statements with the highest response frequencies were still 13 – 23

places higher than their frequency rankings suggesting that frequency underestimates the proximity of the behaviour to problem gambling. The statements comprising the Risk Practice: Later construct came from only two PCA components so the VIF scores were higher, most between 1.63 and 1.84, yet still falling well-below the 3.3 threshold for multicollinearity. Therefore, all six statements comprising this new construct were retained as we feel it captured a range of behaviours that can act as excellent cues for the gambler and can be managed or avoided in personal or assisted efforts to reduce risk and the experience of gambling harm or problems.

**Table 3b: Criteria for Selection of Items in the Risky Practices: Later Construct**

<b>Construct and Statements</b>	<b>Component</b>	<b>Comp. Loading</b>	<b>Frequency</b>	<b>Freq. Rank</b>	<b>Hierarchy Score</b>	<b>Hier. Rank</b>	<b>Diff. Rank</b>	<b>Correlation with PGSI</b>	<b>VIF</b>
<b>Risky Practices: Later</b>									
s96 After losing more money than I wanted on the slots I usually try to win it back by playing again either later that day or on another day.	1	0.71	14.7%	58	55.8	81	23	0.56	1.63
s36b When gambling on the slots I usually use my credit card to get more money so I can keep playing.	1	0.51	10.7%	71	56.3	84	13	0.42	1.37
s110 When I gamble with friends or family I sometimes stay and continue to play after they have stopped or left.	1	0.51	8.0%	84	66.4	103	19	0.41	1.64
s34 I have sometimes borrowed money from others so I could go and gamble on the slots.	2	0.85	4.3%	110	68.4	111	1	0.34	1.75
s69 I have borrowed money from other people at the casino in order to continue gambling.	2	0.73	4.0%	112	74.5	117	5	0.35	1.84
s22 I have left the casino to get more money so I can come back and keep on gambling.	2	0.48	7.8%	88	65.0	97	9	0.40	1.60

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**4.3.4 Impaired Control Continue/Begin (Reflective Constructs) (Tables 4a & 4b)**

Two components originally hypothesised for Impaired Control by Dickerson (1993a) clearly emerged in the PCA results: 1) An inability to cease the gambling activity once engaged (Impaired Control: Continue); and, 2) An inability to resist opportunities to begin a session. (Impaired Control: Begin). These indicators were all very highly correlated with the PGSI, ranging from 0.60 to 0.70.

**Table 4a: Criteria for Selection of Items in the Impaired Control: Continue Construct**

<b>Construct and Statements</b>	<b>Component</b>	<b>Comp. Loading</b>	<b>Frequency</b>	<b>Freq. Rank</b>	<b>Hierarchy Score</b>	<b>Hier. Rank</b>	<b>Diff. Rank</b>	<b>Corr with PGSI</b>
<b>Impaired Control: Continue</b>								
s80 I often spend more money gambling than I intended.	1	0.86	24.3%	27	49.3	62	35	0.63
s113 Even when I intend to spend a few dollars gambling, I often end up spending much more.	1	0.85	25.9%	23	47.7	55	32	0.63
s99 I sometimes gamble with money that I can't really afford to lose.	1	0.78	21.4%	38	50.1	65	27	0.70
s164 Once I have started gambling on the slots I find it very hard to stop.	1	.74	24.1%	29	48.9	59	30	0.64
s14 I often spend more time gambling than I intend to.	1	.71	24.1%	28	47.9	56	28	0.60

**4.3.4.1 Impaired Control: Continue (Reflective) (Table 4a)**

The first component, Impaired Control: Continue was comprised of five statements as compared to three for Impaired Control: Begin. Frequency values were higher for the first component with about one in four to five regular gamblers experiencing an inability to stop playing once they had started ranging from 21.4% to 25.9% as compared to only 8% - 15.0% indicating they were unable to resist the urge to go and start playing the machines (Impaired Control: Begin). The hierarchy scores were also lower for the Impaired Control: Continue construct (47.7 – 50.1) compared to Impaired Control: Begin (53.3 – 68.4) suggesting that gamblers first lose control of their ability to

stop once they are engaged in play (Impaired Control: Continue; unable to stop gambling) and then graduate to an inability to resist going to gamble (i.e., Impaired Control: Begin; unable to resist starting a gambling session). Thus the former would be an earlier indicator of risk than the latter.

#### **4.3.4.2 Impaired Control: Begin (Reflective) (Table 4b)**

There were consistent differences in frequency and hierarchy scores between the two Impaired Control constructs with statements in the Impaired Control: Begin construct associated with a higher-risk level. The hierarchy ranks for statements comprising this construct were between 21 and 35 places higher, indicating that these statements were endorsed by gamblers who were exhibiting levels of risk closer in proximity to problem gambling than was suggested by the frequency of responses. Impaired Control: Begin, with hierarchy rankings ranging from 76 to 109 was a better indicator of those at a higher risk while Impaired Control: Continue was positioned as an earlier risk indicator.

**Table 4a: Criteria for Selection of Items in the Impaired Control: Begin Constructs**

<b>Construct and Statements</b>	<b>Component</b>	<b>Comp. Loading</b>	<b>Frequency</b>	<b>Freq. Rank</b>	<b>Hierarchy Score</b>	<b>Hier. Rank</b>	<b>Diff. Rank</b>	<b>Corr with PGSI</b>
<b>Impaired Control: Begin</b>								
s126 I have tried to cut back on my slots play with little success.	2	0.87	9.1%	77	66.5	104	27	0.68
s170 I have tried unsuccessfully to stop or reduce my gambling on the slots.	2	0.85	8.0%	84	68.4	109	25	0.62
s185 There have been times I have gambled despite my desire not to.	2	0.74	15.0%	57	53.3	76	21	0.61

#### **4.3.5 Negative Consequences Construct (Formative) (Table 5)**

Overall, there were 14 statements meeting the criteria for inclusion in the Negative Consequences construct. PCA grouped the statements comprising the Negatives Consequences construct into five components (Table 5).

Component 1 included five statements. The frequency of regular players endorsing the five statements falling under the first component ranged from 2.9% to 5.9% and all five statements ranked 116 and above in terms of its hierarchy score. Although there tended to be a high degree of overlap or commonality among those experiencing any of these consequences, each item was different in nature, and the VIF fell below the threshold of 3.3 for multicollinearity, thus meeting the criteria for retention in the formative construct.

The next component was comprised of two statements (e.g., feeling depression over slot play and not wanting anyone to know how much time of money was being spent at the casino) with similar frequencies of 13.1% and 14.4% respectively, endorsement rates more than double that observed for any other statement in the Negative Consequence construct. These statements were also lower in the hierarchy rankings at 78 and 86 suggesting that these were consequences experienced in advance of the other items measured.

The last seven statements comprising the construct were drawn from three components with frequencies ranging from 1.6% to 5.6% and hierarchy rankings from 92 to 125 and included various negative impacts associated with relationships, social consequences and isolation.

In total, ten of the fourteen statements comprising Negative Consequences received a hierarchy rank of 100 or higher as would be expected if these statements were closely aligned with problem gambling. The frequencies range from a low of 1.6% to a high of 14.4%. Three of the consequence items (gambling has jeopardized goals, depression due to gambling and not wanting others to know about the time and money spent) have high correlations above 0.50 with the PGSI. However, seven of the items retained have correlations of 0.31 or lower suggesting the PGSI does not identify gamblers suffering consequences that are not explicitly included in that screen.

As noted above, the highest VIF for any one statement comprising the Negative Consequences construct was 2.79, below the 3.3 rule of thumb but still sufficiently high to suggest multicollinearity among these variables. Rather than cull the statements at this time to reduce the VIF and degree of multicollinearity we decided to retain all 14 statements in the construct until further testing is undertaken including a more extensive list of negative consequences. Such items will exclude any obvious high-intensity or evocative consequences such as attempted suicide, assault or losing one's house to gambling debt instead focusing on compiling a comprehensive list of medium intensity

items that assist the gambler in recognizing consequences of less severity. If the goal was to create a brief concise measure of consequences it would have been more appropriate to generate a reflective measure. To put this in perspective, among the 14 statements the most likely candidates for removal would be “I have had problems paying off debts accumulated from playing the slots.” which has a VIF of 2.79 and “Sometimes I have to juggle money and bills to cover the cost of my slot machine gambling.” with a VIF of 2.71. However, the Spearman correlation between these two variables is only 0.34; and, of the 24 gamblers who answered positively to either of these statements, only five answered yes to both, leaving 19 who answered yes to one but not the other. Dropping one of these statements would substantially reduce the instrument’s ability to identify financially related negative consequences. Therefore we have retained both statements in the construct as each was measuring a different consequence.

**Table 5: Criteria for Selection of Items in the Negative Consequences Construct**

<b>Construct and Statements</b>	<b>Component</b>	<b>Comp. Loading</b>	<b>Frequency</b>	<b>Freq. Rank</b>	<b>Hierarchy Score</b>	<b>Hier. Rank</b>	<b>Diff. Rank</b>	<b>Correlation with PGSI</b>	<b>VIF</b>
<b>Consequences</b>									
s49 My goals in life have been jeopardized by my slot play.	1	.58	4.8%	105	75.9	120	15	0.64	2.49
s140 I often can’t sleep because I am worrying about my slot machine gambling .	1	.73	2.9%	116	83.9	127	11	0.31	2.08
s81 I have had problems paying off debts accumulated from playing the slots.	1	.78	5.1%	102	77.6	122	20	0.40	2.79
s178 Since I started playing the slots I don’t like the type of person I have become.	1	.63	3.7%	114	74.2	116	4	0.30	2.29
s161 Sometimes I have to juggle money and bills to cover the cost of my slot machine gambling.	1	.77	5.9%	98	77.3	121	23	0.42	2.71

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s21 I wouldn't want anyone to know how much time or money I spend at the casino.	2	.54	14.4%	61	55.0	78	17	0.54	1.63
s176 Sometimes I feel depressed over my slots play.	2	.54	13.1%	62	58.5	86	24	0.55	1.74
s87 Others are disappointed in me because of my gambling.	3	.68	5.1%	101	66.0	100	-1	0.30	1.62
s156 I have friends or family who are concerned about my slots play.	3	.76	5.1%	103	64.3	94	-7	0.32	1.49
s71 I have sometimes missed events or neglected family, friends or work in order to play the slots.	4	.72	2.7%	118	68.9	112	-4	0.25	2.09
s4 When I leave the casino, I have sometimes been short of cash for parking, food, or a ride home.	4	.78	1.6%	122	83.2	125	3	0.22	2.15
s105 I have become somewhat of a loner because of my slot gambling.	4	.59	1.6%	125	75.2	118	-7	0.21	1.80
s102 I sometimes have spent time gambling on the slots when I was supposed to be doing something else important.	4	.59	5.6%	99	63.6	92	-7	0.35	1.59
s84 My gambling has caused me to have a falling out with the people I used to hang out with	5	.88	1.6%	121	66.5	103	-18	0.16	1.26

**4.3.6 Persistence Construct (Reflective) (Table 6)**

As expected, the four persistence statements loaded highly onto one component with a narrow frequency range from 8.0% to 11.8% (Table 6). The frequency and hierarchy ranks were high, but not as high as those for the Consequence indicators. The hierarchy rankings were 16 to 39 higher than the frequency rankings suggesting those who answered these statements positively were positioned in close proximity to problem gambling. Consistent with this observation there were high correlations with the PGSI, ranging from 0.59 to 0.66.

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**Table 6: Criteria for Selection of Items in the Persistence Construct**

<b>Construct and Statements</b>	<b>Component</b>	<b>Comp. Loading</b>	<b>Frequency</b>	<b>Freq. Rank</b>	<b>Hierarchy Score</b>	<b>Hier. Rank</b>	<b>Diff Rank</b>	<b>Correlation with PGSI</b>
<b>Persistence</b>								
s86 I continue to play the machines despite experiencing problems or other negative consequences.	1	.88	10.2	72	68.6	111	39	0.66
s63 I continue to gamble despite the bad things that happen to me.	1	.85	10.2	73	65.9	99	16	0.60
s44 I gamble even though I know it is likely to lead to problems for me.	1	.79	11.8	67	60.9	90	23	0.64
S139 Even if money is tight, I continue to play the slots to get big wins.	1	.80	8.0	86	68.3	108	24	0.59

#### **4.4 Tests of Constructs (Step 4)**

The fact that the new instrument is comprised of both reflective and formative constructs has implications as to which methods are appropriate for determining the validity and reliability of these measures (Bollen and Lennox 1999).

##### **4.4.1 Reliability of Reflective Constructs**

As the items in formative constructs are not expected to covary it is neither required nor appropriate to use principal component analysis to measure internal consistency for these constructs (Cohen, Cohen, Teresi, Marchi, and Velez, 1990). However, this approach is appropriate for evaluating the quality of reflective constructs.

The indicator and construct reliability for reflective constructs are shown in Table 7. The four constructs consisting of three or more statements all had component reliability above the recommended level of 0.70 (Nunnally, 1978) indicating sufficient internal consistency. The

convergent validity was evaluated using the average variance extracted (AVE) and all five reflective constructs were found to perform above the guideline of 0.5 recommended by Fornell and Larcker (1981).

Communality is the proportion of variance of a particular item that is due to common factors (shared with other items). The communality for each of the constructs is presented in the last column and shows that the reflective constructs all had communality scores ranging from 0.64 up to 0.75 while the communality scores for the formative constructs were much lower as would be expected, ranging from 0.31 to 0.51.

**Table 7: Reliability Measures for Reflective Constructs**

	Average Variance Extracted (AVE)	Composite Reliability	Average Communality
Erroneous Cognitions: Beliefs (Formative)	na	na	<b>0.31</b>
Erroneous Cognitions: Motives (Formative)	na	na	<b>0.49</b>
Preoccupation Desire (Reflective)	<b>0.64</b>	<b>0.88</b>	<b>0.64</b>
Preoccupation: Obsessed (Reflective)	<b>0.68</b>	<b>0.81</b>	<b>0.68</b>
Impaired Control: Begin (Reflective)	<b>0.75</b>	<b>0.90</b>	<b>0.75</b>
Impaired Control: Continue (Reflective)	<b>0.70</b>	<b>0.92</b>	<b>0.70</b>
Risky Practices: Earlier (Formative)	na	na	<b>0.40</b>
Risky Practices: Later (Formative)	na	na	<b>0.51</b>
Negative Consequences (Formative)	na	na	<b>0.41</b>
Persistence (Reflective)	<b>0.69</b>	<b>0.90</b>	<b>0.69</b>

#### **4.4.2 Discriminant Validity among Reflective Constructs**

The discriminant validity of the five reflective constructs was evaluated using two approaches. The first approach compared the square root of the Average Variance Extracted (AVE) to the correlations with the other constructs. Adequate discriminant validity was indicated if the square root of the construct's AVE was greater than its correlations with the other constructs (Compeau et al. 1999). Table 8 below presents the square root of the AVE in the diagonal and the correlations in

the off diagonal. For formative constructs it is inappropriate to report AVE and, therefore, n.a. (not applicable) is entered in the diagonal for these constructs. All five reflective constructs passed the test for discriminant validity.

**Table 8: Square Root of AVE and Inter-construct Correlations to Test for Divergent Validity**

<b>Constructs</b>	<b>Erroneous Cognitions: Beliefs</b>	<b>Preoccupation Desire</b>	<b>Risky Practices: Earlier</b>	<b>Impaired Control: Continue</b>	<b>Erroneous Cognitions: Motives</b>	<b>Preoccupation: Obsessed</b>	<b>Impaired Control: Begin</b>	<b>Risky Practices: Later</b>	<b>Negative Consequences</b>	<b>Persistence</b>
Erroneous Cognitions: Beliefs	n.a.									
Preoccupation Desire	0.40	0.80								
Risky Practices: Earlier	0.43	0.54	n.a.							
Impaired Control: Continue	0.36	0.64	0.76	0.84						
Erroneous Cognitions: Motives	0.49	0.39	0.58	0.53	n.a.					
Preoccupation: Obsessed	0.50	0.44	0.50	0.52	0.55	0.83				
Impaired Control: Begin	0.40	0.41	0.59	0.61	0.48	0.50	0.87			
Risky Practices: Later	0.45	0.48	0.67	0.60	0.59	0.61	0.66	n.a.		
Negative Consequences	0.44	0.40	0.61	0.59	0.62	0.56	0.70	0.74	n.a.	
Persistence	0.47	0.44	0.65	0.67	0.63	0.63	0.73	0.75	0.81	0.83

The second approach suggested by Gefen and Straub (2005) compared the correlations between the individual items and the PLS calculated construct scores as listed with the individual items shown in Table 9. In order for the construct to have discriminant validity the item loadings for the reflective construct must be greater (i.e., greater by 0.10) than the construct's correlations with the other items. Again this test does not apply to formative constructs (Diamantopoulos and Winklhofer 2001) as the items comprising such a construct are not expected to be correlated with each other. However, the five reflective constructs again pass the test for discriminant validity.

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**Table 9: Factor Loadings on Constructs to Measure Discriminant Validity of Reflective Constructs**

Statements	Constructs									
	Preoccupation Desire	Preoccupation: Obsessed	Impaired Control: Continue	Impaired Control: Begin	Persistence	Risky Cognitions: Beliefs	Risky Cognitions: Motives	Risky Practices: Earlier	Risky Practices: Later	Negative Consequences
Pre-des 1 (s29)	<b>0.84</b>	0.34	0.54	0.33	0.37	0.30	0.36	0.44	0.39	0.34
Pre-des2 (s3)	<b>0.81</b>	0.40	0.50	0.39	0.39	0.33	0.35	0.47	0.42	0.37
Pre-des3 (s55)	<b>0.82</b>	0.39	0.55	0.31	0.35	0.24	0.29	0.39	0.41	0.31
Pre-des4 (s9)	<b>0.72</b>	0.25	0.43	0.26	0.29	0.28	0.24	0.42	0.29	0.23
Pre-obs (s140b)	0.25	<b>0.74</b>	0.28	0.27	0.37	0.36	0.38	0.29	0.42	0.40
Pre-obs (s51)	0.44	<b>0.90</b>	0.53	0.52	0.63	0.45	0.52	0.50	0.57	0.51
IC-cont1 (s113)	0.57	0.41	<b>0.87</b>	0.49	0.55	0.29	0.44	0.69	0.53	0.49
IC-cont1 (s164)	0.50	0.46	<b>0.83</b>	0.55	0.57	0.33	0.46	0.63	0.52	0.50
IC-cont1 (s14)	0.53	0.43	<b>0.79</b>	0.53	0.51	0.30	0.45	0.58	0.42	0.47
IC-cont1 (s80)	0.59	0.42	<b>0.89</b>	0.52	0.58	0.31	0.45	0.68	0.54	0.46
IC-cont1 (s99)	0.49	0.46	<b>0.81</b>	0.49	0.60	0.29	0.43	0.62	0.51	0.54
IC-begin (s170)	0.32	0.48	0.55	<b>0.89</b>	0.66	0.36	0.44	0.49	0.59	0.61
IC-begin (s126)	0.38	0.46	0.54	<b>0.91</b>	0.65	0.35	0.38	0.55	0.62	0.67
IC-begin (s185)	0.36	0.35	0.51	<b>0.80</b>	0.58	0.33	0.42	0.51	0.48	0.54
Persist1 (s139)	0.32	0.54	0.47	0.61	<b>0.81</b>	0.44	0.56	0.45	0.62	0.66
Persist2 (s44)	0.37	0.48	0.56	0.58	<b>0.79</b>	0.36	0.47	0.53	0.63	0.65
Persist3 (s63)	0.39	0.52	0.58	0.57	<b>0.84</b>	0.37	0.49	0.59	0.63	0.64
Persist4 (s86)	0.39	0.54	0.61	0.66	<b>0.89</b>	0.40	0.56	0.58	0.63	0.74

#### **4.4.3 Formative Construct Validity**

Henseler, Ringle, and Sinkovics, (2009, page 309), recommended four methods for assessing the validity of formative constructs when utilized in PLS modeling:

1. **“Nomological validity** – The relationships between the formative index and other constructs in the path model, which are sufficiently well known through prior research, should be strong and significant.
2. **External validity** – The formative index should explain a big part of the variance of an alternative reflective measure of the focal construct.
3. **Significance of weights** – Estimated weights of formative measurement models should be significant.
4. **Multicollinearity** – Manifest variables in a formative block should be tested for multicollinearity. The variance inflation factor (VIF) can be used for such tests. As a rule of thumb, a VIF greater than ten indicates the presence of harmful collinearity. However, any VIF substantially greater than one indicates multicollinearity.”

#### **4.4.3.1 Nomological Validity**

As can be seen in our review of the literature, outside of that conducted by the authors, there has been little research in the area of gambling that has used formative constructs and attempted to independently measure gambling risk, harms and problem gambling using path analysis to “connect” each of the factors leading to problem gambling. The authors had created two PLS models in identifying risk factors for problem gambling using formative constructs; one based on data from Nova Scotia, Canada collected in 1998 (Schellinck and Schrans 1998, Schellinck 2004) and a second based on data collected in Victoria, Australia (Schellinck 2006). In both cases the results supported the findings obtained in this current report (See Appendix F for the PLS models derived in each study). Risky Cognitions: Beliefs was found to lead to Risky Cognitions: Motives and did not connect to any other construct. Motives in turn were linked to Risky Behaviours, although in previous analysis this construct had not been broken out into the two versions identified in the current study (i.e., Earlier versus Later Risky Practices) which is seen to improve model performance. Consistent with both previous models Risky Practices was found to lead to Negative Consequences. The current study built upon this initial research confirming relationships and previous findings when adapted for use with slot machine gamblers in Ontario.

**Table 10: Nomological Validity of Formative Constructs: Significant and Hypothesised Links**

<b>Link</b>	<b>Weight</b>	<b>T-Score</b>
Risky Cognitions: Beliefs -> Risky Cognitions: Motives	0.493	7.70
Risky Cognitions: Motives -> Risky Practices: Earlier	0.205	3.92
Risky Cognitions: Motives -> Risky Practices: Later	0.156	2.64
Risky Practices: Earlier -> Risky Practices: Later	0.286	3.97
Risky Practices: Later -> Negative Consequences	0.494	6.56

#### **4.4.3.2 External Validity**

Henseler et al (2009) recommend testing to determine if the formative construct can explain a significant portion of the variance in an alternative reflective measure of the focal construct. We have undertaken this test for Negative Consequences and Persistence, the latter being a reflective measure that has negative consequences as part of its make up. The weight for this connection is 0.569 (t = 9.21) supporting its validity. However, for both Risky Cognitions and Risky Practices, it is difficult to develop a reflective construct that would adequately capture these concepts. Risky Cognitions: Beliefs is made up of statements from six different PCA components. This means for testing purposes we would have to develop a prototype reflective construct based on each component none of which would be expected to explain a large part of the variance. Moreover, a statement asking people if they have misconceptions about gambling would not likely be effective in identifying those people who do since presumably they would not hold these beliefs if they felt they were false. A similar argument could be made concerning the viability of a reflective measure for Risky Cognitions: Motives. Risky Practices were also derived from several PCA components, and gamblers would need to be educated as to what a risky practice was before they could adequately confirm whether or not they engaged in such practices. Merely providing examples of risky practices would not be an adequate compromise as it would be time consuming and impractical to read off a comprehensive list. Therefore, while the recommendation put forth by Henseler and colleagues is desirable it is not practical (nor potentially possible) for all of the formative constructs created to measure gambling risk and harm in this study.

#### **4.4.3.3 Multicollinearity**

The highest VIF score for Risky Cognitions: Beliefs was 1.11 and for Risky Cognitions: Motives it was 1.32 indicating multicollinearity was not an issue for either of these constructs. Both Risky

Practices: Earlier with a high VIF of 1.58 and Risky Practices: Later with a high VIF of 1.84 have some degree of multicollinearity, but they are still acceptably low (i.e., below the 3.3 threshold) for inclusion in a formative construct. Negative Consequences with the highest VIF score of 2.79 may have a substantial degree of multicollinearity, but again still meets the criterion for inclusion in a formative construct (Diamantopoulos and Siguaaw 2006) and was well below the 10.0 indicator of multicollinearity harm put forward by Henseler et al (2009) as part of the criteria for evaluating formative constructs.

#### 4.4.3.4 Significance of weights

Table 11 below presents the significance of the weights derived from the PLS mode

**Table 11: Construct Item Weight T-Scores.**

	<b>Construct Item Weight T-Score</b>
<b>Risky Cognitions: Beliefs</b>	
S174 I feel the machines are fixed sometimes so that you can't win on them.	2.10
s182 You can sometimes tell when the machine is about to pay out big because the symbols start getting closer to lining up on the pay line (Eg. almost winning).	4.67
s183 It is important for me to use a system or a strategy when I play the machines.	1.59
s8 I believe that in the long run I can win playing slots at the casino.	3.35
s88 If a slot machine hasn't had a big pay out in a long time, it is more likely to do so soon.	1.84
<b>Risky Cognitions: Motives</b>	
S2 I sometimes play the slots in hopes of paying off my debts/bills.	4.98
s35 I can escape by playing the slots whenever I am worried or under stress	2.29
s47 Gambling on the slots is a way I can try to get some money when I need it.	2.83
s74 I sometimes play the slots when I'm feeling down or depressed.	5.58
<b>Risky Practices: Earlier</b>	
S129 I have sometimes gambled for more than six hours straight when I was playing the slots.	2.21
s165 If I win big I am likely to put the money back into a machine and keep playing.	4.73
s25 I play max bet if I'm on a winning streak.	1.62
s32 I sometimes exceed the amount of money I intended to spend in order to win back money I have lost.	7.62

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s36a When gambling on the slots I usually use my bank or debit card to get more money so I can keep playing.	4.74
s93 When gambling on a slot machine I usually play as fast as I can.	2.48
<b>Risky Practice: Later</b>	
S110 When I gamble with friends or family I sometimes stay and continue to play after they have stopped or left.	3.40
s22 I have left the casino to get more money so I can come back and keep on gambling.	2.61
s34 I have sometimes borrowed money from others so I could go and gamble on the slots.	0.46
s36b When gambling on the slots I usually use my credit card to get more money so I can keep playing.	3.25
s69 I have borrowed money from other people at the casino in order to continue gambling.	2.11
s96 After losing more money than I wanted on the slots I usually try to win it back by playing again either later that day or on another day.	2.57
<b>Negative Consequences</b>	
S102 I sometimes have spent time gambling on the slots when I was supposed to be doing something else important.	1.20
s105 I have become somewhat of a loner because of my slot gambling.	0.00
s140 I often can't sleep because I am worrying about my slot machine gambling .	1.20
s156 I have friends or family who are concerned about my slots play.	0.89
s161 Sometimes I have to juggle money and bills to cover the cost of my slot machine gambling.	3.31
s176 Sometimes I feel depressed over my slots play.	3.78
s178 Since I started playing the slots I don't like the type of person I have become.	0.15
s21 I wouldn't want anyone to know how much time or money I spend at the casino.	2.43
s4 When I leave the casino, I have sometimes been short of cash for parking, food, or a ride home.	0.00
s49 My goals in life have been jeopardized by my slot play	2.40
s71 I have sometimes missed events or neglected family, friends or work in order to play the slots.	1.50
s81 I have had problems paying off debts accumulated from playing the slots.	0.36
s84 My gambling has caused me to have a falling out with the people I used to hang out with	0.81
s87 Others are disappointed in me because of my gambling.	2.09

Concerning the use of weighted t-scores, Henseler et al (2009 page 303) add “*A final note of caution: formative indicators should never be discarded simply on the basis of statistical outcomes.*”

*Such actions may substantially change the content of the formative index (Jarvis et al., 2003). Thus, the researcher should keep both significant and insignificant formative indicators in the measurement model as long as this is conceptually justified.*” They point out that the instability is usually caused by highly collinear formative indicators but that this should not preclude an item if it has a sufficiently low VIF score. This appears to be the case in the current study; those constructs with higher multicollinearity also have a higher number of non-significant weights. Given this finding and in accordance with the suggested protocols we have retained certain non-significant indicators as we felt they were conceptually correct.

Further supporting this decision we examined overlap in responses between statements with high collinearity. Crosstab analysis showed that three quarters or more of those who responded to two collinear statements did not respond to both, suggesting that the cost of dropping one of the statements in terms of the sensitivity of the construct may be too high. As well, one of the key definitions of a formative construct is that all the items be predictive of a latent variable (Jarvis et al., 2003). Multiple regression is only one method for testing this. Researchers conducting work in the area of determinant attributes have moved away from exclusive reliance on multiple regression to other methods that avoid the problem of unstable weights and instead use methods such as Normalized Pairwise Estimation (NPE) (Gustafsson and Johnson, 2004) which relies on the use of correlation analysis in tandem with multiple regression to estimate the determinance of attributes. For this reason we ensured all items in the instrument were at minimum significantly correlated with the PGSI.

## **4.5 The Identification of Risk Levels Associated with Each Construct (Step 5)**

### **4.5.1.1 Risk Levels Based on the Hierarchy Measure**

Table 12 below presents the mean hierarchy scores for each construct, ranging from 41.2 to 70.7, the range of scores within each construct, and the median hierarchy ranking for each construct. The constructs were listed in order of their hierarchy based primarily on the mean score or the median ranking in the case where discrepancies existed between the two measures (mean versus median). Based on this analysis, individuals would be expected to display these characteristics in this order if they were at risk for problem gambling. While this may not be accurate for all, we hypothesised that it will be true for the majority of gamblers.

**Table 12: Average Hierarchy Scores across Construct Items**

<b>Constructs</b>	<b>Mean Hierarchy Score</b>	<b>Hierarchy Score Range</b>	<b>Median Hierarchy Ranking</b>
Risky Cognitions: Beliefs	44.2	33.2-55.4	20
Preoccupation: Desire	41.2	36.8-44.6	28
Risky Practices: Earlier	44.6	33.2–51.2	45.5
Impaired Control: Continue	48.8	47.7-50.1	59
Risky Cognitions: Motives (Money and Depression)	49.4	36.7-59.0	63.5
Preoccupation: Obsessed	59.4	53.2-65.7	85
Impaired Control: Begin	62.7	53.3-68.4	104
Risky Practices: Later	64.8	55.8-74.5	103
Persistence	65.9	60.9-68.6	103.5
Negative Consequences	70.7	55.0-83.9	114

The table suggests that for many people the path to problem gambling starts with the development of erroneous beliefs and a strong desire to gamble more frequently. They start to exhibit risky practices such as playing longer during sessions than intended, chasing losses during sessions and playing at more extreme levels. The inability to stop during a session is caused in part by impaired control in that they continue to gamble in a session when they know they should stop. Over time their motives for gambling are less for fun and entertainment and more often in the hopes of making money or to relieve depression. Many then become obsessed with gambling so that it fills their thoughts both night and day and they find themselves gambling at times they know they shouldn't (not necessarily more often). They engage in risky practices associated with higher levels of risk such as returning other days to chase losses, financing gambling through debt and seeking cash from non-commercial sources. After this they may suffer negative consequences and, if they persist in these gambling habits despite the consequences, then they have become problem gamblers.

If the sequence of events occurs as outlined above than it is likely that those with indications on the later construct will also have indications on the earlier construct. As well it would be expected that

there would be gamblers who have indications on an earlier construct but have yet to be flagged on the later construct. We examined the data for this pattern using the three sets of constructs that span two levels of risk in the FLAGS instrument: Preoccupation: Desire and Preoccupation: Obsessed, Impaired Control: Continue and Impaired Control: Begin, and Risky Practices: Earlier and Risky Practices: Later.

As predicted, 14 of the 15 gamblers (93%) who flagged on Preoccupation: Obsession also flagged on Preoccupation: Desire. As well there were still 56 gamblers in our sample who scored for Preoccupation: Desire but not Preoccupation: Obsession. The same pattern was found for the two Impaired Control constructs. Of the 32 gamblers in our sample who were flagged on Impaired Control: Begin, 31 were also flagged on Impaired Control: Continue (97%) and there were 57 gamblers in our sample who only had an indication on Impaired Control: Continue.

Risky practices, the third set of split constructs placed at different FLAGS levels in the hierarchy of risk exhibited a similar pattern with 40 of the 48 (83.3%) gamblers exhibiting Risky Practices: Later also exhibiting Risky Practices: Earlier. There were 27 gamblers in our sample who only flagged on Risky Practices: Earlier.

The results provide strong evidence that those with indications on the earlier construct in the pair were the source of gamblers for the second higher level construct in the pair. This means that the hierarchical design of FLAGS and labelling gamblers as earlier and later as well as being in a lower or higher state of risk is appropriate using these constructs.

As we will show subsequently, it appears that not all gamblers follow this linear path to problem gambling. Risky cognitions for some may not lead to problem gambling (e.g., for older gamblers), and many seem to skip the risky cognitions phase while others may skip the medium risk category and move directly to an advanced or high risk situation never exhibiting Impaired Control: Continue or Risky Practices: Early. However, the results suggest a general path that the majority of gamblers will typically follow.

#### **4.5.1.2 Risk Levels Based on Partial Least Squares Analysis**

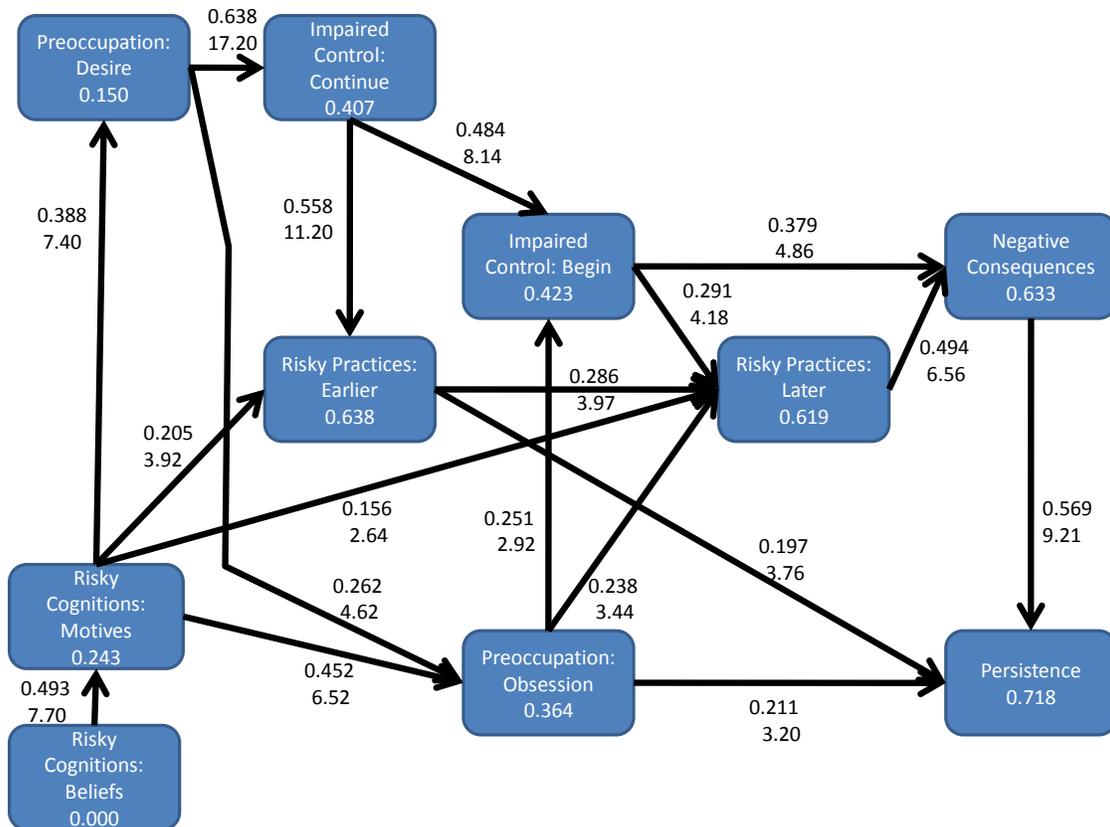
The figure below presents the results of PLS analysis using SmartPLS (Ringle et al 2005) conducted using the ten constructs.

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**Figure 3: PLS Model Showing Path Coefficients, T-Scores and Variance Explained in Each Construct**



The model in Figure 2 is the end product of starting with a fully saturated model and deleting the lowest coefficients until only significant paths remained. The initial direction of arrows was determined using the hierarchy measure in table 10 above. Directions were then reversed one at a time to determine if possible causality went against the direction of the hierarchy. The number in the boxes represents the variance explained; the two numbers associated with each arrow are the coefficient and corresponding t-score. All of the coefficients in this model were significant at  $p < 0.05$  based on a bootstrap in SmartPLS (Ringle et al 2005) using 500 bootstrap resamples. See Chin, (1998) for a discussion of the use of bootstrapping, a nonparametric approach for estimating precision which creates N samples to obtain N sets of parameter estimates.

Table 13 presents the relative effect each preceding construct had on the target construct listed at the top of the column (see Chin (1998) for a description of this method). Risky Practices: Later is

primarily influenced by Risky Cognitions: Motives (0.47), with Risky Practices: Earlier, Impaired Control: Continue, Preoccupation: Desire, Preoccupation: Obsessed and Impaired Control: Begin all having approximately the same effect sizes (0.29 – 0.34). Risky Cognitions: Beliefs is less influential at 0.20.

The profile of effects on Negative Consequences is somewhat different. In this case Impaired Control: Begin (0.54) and Risky Practices: Later (0.49) were major contributors. Impaired Control: Continue (0.34), and Risky Cognitions: Motives (0.33) were also relatively important, followed by the more moderate effects of Preoccupation: Desire (0.28) and Preoccupation: Obsession (0.25). Risky Practices: Earlier (0.14) and Risky Cognitions: Beliefs (0.16) had less effect.

Negative Consequences had the most effect on Persistence (0.57), although this was largely due to how the construct was formulated. Persistence was designed as a reflective measure to identify whether a gambler continues to gamble although they are experiencing negative consequences associated with their gambling. Therefore, by definition, one must be experiencing negative consequences before one can be found to be persistent in gambling despite negative consequences.

Risky Cognitions: Motives (0.38) and Preoccupation: Obsession (0.36) were both found to have the next strongest effect on Persistence, followed by Impaired Control Begin (0.34). The remaining constructs were found to have only moderate effects (0.19 to 0.32) on Persistence.

Overall these results provided guidance for the scoring of the FLAGS instrument as described in Section 4.6.

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**Table 13: Effect of Constructs on Target Constructs**

	<b>Risky Practices: Later</b>	<b>Negative Consequences</b>	<b>Persistence</b>
Risky Cognitions: Beliefs	0.20	0.16	0.19
Risky Cognitions: Motives	0.47	0.33	0.38
Preoccupation: Desire	0.29	0.28	0.30
Risky Practices: Earlier	0.29	0.14	0.28
Impaired Control: Continue	0.32	0.34	0.32
Preoccupation: Obsessed	0.32	0.25	0.36
Impaired Control: Begin	0.34	0.54	0.34
Risky Practices: Later		0.49	0.28
Negative Consequences			0.57

## **4.6 Instrument Design (Step 6)**

Once we had determined the validity and reliability of the constructs the next step was to develop an appropriate scoring system.

### **4.6.1.1 Setting Criterion levels for Constructs as Indicators**

Four criteria were used to assign indicator cut-offs for each of the ten constructs. First, frequency analysis was used to identify scree points that would indicate natural breaks in the data (Table 14), as well as offer insight on the sensitivity of choosing specific cut-offs points (e.g., does lowering the cut-off by one point double the percent of gamblers in the sample who would then be flagged on this construct?). The second and third criteria were sensitivity and 1-specificity found using Receiver Operating Characteristic (ROC) analysis [see Metz (2006) for an excellent description and review of the process]. To perform ROC analysis one specifies a state variable such as the PGSI score and the state value such as those scoring 8+ on the PGSI. A model is then used to predict the state value; in this case models with one variable, the particular construct being assessed.

Sensitivity is the reach or penetration achieved by the model, that is, the percent of those in the state that were identified by the model. Specificity is the percent of those predicted by the model to be in the state (e.g. PGSI score of 8+) that were correctly classified. The remainder (1-specificity) are those incorrectly classified, also called false positives. See Currie et al (2006) for an application

of ROC analysis in the gambling field and Conigrave et al (1995) for an application in the alcohol field. The fourth criterion we used was adoption of a minimum score of two for all cut-offs in order to ensure a reasonable degree of reliability in our indicators.

ROC analysis produces a graph of the ROC curve based on the sensitivity and the false positives that allow the power of the model to classify gamblers to be assessed visually (see Figure 3). A diagonal line in the graph indicates a performance level no better than chance, so the greater the separation of the ROC curve from the diagonal line the better the model's performance. The degree of separation is summarized by the total area under the curve; the closer to 100% area coverage under the curve, the better the model performance. The ROC analysis also produces an overall significance level. For all ten constructs analyzed the statistical significance for the models was  $p < 0.000$ .

The results of the model's performance was also summarised in a test results table that presents sensitivity and 1-specificity (false positives) for each level of the model output (Table 15). A standard approach to selecting cut-off points is to pick the value that maximizes the discrimination between those with the target value and those without (Conigrave et al 1995). This corresponds to the point in the ROC curve where the chi-square test score is maximized. This approach weights both sensitivity and specificity equally. However, in our opinion maintaining a high degree of specificity is more important than sensitivity with the current measure. Whether the FLAGS is self administered or administered to the gambler by someone else for policy purposes (e.g., in-person or telephone survey), we feel it is important that all users have confidence in how the gambler is classified. There is significant stigmatization in being labelled as a problem gambler. Moreover, the FLAGS instrument is more sensitive in detecting early and intermediate risk. Therefore, even if a small portion of problem gambler are not flagged as being at high risk or problem gambling levels the likelihood they will be labelled as No Risk gamblers is minimal; being flagged on any one of the ten indicators comprising FLAGS places the gambler in one of the risk categories. Therefore, we first selected cut-offs based on first achieving a specificity of 80% (low false positive rate of 20% or less) while maintaining a high sensitivity rate of 80% or more if possible (high true positive rate).

The two tables and graph for each construct are presented in Appendix C. For illustrative purposes we have presented the tables and graph for the Negative Consequences construct below. The state variable used in this analysis was the PGSI and the state value was those scoring eight or more (i.e.,

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8+ = problem gambler designation on the PGSI). From Table 14 we see that choosing a cut-off of two, three or four would select 13.6%, 9.9% or 5.9% of our sample of regular casino gamblers to be experiencing negative consequences respectively. The graph in Figure 3 shows the ROC curve well separated from the diagonal and the area under the curve is 0.963 indicating a highly predictive model.

**Table 14: Frequency of Scores on the Negative Consequences Construct**

<b>Construct Score</b>	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
.00	282	75.4	75.4
1.00	41	11.0	86.4
2.00	14	3.7	90.1
3.00	15	4.0	94.1
4.00	2	.5	94.7
5.00	6	1.6	96.3
6.00	3	.8	97.1
7.00	1	.3	97.3
8.00	3	.8	98.1
9.00	2	.5	98.7
10.00	2	.5	99.2
11.00	2	.5	99.7
13.00	1	.3	100.0
Total	374	100.0	

**Figure 4: ROC for Negative Consequences using PGSI Score 8+ for State Variable Value**

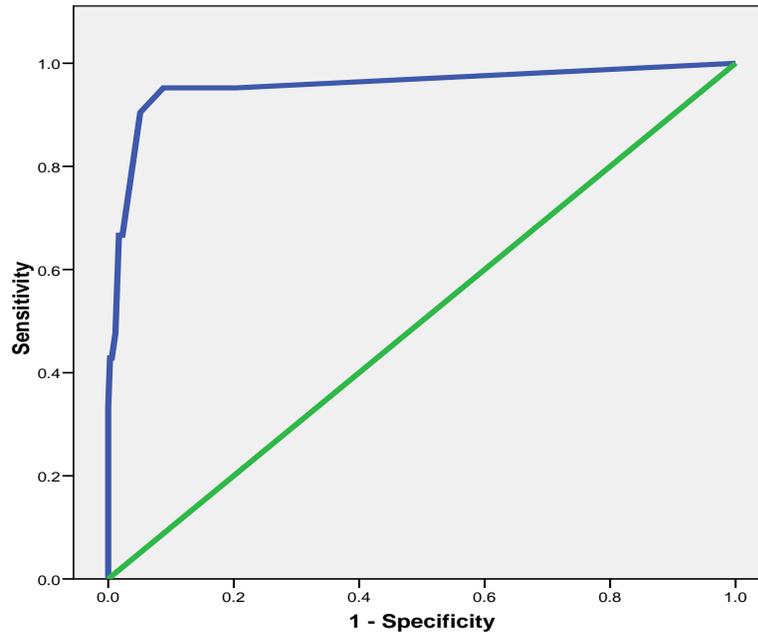


Table 15 shows the model achieves a false positive rate less than 20% when selecting a cut-off of two or higher, but we achieved a sensitivity of 90.5% and false negative level of only 5.1% by using a cut-off of three. Going to four reduces the sensitivity substantially. Therefore, we selected three as the cut-off score which indicated that 9.9% of this sample of regular casino gamblers was experiencing negative consequences.

**Table 15: Coordinates of the Curve for Consequences and PGSI 8+**

<b>Positive if Greater Than or Equal To:</b>	<b>Sensitivity (Proportion)</b>	<b>1 – Specificity (Proportion)</b>
0.0	1.000	1.000
1.0	.952	.204
2.0	.952	.088
3.0	.905	.051
4.0	.667	.023
5.0	.667	.017
6.0	.476	.011
7.0	.429	.006
8.0	.429	.003

<b>Positive if Greater Than or Equal To:</b>	<b>Sensitivity (Proportion)</b>	<b>1 – Specificity (Proportion)</b>
9.0	.333	.000
10.0	.238	.000
11.0	.143	.000
12.0	.048	.000

We selected different state variables depending on the construct being evaluated. This was done because FLAGS is based on a hierarchical model; we do not expect the constructs at the beginning of the hierarchy to accurately predict the final level of the hierarchy, that is, risk of problem gambling (this is the same assumption under which structural equation modeling is performed). Negative Consequences and Persistence were evaluated using a score of 8+ on the PGSI as the state value. The remainder of the constructs were evaluated using the other constructs to which they were found to be directly and significantly connected (i.e., high coefficients) as state values (See Figure 5). For example Preoccupation: Obsession; Impaired Control: Begin, and Risky Practices: Later were all constructs assessed using the FLAGS problem gambling indicator (i.e., gamblers flagged by both Negative Consequences and Persistence indicators) whereas Risky Practices: Earlier was tested using Risky Behaviours: Later as the state variable. The results of these analyses are shown in Table 16.

**Figure 5: Constructs and Corresponding State Values for Testing Sensitivity and Specificity**

<b>Construct</b>	<b>State Value Used for Testing</b>
Risky Cognitions: Beliefs	Risky Cognitions: Motives
Risky Cognition: Motives	Preoccupation: Desire
Impaired Control: Continue	Risky Practices: Earlier
Risky Practices: Earlier	Risky Practices: Later
Preoccupation: Desire	Preoccupation: Obsession
Risky Practices: Later	FLAGS Problem Gambling Indicator (Negative Consequences & Persistence)
Preoccupation: Obsession	FLAGS Problem Gambling Indicator (Negative Consequences & Persistence)
Impaired Control: Begin	FLAGS Problem Gambling Indicator (Negative Consequences & Persistence)

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Negative Consequences	PGSI Score 8+ (Canadian Problem Gambling Index)
Persistence	PGSI Score 8+ (Canadian Problem Gambling Index)

**Table 16: Results of ROC Analysis for Ten FLAGS Constructs**

Construct	State Variable	Cut-Off Chosen	% Indicated	Sensitivity	1-Specificity (False Positives)	Area Under Curve
Persistence	PGSI 8+	2	11.0%	85.7%	6.5%	95.0%
Negative Consequences	PGSI 8+	3	9.9%	90.5%	5.1%	95.6%
Preoccupation: Obsession	FLAGS PG	2	3.7%	41.4%	0.6%	78.1%
Impaired Control: Begin	FLAGS PG	2	8.6%	65.5%	3.8%	91.4%
Risky Practices: Later	FLAGS PG	2	12.8%	82.8%	7.0%	95.0%
Risky Practices: Earlier	FLAGS Risky Beh: Later	3	17.9%	83.3%	8.3%	91.1%
Impaired Control: Continue	FLAGS Risky Beh: Earlier	3	23.5%	82.1%	10.7%	91.3%
Preoccupation: Desire	FLAGS Imp. Control: Continue	3	18.4%	58.0%	6.3%	84.4%
Risky Cognitions: Motives	FLAGS Preocc: Desire	2	17.8%	42.0%	11.5%	71.8%
Risky Cognitions: Beliefs	FLAGS Risky Cog: Motives	3	8.8%	23.4%	5.8%	69.3%

Preoccupation: Obsession achieved a sensitivity of only 41.4% which was lower than desired. However, at this time the construct was only composed of two statements. The addition of more statements will raise the sensitivity of the construct and provide more flexibility in choosing an appropriate cut-off.

Using a cut-off of three for Risky Cognitions: Beliefs produced a sensitivity of only 23.4% for Risky Cognitions: Motives. However, the Beliefs construct was a relatively poor predictor of problem gambling and overall suffers from a high rate of false positive identification. If we had chosen a cut-off of two the false positives would have been 21.3% which is above our criterion for accuracy on this dimension.

The percentage of gamblers flagged on each of the indicators tended to be smaller for those constructs that had a higher average hierarchy score. However, only 8.8% of gamblers were flagged on the Risky Cognitions: Beliefs indicator even though this construct had the lowest hierarchy ranking (compared to 17.8% to 23.5% for the other low and medium risk indicators). This occurred due to the low association of the Beliefs construct with problem gambling and subsequently the need to specify a relatively high indication score of three. If the indication level had been set to two this would have more than doubled the percentage flagged on this indicator but again would have an excessive rate of false positives. The Preoccupation: Obsession indicator was also low at 3.7% compared to the other high risk and problem indicators which range from 8.6% to 12.8%. We propose to adjust this construct by adding two more statements and this may increase the percentage flagged on this indicator to some extent.

#### **4.6.1.2 Procedure for the Scoring of FLAGS**

Our overall approach for scoring FLAGS was to assign gamblers to problem or risk levels based on their 'state of mind' (e.g., cognitions, preoccupation, impaired control) and experiences (e.g., behaviours, consequences) rather than using a score or continuum for classification. That is, a gambler must meet certain conditions before he/she qualifies for a specific category of risk. We have used the definition of a problem gambler as a person who experiences harm as a result of excessive and persistent gambling irrespective of the presence of impaired control or dependence (Nower and Blaszczynski 2008).

Three constructs, Impaired Control: Begin, Risky Practices: Later, and Preoccupation: Obsessed, were designated as high risk indicators based on the following three criteria: each was found to lead directly into one of the problem gambling constructs of Negative Consequences or Persistence (Figure 2); each was significantly influential on either Negative Consequences or Persistence (Table 13) and each were found to have high hierarchy scores (Table 10) ranked from 85 to 103. While Risky Practices: Earlier was directly connected to Persistence (Figure 2) this construct scored much

lower on the hierarchy scale (ranked 45.5 compared to 103 for Risky Practices: Later) and was not one of the stronger influences on either Persistence or Negative Consequences and, therefore, was not included in the group of high risk indicators.

Two constructs were designated as medium risk indicators; Impaired Control: Continue and Risky Practices: Earlier. Both were mid-range in terms of average hierarchy scores, with median ranks of 45.5 and 59 (Table 12), and both lead to high risk constructs and were linked progressively to lower risk constructs (Figure 2). The evidence suggests that session related behaviours such as gambling longer than intended in a session were lower risk behaviours than high risk between session factors such as chasing during subsequent sessions and an inability to resist starting new sessions. The Risky Practices: Earlier construct also included elements of more extreme gambling behaviours during a session such as playing max bet and playing for at least six hours.

Two of the three low risk constructs were those that scored lowest on the hierarchy scale; Risky Cognitions: Beliefs which has the lowest median hierarchy ranking of 20 and Preoccupation: Desire with a median ranking of 28 (Table 12). Risky Cognitions: Beliefs was found to only influence Risky Cognitions: Motives and was positioned at the very start of the path with no other constructs influencing it (Figure 2). Its overall effect on either Negative Consequences or Persistence was lowest of all constructs at 0.16 and 0.19 respectively suggesting that in the end it may not be a major factor leading to problem gambling. Preoccupation: Desire, while low on the hierarchy scale had moderate levels of influence (0.28 – 0.30) on Negative Consequences and Persistence (Table 13). However, as this construct follows Impaired Control: Motives and was found to influence Impaired Control: Continue and Preoccupation: Obsession (Figure 2) it was located early on the path to problem gambling.

Risky Cognitions: Motives is a formative construct with a median hierarchical ranking of 63.5 which placed it, on average, further down the path than the two medium risk constructs of Impaired Control: Continue and Risky Behaviours: Earlier. However, given its location in the PLS model where it affects both earlier and later constructs, we have used this construct to identify those gamblers who were earlier in the hierarchy of risk for problem gambling, that is, they have yet to exhibit risky practices or impaired control and were simply playing for the wrong reasons, which may be caused in part by erroneous beliefs. The intent was to use this construct to identify people who have a clear indication of risk before they are gambling in a risky manner.

Based on these results we adopted the following criteria for classifying machine gamblers to one of five levels of risk for problem gambling (see Figure 6).

Figure 6: FLAGS Five Levels of Player Risk for Machine Gambling

Risk Level	Label	Description
Level V	Problem Gambler	A Problem Gambler is a person who flagged as exhibiting both Negative Consequences and Persistence and is characterized as having experienced harm in association with their gambling.
Level IV	Advanced Risk (High Risk – Problematic)	Those at Advanced Risk are not flagging as a problem gambler (i.e., scoring on Negative Consequence and Persistence) but have one or more indications on the five constructs ranked highest in the hierarchy score and are directly connected to either Negative Consequences or Persistence. Three of these constructs are Impaired Control: Begin, Preoccupation: Obsessed and Risky Practices: Later. Negative Consequences and Persistence are included as it is possible that a person only flagged on one of these constructs and, therefore, has not (yet) reached the threshold for identification as a problem gambler. Those at Advanced Risk may or may be experiencing harm.
Level III	Intermediate Risk	Those at Intermediate Risk are not Problem or Advanced Risk gamblers, but have been flagged on one or more of the medium risk constructs. The Intermediate Risk constructs are Impaired Control: Continue and Risky Practices: Earlier. Intermediate Risk Gamblers are not triggering on negative consequences or exhibiting signs of persistence. While higher in the risk hierarchy than the Early Risk group these players are comprised of those at pre-harm risk levels.
Level II	Early Risk	Those at Early Risk have flagged on at least one of Risky Cognitions: Beliefs, Risky Cognitions: Motives or Preoccupation: Desire but are not triggering for high-risk or problem gambling, and thus are also characterized as a pre-harm risk group.
Level I	No Detectable Risk	Those at No Detectable Risk do not flag on any of the risk indicators although it is possible that they answered yes to one or more statements making up some of the constructs. For those who answered yes to at least one statement there was insufficient certainty for us to say there was an indication on one of the dimensions. These people may still have unobservable or latent characteristics that would make them susceptible to becoming a problem gambler should the right conditions exist.
Level 0	Non-Gambler	FLAGS instrument categorizes a person’s risk based on their perceptions about and behaviours associated with gambling. It cannot therefore categorize a person’s risk if they do not have gambling experience within the last year. There is a long list of correlates that have been shown to be associated with risk of problem gambling that we have left out of FLAGS that if possessed by an individual could indicate risk for problem gambling should they start to gamble. It was decided that in order to keep the instrument to a reasonable size its constructs would only be gambling specific; from the point of view of FLAGS these risk factors are therefore latent or unobservable.

## 4.6.2 A Profile of the Five Risk Levels

This section provides a brief profile of the five risk categories on the ten risk indicators.

**Table 17: Mean Number of Indications by FLAGS Risk/PG Segments**

<b>Risk Categories</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>N</b>
All Gamblers	1.42	2.43	374
No Detectable Risk	0.00	0.00	226
Early Risk	1.08	0.27	39
Intermediate Risk	1.95	0.81	44
Advanced Risk	4.06	1.77	36
Problem Gamblers	7.55	1.92	29

*Between Groups F = 684.8, df 4, p < 0.00 R = 0.901*

As seen in Table 17 above, the mean number of indicators for the Early Risk segment was 1.08. Subsequently, in Table 18 the percentage of Early Risk gamblers flagging on the three low risk indicators summed to 108%, with 43.6% triggering on Risky Cognitions: Motives, 35.9% on Risky Cognitions: Beliefs and 28.2% on Preoccupation: Desire.

At the Intermediate Risk level a large percentage (77.3%) flagged on Impaired Control: Continue with almost half scoring on Risky Practices: Earlier (47.7%). The percentage flagged on Preoccupation: Desire increased to 45.5%, but the percentage flagging on the two Risky Cognitions indicators declined to 20.5% for motives and 4.5% for beliefs. This suggests that many of those at Intermediate Risk may have skipped the lower risk category (Early Risk) and developed Impaired Control: Continue and Risky Practices: Earlier independent of Risky Cognitions. In Figure 2, the PLS model shows that Preoccupation: Desire was strongly (0.638) connected to Impaired Control: Continue and that it in turn was strongly (0.558) connected to Risky Practices: Earlier. This route to problem gambling (i.e., bypassing Risky Cognitions) may occur in response to external stimuli such as marketing that increases the desire to gamble and/or conditioning which may lead to more extreme behaviours and stimulates lack of control during a session of gambling.

These results support the argument that there are multiple paths to problem gambling and that at risk gamblers come in sub-types. The results suggest that one sub-type, those who bypass risky cognitions, are at higher risk level when they start to have indications of risk such as impaired control: continue.

**Table 18: Percent of FLAGS Risk/PG Segments with Specific Indications of Risk**

<b>Constructs</b>	<b>All Gamblers</b>	<b>No Detectable Risk</b>	<b>Early Risk</b>	<b>Intermediate Risk</b>	<b>Advanced Risk</b>	<b>Problem Gambler</b>
Persistence	11.0%	0.0%	0.0%	0.0%	33.3%	100%
Negative Consequences	9.9%	0.0%	0.0%	0.0%	22.2%	100%
Preoccupation: Obsession	3.7%	0.0%	0.0%	0.0%	14.3%	41.4%
Impaired Control: Begin	8.6%	0.0%	0.0%	0.0%	36.1%	65.5%
Risky Practices: Later	12.8%	0.0%	0.0%	0.0%	66.7%	82.8%
Impaired Control: Continue	23.5%	0.0%	0.0%	77.3%	69.4%	100.0%
Risky Practices: Earlier	17.9%	0.0%	0.0%	47.7%	55.6%	89.7%
Risky Cognitions: Motives	17.1%	0.0%	43.6%	20.5%	38.9%	82.8%
Preoccupation: Desire	18.4%	0.0%	28.2%	45.5%	55.6%	62.1%
Risky Cognitions: Beliefs	8.8%	0.0%	35.9%	4.5%	22.2%	31.0%

As we move up the hierarchy of risk more of the Advanced Risk Gamblers exhibited characteristics leading directly to problem gambling such as Risky Behaviours: Later (66.7%), Impaired Control: Begin (36.1%), Negative Consequences (22.2%), Persistence (33.3%), and Preoccupation: Obsession (14.3%). There was a jump in the proportion of Advanced Risk gamblers who exhibit Risky Cognitions: Beliefs to 22.2%. However, only 31% of Problem Gamblers have Risky Cognitions: Beliefs suggesting that this was not an important factor in causing problem gambling. Problem Gamblers, compared to Advanced Risk gamblers were much more likely to have Risky Cognitions:

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Motives (82.8%). By definition all of the Problem Gamblers experienced Negative Consequences and persisted in gambling despite these consequences, but we found the largest percentage of gamblers who were scoring for Preoccupation: Obsessed (41.4%), Impaired Control: Begin (65.5%) and Impaired Control: Continue (100%) in this group as well.

The value of separating out two forms of Risky Cognitions, Impaired Control, Risky Practices and Preoccupation was evident from results in Table 18 as each becomes important at different levels of risk.

Table 19 presents the age, sex, employment status and household income profile of the five risk categories.

**Table 19: Demographic Profile by Risk Category**

<b>Demographic Variable (Chi Square Significance)</b>	<b>No Detectable Risk (%)</b>	<b>Early Risk (%)</b>	<b>Intermediate Risk (%)</b>	<b>Advanced Risk (%)</b>	<b>Problem Gambler (%)</b>
<b>Age (0.001)</b>					
Age under 55years	27.2	17.9	38.6	52.8	34.5
Age 55 to 64 years	27.7	30.8	25.0	22.2	44.8
Age 65+ years	45.1	51.3	36.4	25.0	20.7
<b>Sex (0.359)</b>					
Male	42.0	35.9	47.7	27.8	34.5
Female	58.0	64.1	52.3	72.2	65.5
<b>Work Status (0.003)</b>					
Employed Full or Part Time	39.4	28.2	43.2	58.3	55.2
Retired	51.8	64.1	38.6	25.0	24.1
Other	8.8	7.7	18.2	16.7	20.7
<b>Annual Household Income (0.049)</b>					
Less Than \$40k	29.6	48.7	36.4	36.1	41.4
\$50k up to \$90k	42.5	38.5	50.0	30.6	48.3
\$90k or more	27.9	12.8	13.6	33.3	10.3

Except for sex, a number of categories in each variable were combined and, therefore, results for the Chi Square significance tests were inconclusive and should be viewed with caution. The key significant difference observed was for age, with higher risk categories being comprised of younger gamblers. Half of the Early Risk gamblers in our sample were over 65 years of age compared to 25% and 21% respectively for those in the Advanced Risk and Problem Gambler segments. This resulted in different income and work status profiles among the groups that was largely attributable to the age differences observed. There was no significant difference in gender composition among the groups.

#### **4.7 Comparison to PGSI (Step 7)**

Overall the FLAGS categories were highly correlated with the PGSI categories (Spearman=0.730). However, when those categorised as Problem Gamblers by FLAGS were excluded the correlation dropped to 0.644 (n= 345), and declined even further if those in the FLAGS Advanced Risk category were also removed (0.514; n = 309). This finding suggests the two screens were more consistent in categorizing Problem Gamblers and those at higher risk than was the case among the lower risk segments.

The overall distribution by risk categories was quite similar among the two measures:

- FLAGS identified 60.4% No Detectable Risk, 10.4% Early Risk, 11.8% Intermediate Risk, 9.6% High Risk, and 7.8% as Problem Gamblers;
- PGSI identified 54.8% as No Risk, 19.3% as Low Risk, 20.3% as Moderate Risk and 5.6% as Problem Gamblers (Table 20).

If it is assumed that the FLAGS Intermediate and Advanced Risk segments are roughly equivalent to the PGSI Moderate Risk categorization and that the No Risk, Low Risk and Problem Gambler categories corresponded to the similarly labelled FLAGS categories (No Detectable Risk, Early Risk and Problem Gambler), then there was 68.2% agreement between the two measures in terms of overall classification of risk level. However, for those classified at some level of risk by either instrument the two instruments agreed on only 39.9% of the cases (again collapsing the FLAGS Advanced and Intermediate Risk categories together and assuming they would comprise the PGSI Moderate Risk group). These levels of disparity suggest the two instruments differ significantly in how At Risk gamblers are classified.

Table 20 below illustrates the following discrepancies:

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- Of the 54.8% of gamblers classified as No Risk by the PGSI 7.7% were classified as Early and Advanced risk by FLAGS.
- Of the 60.4% of gamblers classified as No Detectable Risk by FLAGS, 13.3% were classified as Low and Moderate Risk by the PGSI.
- Of the 19.3% classified as Low risk by the PGSI only 2.4% were classified as Early Risk or higher by FLAGS and 11.2% as No Detectable Risk.
- Of the 7.8% classified as Problem Gamblers by FLAGS 3.0% were classified as Low to Moderate Risk by the PGSI.

**Table 20: Overlap in Classification by Risk Categories between FLAGS and PGSI**

PGSI Categories	FLAGS Categories					
	No Detectable Risk	Early Risk	Inter-mediate Risk	Advanced Risk	Problem Gambler	Row Total
No Risk	47.1%	6.4%	0.8%	0.5%	0.0%	54.8%
Low Risk	11.2%	2.4%	4.3%	1.1%	0.3%	19.3%
Medium Risk	2.1%	1.6%	6.7%	7.2%	2.7%	20.3%
Problem Gambler	0.0%	0.0%	0.0%	0.8%	4.8%	5.6%
Column Total	60.4%	10.4%	11.8%	9.6%	7.8%	100.0%

In order to better understand the differences between the measures four discrepancy segments were created and profiled in terms of player outcomes for the ten FLAGS constructs and whether they answered sometimes or more often to the PGSI statements (Table 21):

**Figure 7: Discrepancies Segments for Comparison of PGSI and FLAGS**

<b>Discrepancy Segment</b>	<b>Description</b>
Segment One (1)	Comprised of those gamblers categorized as <b>No Detectable Risk by FLAGS</b> and <b>At Risk by PGSI-CPGI</b>
Segment Two (2)	Comprised of those gamblers categorized as <b>At Risk by FLAGS</b> and <b>No Risk by PGSI-CPGI</b>
Segment Three (3)	Comprised of those gamblers categorized as <b>Advanced Risk by FLAGS</b> and <b>Low Risk by PGSI-CPGI</b>
Segment Four (4)	Comprised of those gamblers categorized as <b>Early Risk by FLAGS</b> and <b>High Risk by PGSI-CPGI</b>

**Segment One - No Detectable Risk by FLAGS and At Risk (Low to Moderate Risk) by the PGSI.**

Segment One was comprised of those gamblers identified by the PGSI as being At Risk but that FLAGS placed in the No Detectable Risk category. The single largest contributor to designating players as At Risk using the PGSI was the statement “*you bet more than you could really afford to lose*” (54.2%). There were two related constructs in FLAGS, Impaired Control: Continue and Risky Behaviours: Early which both referred to overspending during a session of play. Gamblers flagged by these indicators were classified as being at Intermediate Risk by FLAGS. The second highest contributor to being categorized as At Risk by the PGSI was the statement “*went back another day to try and win back the money you had lost*” (39.6%). The equivalent FLAGS indicators were Impaired Control: Begin and Risky Behaviours: Later which, if flagged, classified a player as an Advanced Risk gambler. The third largest contributor to being identified as At Risk using the PGSI was the statement “*have felt guilty about the way you gamble*” (22.9%) which was a form of negative consequence in FLAGS and would place the person in either the Problem Gambler or the Advanced Risk category.

It is noteworthy that 94% of the responses used to designate players as “At Risk” by the PGSI occurred due to those selecting the “sometimes” response category suggesting such players only occasionally exhibited the characteristics identified by the PGSI. Moreover, in the casino environment where these people gamble, overspending “sometimes” occurs for a variety of reasons outside of personal risk for problems (e.g., their friends aren’t ready to leave so they keep

playing, the bus is not ready to go yet so they keep gambling, their friend is winning so they keep gambling to keep them company, the exciting environment sometimes entices them to overspend, etc.). Therefore, occasional experience of certain conditions (e.g., over-expenditure, guilt and/or returning to win back losses) may not be a risk factor or reasonable indicator for use in this gambling environment. The statements in FLAGS use the word “often” rather than allowing for a “sometimes response (e.g., “I often spend more money than I intended”, I often end up spending more”. I often spend more time gambling than I intend to”). Therefore, FLAGS does not categorize a casino gambler who sometimes spends more than intended as an at risk gambler.

There is some concern about wording of the statement “*went back another day to try and win back the money you had lost*”. We feel there is a frequency bias built into the statement that will produce inflated estimates when used for regular casino gamblers. During the Phase 1 of the study (e.g., qualitative evaluation) many casino gamblers indicated that they regularly visit the casino but are not necessarily problem gamblers or even at risk. However, when faced with the question as to what their intentions are when they return another day they admitted to “sometimes” wanting to win back the money they had lost during a previous visit. The equivalent FLAGS statement attempts to be more specific in order to clarify the referenced situation for the gambler (“*After losing more money than I wanted*”) as well as the behavioural and motivational aspects (“*I usually try to win it back by playing again either later that day or on another day*”). The difference in these statements suggests that the PGSI may be classifying gamblers as being at risk based on behaviour that occurs as an artefact of the gaming experience rather than being linked specifically to chasing behaviour.

Similarly, our past research shows that many casino gamblers sometimes feel guilty about their casino gambling, but this is not necessarily an indicator of risk. The negative consequences identified in FLAGS are considerably more severe and include “life goals have been jeopardized”, “can’t sleep because I am worrying”, “I don’t like the person I have become” and “I feel depressed over my slots play”. In general gamblers classified as Low Risk gamblers by the PGSI but not captured by FLAGS were found to answer “sometimes” to questions that have relatively low thresholds for casino gamblers (e.g., sometimes feeling guilt). We believe this criterion is too sensitive for regular gamblers of certain forms of gambling such as casino gambling and, therefore, over-identifies risk among the regular slot machine population.

**Segment Two – Any Risk (Early to Advanced Risk) by FLAGS and No Risk by the PGSI.**

Segment two was comprised of those gamblers identified as being Any Risk by FLAGS that were categorized as No Risk by the PGSI. The reason for differences in the classification outcomes was clear from the distribution of responses to the ten indicators in Table 21. Using FLAGS, between 20% and 40% of regular slot gamblers were flagged for risk based on responses to the first three indicators, Risky Cognitions: Beliefs, Risky Cognitions: Motives and Preoccupation: Desire. The PGSI does not have any statements that directly relate to these constructs and therefore could not classify risk for these particular gamblers who believe the gambler's fallacy, play to win money or relieve depression and/or have a strong desire to gamble more often, but who have not yet exhibited risky behaviours, impaired control or negative consequences.

**Segment Three – Intermediate to Advanced Risk by FLAGS and Low Risk by the PGSI.**

Segment three included those gamblers classified as Low risk by the PGSI but who were classified as Intermediate to Advanced Risk by FLAGS. The PGSI profile was similar to the Low Risk gamblers profiled in Segment One (At Risk PGSI versus No Detectable Risk FLAGS) with the same statements contributing significantly to the Low Risk classification: "*betting more than can afford*"; "*went back another day*"; and "*felt guilty*". This time however, these gamblers triggered on an indicator that in FLAGS placed them in the Intermediate (Risky Behaviours: Earlier and Impaired Control: Session), and Advanced Risk categories (Risky Behaviours: Later). In this case, because most of the positive responses to the PGSI were endorsements of "sometimes", the total PGSI score did not exceed two for these gamblers which kept them in the Low Risk category. However, with FLAGS the "sometimes" selection for certain higher risk characteristics is sufficient to place them in a higher risk category. FLAGS does not treat all behaviour, motivation and beliefs and hence all statements equally in terms of risk indication (e.g., in FLAGS the words sometimes, often, frequently were used to effectively weight a statement relative to its occurrence and association with risk). This means that we can better assign a person to a risk category based on both the extent and the level of 'riskiness' of the behaviour. For example, the gambler needs to *often* spend more time gambling than intended to have an indication of intermediate risk but they only need to *sometimes* borrow money from others to trip for high risk.

**Segment Four – Problem Gambler by FLAGS and Moderate Risk by the PGSI.**

Segment four was comprised of those gamblers who were classified as Problem Gamblers by FLAGS and at Moderate Risk by the PGSI. The two instruments agreed on many of the criteria, including chasing behaviour during a session and between sessions. Almost all (90%) of these gamblers stated they felt they (at least sometimes) had a problem so they were also self-designated problem gamblers. The difference lies in the fact that when using FLAGS these players also indicated at least three harms due to gambling (i.e., negative consequences) and triggered for Persistence. For the PGSI, if we assume the last four statements represent negative consequences then the respondents reported that they 'sometimes' experienced these consequences, but this was not sufficient (i.e., not scored highly enough) to move the player into the problem gambling category. In other cases, gamblers in this segment indicated experiencing some of the fourteen consequences listed in FLAGS that are not included in the PGSI and, therefore, met the criteria for problem gambler in the former but not the latter. For the ten gamblers who fell into this segment the number of consequences selected in FLAGS ranged from three to eight. The main consequences indicated were *not wanting others to know about their gambling behaviours* (8 of the 10 gamblers), *feeling depressed about their gambling* (7), *feeling gambling has interfered with their life goals* (6), *they do not like the type of person they have become* (5) and *they are having difficulties paying off gambling debts* (4). There were one to three gamblers who experience eight of the remaining nine forms of negative consequences. This suggested that the PGSI was not picking up on negative consequences that were related to the gamblers self-perception and state of mind. Conversely, because FLAGS was formed using formative constructs to measure negative consequences, it identified these people and classified them as problem gamblers.

Overall we believe that where there were discrepancies between the two instruments that the FLAGS classifications were more accurate. The key difference between FLAGS classification scheme and the other instruments such as the PGSI, SOGS and the DSM IV is that with FLAGS the gambler is classified based on the nature of the indicators flagged; whereas with screens similar to the PGSI the gambler is classified based on the number of items on which they score. Thus, a person who says they sometimes borrow money to gamble could be placed at a low risk level by the PGSI whereas with the FLAGS this is deemed a high risk behaviour that is positioned higher in the

**FLAGS: Development of an Instrument for Identifying Risk for Problem Gambling among Slot Machine Gamblers in Ontario**

**FINAL REPORT**

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hierarchy of risk and, therefore, classifies them as having Advanced Risk for gambling problems, regardless of how many other indicators of risk there are for that particular gambler.

**Table 21: Comparisons of Discrepant Segments: Percent Flagged on Constructs**

Discrepancy Segment Number	CPGI At Risk –			
	FLAGS No Detectable Risk 1	FLAGS At Risk – PGSI No Risk 2	PGSI Low Risk – FLAGS Higher Risk 3	FLAGS PG – PGSI Intermed. Risk 4
<b>FLAGS Constructs</b>	<b>N = 50</b>	<b>N = 29</b>	<b>N = 21</b>	<b>N = 10</b>
Risky Cognitions: Beliefs	0.0%	44.8%	0.0%	10.0%
Risky Cognitions: Motives	0.0%	37.9%	33.3%	80.0%
Preoccupation: Desire	0.0%	24.1%	42.9%	30.0%
Risky Behaviours: Earlier	0.0%	10.3%	42.9%	80.0%
Impaired Control: Session	0.0%	17.2%	57.1%	100.0%
Impaired Control: Begin	0.0%	3.4%	0.0%	40.0%
Risky Behaviours: Later	0.0%	3.4%	23.8%	60.0%
Obsession	0.0%	0.0%	0.0%	20.0%
Negative Consequences	0.0%	6.9%	0.0%	100.0%
Persistence	0.0%	6.9%	4.8%	100.0%
<b>PGSI (% responded sometimes or more often)</b>				
Bet more than can afford.	54.0%	0.0%	42.9%	90.0%
Larger amounts of money needed.	14.0%	0.0%	19.0%	30.0%
Went back another day.	38.0%	0.0%	33.3%	60.0%
Borrowed money to gamble	2.0%	0.0%	4.8%	30.0%
Felt may have a problem	10.0%	0.0%	23.8%	90.0%
People have criticized	14.0%	0.0%	14.3%	50.0%
Felt guilty	24.0%	0.0%	14.3%	80.0%
Health problems	2.0%	0.0%	0.0%	10.0%
Financial problems	0.0%	0.0%	0.0%	40.0%

## **5.0 SUMMARY, DISCUSSION AND CONCLUSIONS**

The FLAGS instrument was designed not only to identify gamblers at risk but also to assess the relevance of various factors associated with gambling risk. In so doing, it will assist the gambler and policy makers in preventing and/or reducing gambling risk and harm and problem gambling.

The following criteria were used during the design process to ensure the resulting instrument met the stated objectives:

- Useful for self-assessment (e.g., self-administered by pen and paper or on-line) or assisted administration (e.g., telephone surveys, public health or host responsibility applications).
- Language and scoring is suitable for current casino gamblers in Canada and minimizes the occurrence of method bias.
- Customized for those who gamble on slot machines/electronic gambling machines in casino-type settings.
- Designed specifically to identify problem gamblers and those who are at various levels of risk for experiencing gambling problems playing electronic gambling machines.
- Identification of problem gamblers is based on a set of constructs shown to influence either directly or indirectly the chances of a gambler becoming a problem gambler.
- In addition to problem gambling, the instrument can differentiate between early pre-harm risk versus intermediate and advance risk and harm for prevention purposes for evaluating harm reduction applications.

The following procedure was used to derive and test the instrument:

The constructs were designed either as formative or reflective depending on the nature and purpose of the construct.

Formative constructs comprised five of the FLAGS indicators:

- Risky Cognitions: Beliefs, a list of erroneous beliefs such as a belief they can win in the long run playing on the slots;
- Risky Cognitions: Motives, playing either to make money or to alleviate anxiety;

- Risky Practices: Earlier, chasing losses during sessions and playing at more extreme levels during a session;
- Risky Practices: Later, behaviours such as chasing losses between sessions and borrowing to finance gambling; and,
- Negative Consequences: a list of harms to one's state of mind, relationships and financial well being.

These constructs were designed as formative rather than reflective for three primary reasons: 1) To better operationalize concepts that players may not be able to explicitly recognize or express (e.g., awareness of erroneous cognitions); 2) To ensure coverage of a wider range of items that can be expected to differ among players and/or over time (i.e., accommodate player diversity); and, 3) To provide greater insight and information for risk and harm reduction. First, for constructs such as erroneous beliefs it is difficult if not impossible, to design reflective constructs that will be appropriate or accurate; the respondent is unaware of the accuracy of their beliefs and the impact of this information on their reasoning, and thus, cannot indicate if such cognitions are 'erroneous' or not. Second, a reflective construct could likely be designed to identify those experiencing negative consequences; however, a list of items that happens to be sufficiently correlated with each other such that it passes a reliability test using, for example, Chronbach's Alpha does not mean the resulting reflective construct is comprehensive or effective and may only identify a distinct segment of those experiencing harm. Negative impacts can be expected to vary among players depending upon their life stage, life-style and circumstances (e.g., physical or mental health, financial, social, professional, family). While a reflective construct could be generated for each type of negative consequence it is more efficient to use a formative construct which (by definition) takes into account the diversity of impacts that may or may not be correlated with each other. For example, if one is 'rich' or financially secure gambling may have minimal impact for financial problems but could be interfering with family relations or mental health (e.g., self-esteem). Conversely, if one is single, widowed or living alone family impacts may be irrelevant and while gambling could have significant negative financial impacts it may also offer social benefits. Third, administering the items contained in these formative constructs (e.g., what they erroneously believe, whether they gamble inappropriately, if they gamble for the wrong reasons, and the nature of the effects on the

gambler) can provide the gambler, if this were self administered, and the policy maker, if administered by an agency, sufficient detailed information to act upon in reducing and or preventing gambling risk and/or harm; the areas contributing to risk are identified.

In contrast, there were five reflective constructs used for indicators that dealt directly with the gambler's state of mind comprised of items for which the gambler could reasonably be expected to be aware of, able to judge and report upon:

- Impaired Control: Continue, an inability to end a session once started;
- Impaired Control: Begin, an inability to resist opportunities to begin a slot session;
- Preoccupation: Desire, a strong drive state to gamble on the slots more often;
- Preoccupation: Obsession, when the gambler's mind is constantly filled with thoughts surrounding their gambling.
- Persistence, where gamblers continues to gamble even though they are experiencing negative consequences associated with their gambling (whatever such consequences may be for that individual). Thus, while negative consequences experienced from gambling may vary among players, persistence (i.e., continued play despite consequences) is similar.

We developed a hierarchy of risk measure which allowed us to stack the constructs in rough hierarchical order to facilitate the development of the risk model.

PLS modeling of the ten constructs was used to further allocate the constructs to appropriate risk levels and to prove nomological validity.

The constructs were tested for reliability and validity using standard procedures appropriate for reflective and formative constructs.

A combination of frequency analysis and ROC analysis allowed us to select appropriate cut-offs in order to determine an indication level or 'flag' criterion for each construct.

The final instrument categories were not based on a continuum but instead were based on the definition of problem gambling and the identification of early, intermediate and advanced risk indicators that were used to classify gamblers into five levels of risk.

The results using the new FLAGS instrument were compared to the results using the PGSI and those gamblers who were categorized differently by the two instruments were profiled to gain insight into how the two instruments differ in their classification of gamblers.

## **5.1 Discussion**

Our empirical analyses led to further refinement of the FLAGS. Exploratory factor analysis (supported by the literature) suggested that three of the constructs; Risky Cognitions, Preoccupation and Impaired Control were in fact two separate constructs, each found to vary in proximity to problem gambling in the model. Subsequent testing proved this to be true suggesting that splitting these constructs provided a superior model of risk factors associated with problem gambling, in particular in terms of positioning such constructs in the hierarchy of risk for problem gambling (e.g., earlier versus later risk factors).

There was also considerable disparity in the hierarchy scores for items comprising the Risky Practices construct. Dividing the items into two components (i.e., Risky Practices: Earlier and Risky Practices: Later) was sound both from a practical and theoretical position differentiating between risky practices that occurred during a session (e.g., chasing during a session, not taking big wins, obtaining money from existing reserves, and playing at extreme levels) and risky practices that occurred between sessions (e.g., chasing by returning another day). The latter comprised the Risky Practices: Later construct which also included going into debt to finance gambling, using non-commercial sources of funds and isolating oneself from friends in order to gamble.

We developed an SEM model using PLS and found the overall configuration of the model and construct linkages generally conformed to the predicted direction and arrangement. We used this model to assist us in identifying the appropriate risk level for each of the indicators (e.g., low, medium or high risk indicators) and to select the state variables in the ROC analysis.

The final instrument emerging from the Phase 2 analysis was comprised of 48 statements and ten constructs. Throughout the analysis opportunities were identified for adjusting the constructs (i.e., tweaking) in order to improve model performance – in particular for the Preoccupation: Obsession and Persistence constructs. The Preoccupation: Obsession construct was found to have too few statements formulated in such a way as to accurately reflect the theoretical definition of obsession and, therefore, should be expanded and strengthened. Persistence proved to be a difficult concept

to formulate and measure. Reviewers pointed out that the term persistence has been used to describe items that measures whether a person believes that persistence in gambling pays off, or that it is worthwhile to continue gambling until they win. The CAMH Gambling Screen (CAMH 2011) has the item “In the past 12 months did you feel you had to persist until you won?” which captures this concept. We feel this form of persistence would likely fit in the Risky Practices: Earlier construct and will incorporate it into our next version of the instrument to be tested.

We feel the best definition of persistence as we define the concept is ‘continuing to practice risky behaviours in such a way that it leads to negative consequences’. If a reflective measure is to be used then the gambler first must be aware that he/she is suffering negative consequences in order to indicate they are ‘persisting’ despite such experience. Additionally, players would need to know ‘what’ risky practices are in order to indicate they are continuing to use such practices. We cannot assume gamblers know what these practices are and we do not believe that providing an example or two within the item would be sufficient to define such practices for the gambler. Instead, we asked players if they continued to gamble despite negative consequences with the implicit assumption that risky practices are causing these consequences. We recognize this means that they may have to be in at least the contemplation stage, but having completed the earlier components of the instrument and indicated harms, they would likely have recognized their situation regardless. This is a compromise but we feel that the resulting indicator of persistence is reasonably accurate.

The instrument’s ability to accurately classify slot gamblers into the various risk categories was enhanced by the approach of setting frequency criteria or minimums for the items where possible (which effectively weights the behaviour) such that ‘sometimes’ exhibiting a characteristic was sufficient to be a risk indication while other characteristics needed to be exhibited frequently before qualifying as an indication of risk. As well, some statements were designated as low, medium or high risk indicators based on their hierarchy score (i.e., relative proximity of association with problem gambling) and the results of the PLS modeling. Combining these two features of FLAGS permitted more accurate risk classification of individuals without reliance on an arbitrary uniform scoring system (e.g., fixed response scales using additive or summed scores over each item) based on the assumption of a risk continuum.

Nonetheless in the current study there was room identified for tightening up the FLAGS measure. This was evident by the fact that 33.3% of those scoring for Advanced Risk also flagged on the Persistence indicator. In part, we believe this finding was due to item wording in the construct leading gamblers to flag on persistence by associating their play with less serious consequences. As noted above, the Persistence construct can be improved by adding phrases to ensure better linkage between continued play and the experience of significant negative consequences; the gambler has continued over an extended yet reasonable period to engage in risky practices leading to consequences. Item wording will be adjusted to eliminate ambiguity and the inclusion of relatively minor consequences (e.g., I have gambled on the slots for an extended period even though I was experiencing significant negative consequences.)

There was evidence of sub-types of gamblers who may progress toward problem gambling using different paths. In particular there were sub-types who had indications of impaired cognitive processes (risky beliefs, motives and a preoccupation with gambling) and others who seemed to be more influenced by gambling experiences resulting in risky behaviours, and a lack of impulse control leading to extended sessions. In the end problem gamblers tend to have both sets of indications suggesting they all tend to play a role but for some the order is different. This suggests that those who start the progression toward problem gambling with indications based on behaviours are at higher risk than those who start with risky cognitions and a strong desire to gamble.

Each risk group had a distinctive demographic profile, particularly in terms of age, which should facilitate the targeting of each group. The differences suggested that not all of those at each risk level were equally likely to proceed to the next level of risk. Specifically, a large portion of gamblers aged 55 years or over who were classified in the Early Risk segment may be less likely than their younger counterparts to advance to a higher level of risk. It would make sense therefore to target those aged 55 years or less as they have a much higher probability of progressing toward problem gambling. This relationship needs to be explored further and verified in a random representative sample and a longitudinal study.

There was considerable similarity in outcomes between FLAGS and the results of PGSI with significant overlap of classification. This overlap was greatest for the problem gamblers but lowest for the low risk gamblers. Our analysis suggests that the FLAGS classification of gamblers in the low

to high risk categories was superior to that of the PGSI. FLAGS as designed now should work well as a self administered instrument and as an instrument for facilitating gambling policy development, although as noted there is clearly room for improvement. The next phase will be able to utilize the results of this research to inform the statistical analysis thus permitting a better analysis of the validity of the constructs.

### **5.1.1 Future Research**

The results of the exploratory factor analysis, the hierarchy analysis, the construction of the SEM model, and the testing of the individual constructs have lead to the development of hypotheses related to the determinants of problem gambling that can be tested in a larger scale study to follow. A larger and more representative sample of slot gamblers is needed to provide reasonable estimates of the percentage of players who have indications on the ten constructs and to allow for accurate profiling of these segments.

The empirical analysis exposed the need to formulate two improved constructs: Preoccupation: Obsession and Persistence. We need to provide more statements for Preoccupation: Obsession and the statements in Persistence need to be amended so that items capture behaviour over an extended period of time and reference significant consequences. The reliability and validity of these redesigned constructs then need to be tested.

The instrument needs to be tested in its final form by administering it over the phone, and as a self administered instrument.

Other conventional gambling screens have been designed primarily to obtain a score to identify problem gamblers and subsequently classify remaining gamblers to various levels of risk based on scores falling below the problem gambling threshold. In contrast FLAGS was designed specifically to identify various stages of risk (i.e., No Detectable Risk, Early, Intermediate and Advanced Risk) prior to the experience of problem gambling and, ideally, should be more prescriptive in nature by providing the gambler with detailed information. It is intended to act as an agent of change, in particular for the gamblers themselves if it is self administered. Therefore, the impact and value the instrument as a self administered instrument needs to be determined. Are at risk gamblers motivated to change their behaviours and seek information or assistance based on the process and

results of filling out this instrument? Do such players progress through the stages of change at a faster rate (DiClemente and Prochaska 1998, Hodgins 2001, Schellinck and Schrans 2004a)? Now that we have a tool designed with this purpose in mind it is important to test its effectiveness in this regard.

Confirmatory factor analysis can be conducted in the next phase of the research to confirm the composition of the constructs.

We used five criteria (frequency of response, hierarchy score, PLS analysis, logical crosstabs, and theory) to place the constructs in a progression toward problem gambling and therefore classify gamblers according to risk. However, we recommend that a longitudinal study be conducted where gamblers would first be categorized using FLAGS and then re-administered the instrument over time to see if some gamblers progress toward problem gambling. However, it is hoped that, whether the instrument is self administered or administered by others that merely taking the test will help motivate and inform gamblers such that they are less likely to progress to problem gambling. The problem for future researchers is to overcome is the testing effect where the administration of the instrument itself is likely to reduce the chances that gamblers will progress toward problem gambling.

### **5.1.2 Implications for Assisting Gamblers**

While the approach adopted for FLAGS represents advancement in the measurement of risk and problem gambling this new instrument also has practical value. It provides information to design and evaluate policy, practices programs, and systems intended to support player self-management, risk and harm reduction as well as natural and assisted recovery. Based upon the profiles of the segments, we have provided a description below of the type of assistance that may be effective for these players.

For example the current sample was segmented and profiled by FLAGS risk classification:

#### **Early Risk (10.4% of sample)**

**Profile** – In our sample more than 80% of the Early Risk gamblers were aged 55 or older, with half aged 65 years and over. Almost two-thirds were female, two-thirds were retired and approximately half had household incomes under \$40k per year. These gamblers had risky

cognitions in terms of beliefs and/or motives (Risky Cognitions: Beliefs & Motives) and a strong desire to gamble (Preoccupation: Desire). They do not yet exhibit indications of impaired control while playing the machines (Impaired Control: Continue) nor Risky Practices: Early such as playing longer than intended, getting more money to continue or exhibiting more extreme play behaviours.

**Type of Assistance** – These players will not likely contact agencies for assistance and are unlikely to feel they are at any risk. They need to be made aware of potential dangers and both educated and convinced that they cannot make money gambling on the machines in the long run. Tools and policies aimed at these players would include educational brochures, school educational programs, computer simulations (e.g., Slot Tutorial that educate the gambler on how the slots work), general responsible gambling advertising, carefully crafted marketing campaigns that do not sell the concept of long-term wins over short term wins (in this case making sure the message received does not contribute to development or support of high risk motivations for gambling).

### **Intermediate Risk (11.8% of the sample)**

**Profile** – Age was more evenly distributed, men and women were equally represented and there was a skew toward middle incomes. This gambler may have had a lack of Impulse Control: Continue, leading them to gamble longer than intended during a session and obtaining additional money to do so (but does not borrow money as yet). They were likely gambling at more extreme levels by playing faster, betting at a higher rate, and playing for extended periods. They showed a strong desire to gamble more frequently. Few had risky cognitions in terms of beliefs (4.5%) and motives (21%), but it was possible many of these players have skipped this phase and were at risk due to the lack of Impulse Control: Continue, that is, they were following another path toward problem gambling and consequently started off at Intermediate Risk.

**Types of Assistance** – Self help or educational brochures are less likely to be as effective with this group. Feedback during a session (e.g., such as the features available through player management systems such as those offered by responsible gambling systems such as Techlink's 'My Play' System), encouragement to stop playing at certain points in a gambling

session, and a control mechanism prior to the start of gambling (some form of pre-commitment) may assist these gamblers.

### **Advanced Risk (9.6% of the sample)**

**Profile** – Those scoring at Advanced Risk were found to be the youngest gamblers with more than 50% of the segment falling under 55 years of age. There tended to be a higher proportion of females in this group (more than 70%), with the highest full or part time employment rate at around 60%, and one-third reporting household incomes greater than \$90k per year. These gamblers were exhibiting Impaired Control: Begin in that they are going to gamble when they do not necessarily want to. Their risky practices now include chasing losses another day, going into debt to finance their gambling or even borrowing from non-commercial sources when they run out of credit. They were more likely than lower risk gamblers to have indications of Risky Practices: Earlier and Preoccupation: Desire. Compared to those at Intermediate Risk indications of Risky Cognitions were also higher, approximately equal to those of Early Risk gamblers. Some of them have suffered negative consequences but have not yet persisted in gambling despite their experiences and, therefore, are not yet labelled a problem gambler.

**Type of Assistance** – These gamblers would likely benefit from some form of assistance though they are unlikely to actively seek it out. A player tracking system such as the one developed by Techlink Entertainment System which allows gamblers to ban themselves for periods or specific days (e.g., payday) should be of assistance to these people. Using such a system to track gambling expenditures and perhaps set budgets should also assist these gamblers. They also need to be made aware of the potential for their behaviour to lead to harm before they begin to suffer significant negative consequences. Therefore, self-assessments such as filling out a self administered gambling screen (e.g., FLAGS) should be of particular value to these gamblers. The strength of their desire to gamble needs to be reduced so they may be delisted from some types of gambling promotions. System identification of high risk and problem gamblers using algorithms such as those developed by Focal Research and currently used at Casinos in Saskatchewan could identify a large proportion of these gamblers; they can be targeted for customer interactions and removed from some direct marketing initiatives. We believe these people are unlikely candidates for

self-exclusion, not having suffered substantial or persistent negative consequences due to their behaviours.

### **Problem Gamblers (7.8% of the sample)**

**Profile** – Approximately two-thirds of the problem gamblers in this sample were female. Only one-fifth of these gamblers were over age 65 and one-quarter were retired, with a comparatively higher full/part time employment rate of 55%. There was a downward skew in income with only about one in ten making \$90k or more per year although close to half have household incomes between \$50k and \$90k per year. By definition these gamblers have experienced negative consequences due to gambling and persist in gambling in such a way as to be deemed a problem gambler. All exhibited Impaired Control: Continue (i.e., have trouble stopping during a play session) and about two-thirds have Impaired Control: Begin (i.e., are unable to resist going to play). Most engage in risky practices, both the earlier and later types. At this point most were gambling for the high-risk reasons (Risky Cognitions: Motivations), although only one-third had erroneous beliefs (Risky Cognitions: Beliefs). Most of those found to be obsessed with gambling were among these problem gamblers.

**Type of Assistance** –It is possible that those who seek help are likely to be in this group, but the literature and research indicates that relatively few gamblers experiencing problems seek out formal assistance on their own. However, many of these gamblers can be identified using an algorithm such as those developed by Focal Research (implemented in the iCare Responsible Gaming System) assisting host responsibility staff at gaming venues in targeting on-site interactions and resources most effectively. This may nudge those at high risk for gambling problems towards seeking assistance from either formal or informal sources and encourage natural recovery or self-exclusion. Player tracking systems offering gamblers the opportunity to set and manage budgets as well as activate self exclusion options may also be of assistance to many problem gamblers both within and outside of treatment.

### **5.1.3 Conclusions**

In order to prevent problem gambling there is a need for an instrument that can identify risk independent of gambling harm and problem gambling. Such a measure makes it possible to target

and assess upstream efforts to reduce risk, ultimately reducing downstream gambling harm and problem gambling.

The current research was undertaken to continue development of the next generation of gambling risk and problem gambling assessment by adapting a new gambling risk assessment instrument, Focal's Adult Gambling Screen (FLAGS), for use with slot machine gamblers. The new instrument used both reflective and formative constructs to independently measure pre-harm gambling risk (before the onset of negative consequences) as well as problem gambling and harms that have already occurred. The new gambling risk instrument was also intended to be a practical and useful tool for helping gamblers to self-identify as experiencing gambling related risk, harm or problem gambling so that they may take steps to protect and/or assist themselves. Such an instrument should be useful in prevention and surveillance applications for public health and responsible gambling. Unlike other problem gambling instruments, it permits jurisdictions to monitor preventative efforts by tracking those with pre-harm risk and those who move on to experience harm and/or subsequently develop problem gambling. It also links identification and tracking of gambling harm and problem gambling to specific negative impacts (e.g., relationships, financial, personal), persistence, and impaired control thereby providing information about the effects of actions taken to reduce harm.

Comparing pre-harm risk gamblers with those found to be experiencing harm and/or problem gambling contributes to the larger body of knowledge concerning psychosocial and cultural factors that contribute to problem gambling, which could clarify conceptual issues. In short, the new gambling risk assessment instrument represents a fundamental conceptual and methodological departure from existing measures of problem gambling behaviour. By improving the identification of risk factors the instrument should prove very useful to Ontario slot players, gaming operators, and policy makers specifically, as well as other national and international gambling stakeholders generally in formulating and implementing policy and practices to monitor, manage, and reduce gambling harm and the proportion of problem gamblers.

The authors would like to thank those who took the time to review this document and provide us with invaluable feedback. In particular the OPGRC reviewer provided detailed and accurate critiques that we have endeavoured to address in the final version of the report.

**FLAGS: Development of an Instrument for Identifying Risk for Problem Gambling among Slot Machine Gamblers in Ontario**

**FINAL REPORT**

*Prepared by Schellinck, T., Schrans, T., Bliemel M., & Schellinck, H.*

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## **Appendix A**

### **FLAGS Version II**

#### **Risky Cognitions: Beliefs**

- You can sometimes tell when the machine is about to pay out big because the symbols start getting closer to lining up on the pay line (e.g. almost winning).
- I feel the machines are fixed sometimes so that you can't win on them.
- It is important for me to use a system or a strategy when I play the machines.
- I believe that in the long run I can win playing slots at the casino.
- If a slot machine hasn't had a big pay out in a long time, it is more likely to do so soon.

#### **Risky Cognitions: Motives**

- I sometimes play the slots in hopes of paying off my debts/bills.
- I sometimes play the slots when I'm feeling down or depressed.
- Gambling on the slots is a way I can try to get some money when I need it.
- I can escape by playing the slots whenever I am worried or under stress

#### **Preoccupation: Desire**

- If I could play the machines all the time I would.
- I wish I could gamble on the slots more often.
- I would like to play the slots almost every day.
- I like to play the slot machines every chance I get.

#### **Preoccupation: Obsessed**

- I sometimes dream about playing the slot machines.
- I spend more time than I used to thinking about playing the slots.
- Possible additional statements
- I am obsessed with gambling on the slots.
- I spend considerable time planning my life around playing the slots at the casino.
- I think about my next trips to the casino slots all the time.
- Thoughts of gambling on the slots fill my mind day and night.
- Over the last year I spent a lot of time re living my slot gambling experiences.

*Note: Many of the obsession factors identified in the literature such as the gambler constantly focusing on how to get money to finance gambling, or making attempts to cut down the amount of time and money, assumes the gambler is having problems due to their gambling. These factors are associated with obsessed gamblers but are not obsessive elements in themselves. Their inclusion would create a spurious relationship in the PLS model between Obsession and Negative Consequences and therefore they should not be used in a reflective measure of Obsession.*

**Risky Practices: Earlier**

- I sometimes exceed the amount of money I intended to spend in order to win back money I have lost.
- When gambling on the slots I usually use my bank or debit card to get more money so I can keep playing.
- I play max bet if I'm on a winning streak.
- If I win big I am likely to put the money back into a machine and keep playing.
- When gambling on a slot machine I usually play as fast as I can.
- I have sometimes gambled for more than six hours straight when I was playing the slots.

**Risky Practices: Later**

- After losing more money than I wanted on the slots I usually try to win it back by playing again either later that day or on another day.
- When gambling on the slots I usually use my credit card to get more money so I can keep playing.
- When I gamble with friends or family I sometimes stay and continue to play after they have stopped or left.
- I have sometimes borrowed money from others so I could go and gamble on the slots.
- This statement might work better if we took out "from others" as it is the fact that they are going into dept to finance their gambling that is the important factor here.
- I have borrowed money from other people at the casino in order to continue gambling.
- I have left the casino to get more money so I can come back and keep on gambling.

**Impaired Control: Continue**

- I often spend more money gambling than I intended.
- Even when I intend to spend a few dollars gambling, I often end up spending much more.
- I sometimes gamble with money that I can't really afford to lose.

- Once I have started gambling on the slots I find it very hard to stop.
- I often spend more time gambling than I intend to.

**Impaired Control: Begin**

- I have tried to cut back on my slots play with little success.
- I have tried unsuccessfully to stop or reduce my gambling on the slots.
- There have been times I have gambled despite my desire not to.

**Negative Consequences**

- My goals in life have been jeopardized by my slot play.
- I often can't sleep because I am worrying about my slot machine gambling .
- I have had problems paying off debts accumulated from playing the slots.
- Since I started playing the slots I don't like the type of person I have become.
- Sometimes I have to juggle money and bills to cover the cost of my slot machine gambling.
- I wouldn't want anyone to know how much time or money I spend at the casino.
- Sometimes I feel depressed over my slots play.
- Others are disappointed in me because of my gambling.
- I have friends or family who are concerned about my slots play.
- I have sometimes missed events or neglected family, friends or work in order to play the slots.
- When I leave the casino, I have sometimes been short of cash for parking, food, or a ride home.
- I have become somewhat of a loner because of my slot gambling.
- I sometimes have spent time gambling on the slots when I was supposed to be doing something else important.
- My gambling has caused me to have a falling out with the people I used to hang out with

**Persistence**

- I continue to play the machines despite experiencing problems or other negative consequences.
- I continue to gamble despite the bad things that happen to me.
- I gamble even though I know it is likely to lead to problems for me.
- Even if money is tight, I continue to play the slots to get big wins.

## **Appendix B**

### **Method Bias – Single Source**

**Table B.1 Number of Components Produced by PCA Analysis to Test for Method Bias**

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	16.028	33.392	33.392	5.771	12.024	12.024
2	2.958	6.162	39.554	5.633	11.736	23.760
3	2.180	4.542	44.096	3.472	7.233	30.993
4	1.724	3.592	47.688	3.156	6.574	37.567
5	1.429	2.977	50.664	3.115	6.489	44.056
6	1.385	2.886	53.550	2.460	5.125	49.182
7	1.373	2.861	56.412	2.145	4.469	53.651
8	1.328	2.768	59.179	2.080	4.333	57.985
9	1.241	2.585	61.765	1.463	3.048	61.032
10	1.169	2.435	64.199	1.312	2.733	63.765
11	1.026	2.137	66.337	1.234	2.571	66.337

Extraction Method: Principal Component Analysis.

## *Appendix C*

### Tables and Figures for ROC Analysis

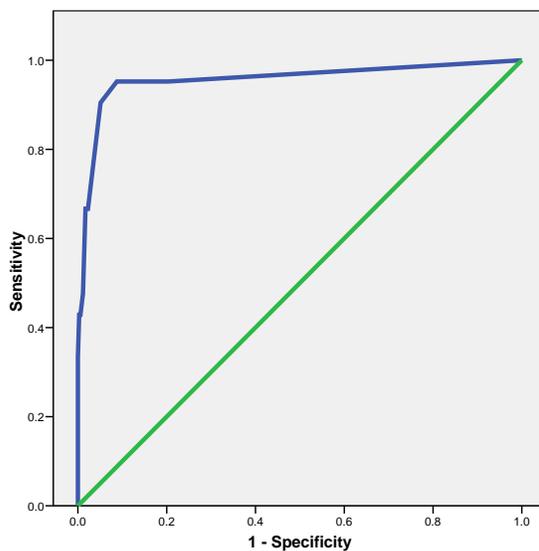
We have used ROC analysis to determine the optimal cut-offs in order to designate a score as an indicator of risk or problem gambling (Metz 2006).

#### Negative Consequences

**Table C1.1 Frequency Distribution of Negative Consequences Item Responses**

	Frequency	Percent	Cumulative Percent
.00	282	75.4	75.4
1.00	41	11.0	86.4
2.00	14	3.7	90.1
3.00	15	4.0	94.1
4.00	2	.5	94.7
5.00	6	1.6	96.3
6.00	3	.8	97.1
7.00	1	.3	97.3
8.00	3	.8	98.1
9.00	2	.5	98.7
10.00	2	.5	99.2
11.00	2	.5	99.7
13.00	1	.3	100.0
Total	374	100.0	

**Figure C1.1 ROC Curve for Negative Consequences using PGSI Score 8+ for State Variable Value**



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**Table C1.2 Coordinates of the Curve for Consequences and PGSI 8+**

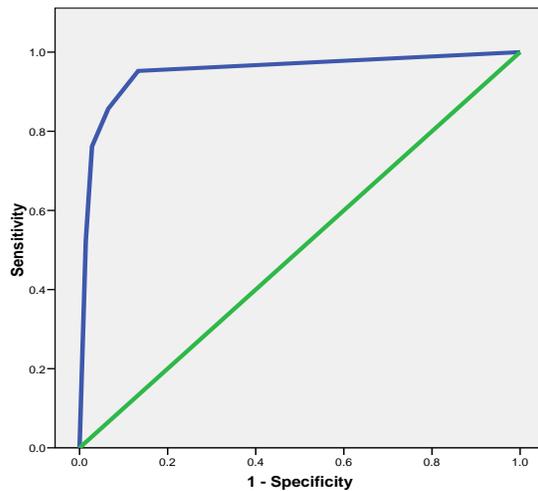
Positive if Greater Than or Equal To	Sensitivity	1 - Specificity
0.0	1.000	1.000
1.0	.952	.204
2.0	.952	.088
3.0	.905	.051
4.0	.667	.023
5.0	.667	.017
6.0	.476	.011
7.0	.429	.006
8.0	.429	.003
9.0	.333	.000
10.0	.238	.000
11.0	.143	.000
12.0	.048	.000

**Persistence**

**Table C2.1 Frequency Distribution of Persistence Item Responses**

	Frequency	Percent	Cumulative Percent
Valid .00	307	82.1	82.1
1.00	26	7.0	89.0
2.00	15	4.0	93.0
3.00	10	2.7	95.7
4.00	16	4.3	100.0
Total	374	100.0	

**Figure C2.1 ROC for Persistence using PGSI Score 8+ for State Variable Value**



**Table C2.2 Coordinates of the Curve for Persistence and PGSI 8+**

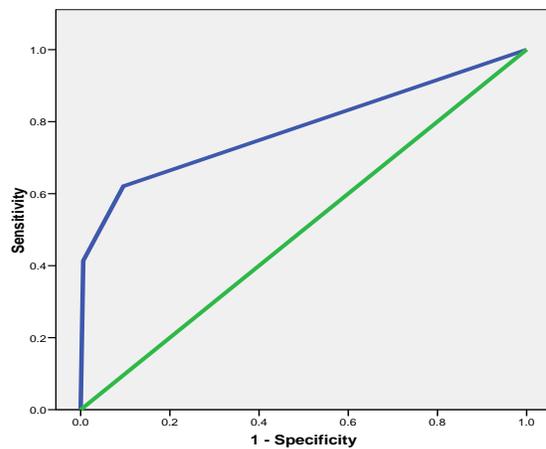
Positive if Greater Than or Equal To	Sensitivity	1 - Specificity
0.0	1.000	1.000
1.0	.952	.133
2.0	.857	.065
3.0	.762	.028
4.0	.524	.014

**Preoccupation: Obsession**

**Table C3.1 Frequency Distribution of Preoccupation: Obsession Item Responses**

	Frequency	Percent	Cumulative Percent
.00	323	86.4	86.4
1.00	37	9.9	96.3
2.00	14	3.7	100.0
Total	374	100.0	

**Figure C3.1 ROC for Preoccupation: Obsession using FLAGS Problem Gambler for State Variable Value**



**Table C1.2 Coordinates of the Curve for Preoccupation: Obsession and FLAGS PG**

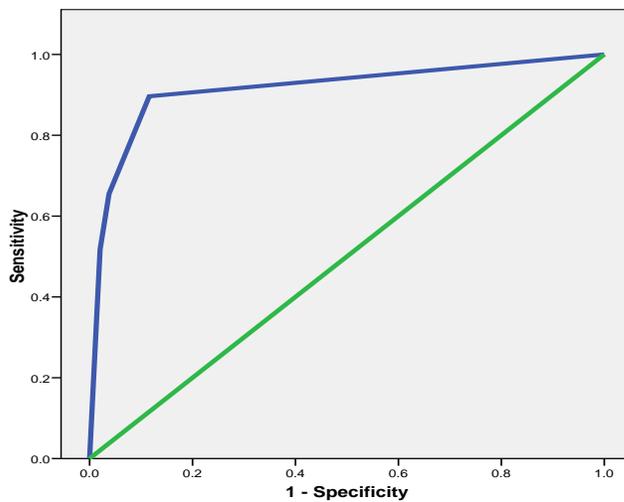
Positive if Greater Than or Equal To	Sensitivity	1 - Specificity
1.0	.621	.096
2.0	.414	.006

**Impaired Control: Begin**

**Table C4.1 Frequency Distribution of Impaired Control: Begin Item Responses**

	Frequency	Percent	Cumulative Percent
.00	308	82.4	82.4
1.00	34	9.1	91.4
2.00	10	2.7	94.1
3.00	22	5.9	100.0
Total	374	100.0	

**Figure C4.1 ROC for Impaired Control: Begin using FLAGS Problem Gambler for State Variable Value**



**Table C4.2 Coordinates of the Curve for Impaired Control: Begin and FLAGS PG**

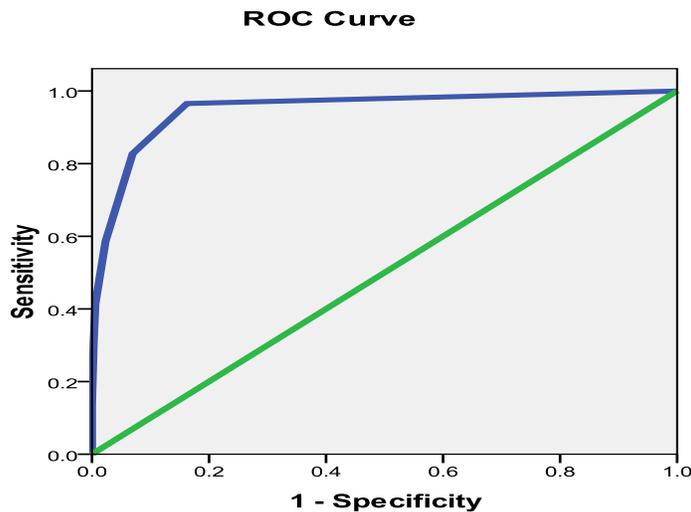
Positive if Greater Than or Equal To	Sensitivity	1 - Specificity
1.0	.897	.116
2.0	.655	.038
3.0	.517	.020

**Risky Practices: Later**

**Table C5.1 Frequency Distribution of Risky Practices Later Item Responses**

	Frequency	Percent	Cumulative Percent
.00	290	77.5	77.5
1.00	36	9.6	87.2
2.00	23	6.1	93.3
3.00	11	2.9	96.3
4.00	4	1.1	97.3
5.00	6	1.6	98.9
6.00	4	1.1	100.0

**Figure C5.1 ROC for Risky Practice: Later using FLAGS Problem Gambler for State Variable Value**



**Table C5.2 Coordinates of the Curve for Risky Practice: Later and FLAGS PG**

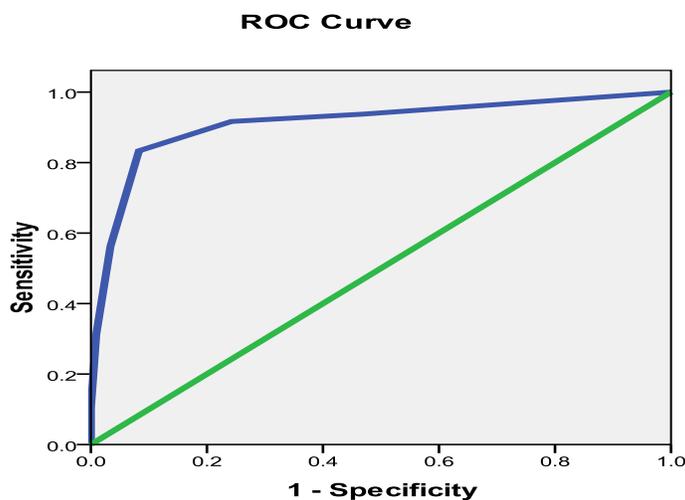
Positive if Greater Than or Equal To	Sensitivity	1 - Specificity
0.0	1.000	1.000
1.0	.966	.162
2.0	.828	.070
3.0	.586	.023
4.0	.414	.006
5.0	.310	.003
6.0	.138	.000

**Risky Practices: Earlier**

**Table C6.1 Frequency Distribution of Risky Behaviours: Earlier Item Responses**

	Frequency	Percent	Cumulative Percent
.00	176	47.1	47.1
1.00	75	20.1	67.1
2.00	56	15.0	82.1
3.00	29	7.8	89.8
4.00	20	5.3	95.2
5.00	13	3.5	98.7
6.00	5	1.3	100.0
Total	374	100.0	

**Figure C6.1 ROC for Risky Practice: Earlier using FLAGS Risky Behaviour: Later for State Variable Value**



**Table C6.2 Coordinates of the Curve for Risky Practice: Earlier and Risky Practice: Later**

Positive if Greater Than or Equal To	Sensitivity	1 - Specificity
.00	1.000	1.000
1.00	.938	.469
2.00	.917	.242
3.00	.833	.083
4.00	.563	.034
5.00	.313	.009
6.00	.104	.000

**Impaired Control: Continue**

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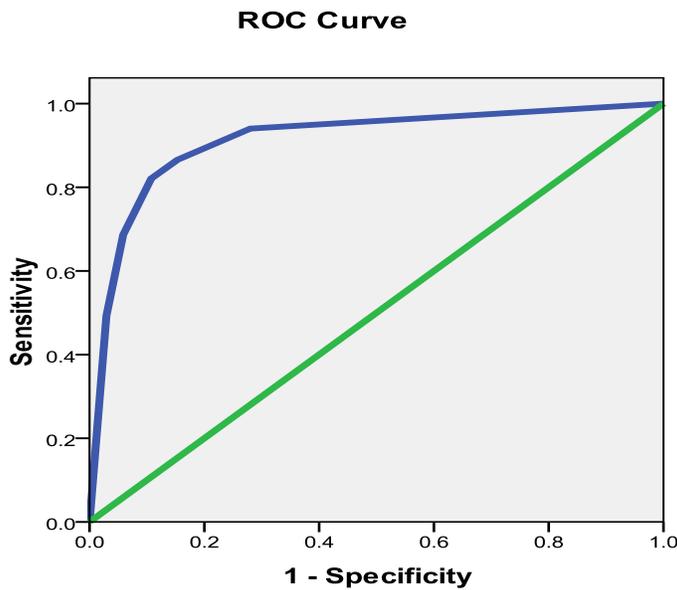
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**Table C7.1 Frequency Distribution of Impaired Control: Continue Item Responses**

	Frequency	Percent	Cumulative Percent
0.00	225	60.2	60.2
1.00	44	11.8	71.9
2.00	17	4.5	76.5
3.00	24	6.4	82.9
4.00	22	5.9	88.8
5.00	42	11.2	100.0
Total	374	100.0	

**Figure C7.1 ROC for Impaired Control: Continue using FLAGS Risky Behaviour: Earlier for State Variable Value**



**Table C7.2 Coordinates of the Curve for Impaired Control: Continue and Risky Practice: Earlier**

Positive if Greater Than or Equal To	Sensitivity	1 - Specificity
.00	1.000	1.000
1.00	.940	.280
2.00	.866	.153
3.00	.821	.107
4.00	.687	.059
5.00	.493	.029
6.00	.000	.000

**Preoccupation: Desire**

**Table C8.1 Frequency Distribution of Preoccupation: Desire Item Responses**

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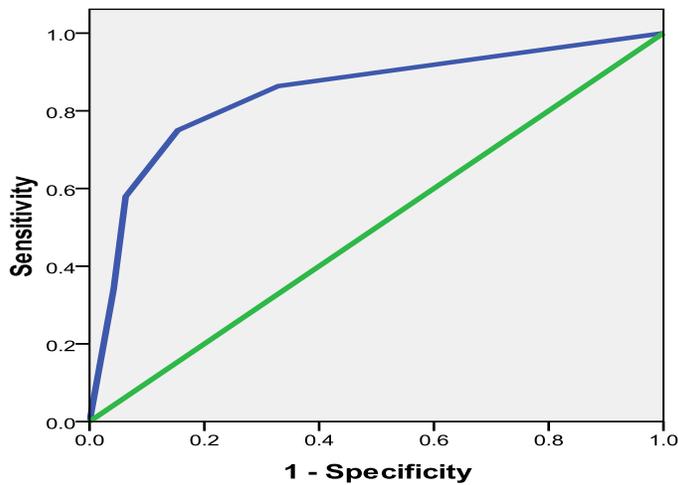
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	Frequency	Percent	Cumulative Percent
.00	204	54.5	54.5
1.00	60	16.0	70.6
2.00	41	11.0	81.6
3.00	27	7.2	88.8
4.00	42	11.2	100.0
Total	374	100.0	

**Figure C8.1 ROC for Preoccupation: Desire using FLAGS Impaired Control: Continue for State Variable Value**

**ROC Curve**



**Table C8.2 Coordinates of the Curve for Preoccupation: Desire and Impaired Control: Continue**

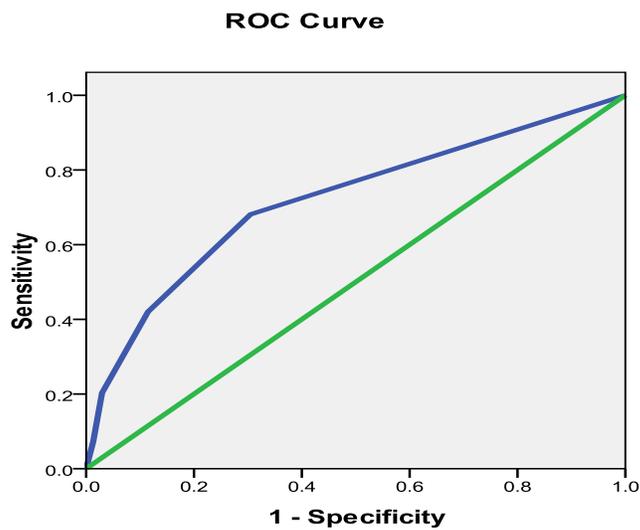
Positive if Greater Than or Equal To	Sensitivity	1 - Specificity
.00	1.000	1.000
1.00	.864	.329
2.00	.750	.154
3.00	.580	.063
4.00	.341	.042

**Risky Cognitions: Motives**

**Table C8.1 Frequency Distribution of Risky Cognitions: Motives Item Responses**

	Frequency	Percent	Cumulative Percent
.00	234	62.6	62.6
1.00	76	20.3	82.9
2.00	41	11.0	93.9
3.00	14	3.7	97.6
4.00	9	2.4	100.0
Total	374	100.0	

**Figure C9.1 ROC for Risky Cognitions: Motives using FLAGS Preoccupation: Desire for State Variable Value**



**Table C9.2 Coordinates of the Curve for Risky Cognitions: Motives and Preoccupation: Desire**

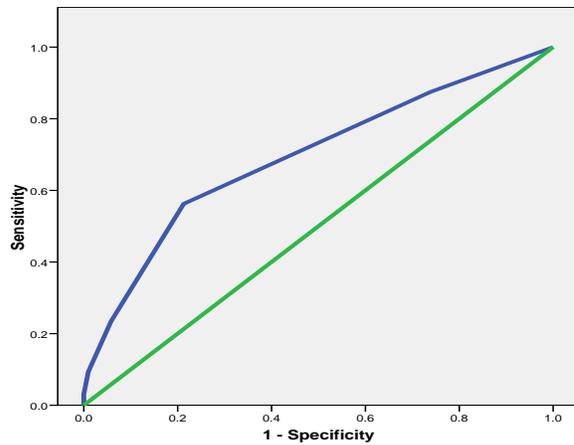
Positive if Greater Than or Equal To	Sensitivity	1 - Specificity
0.0	1.000	1.000
1.0	.681	.305
2.0	.420	.115
3.0	.203	.030
4.0	.072	.013

**Risky Cognitions: Beliefs**

**Table C8.1 Frequency Distribution of Risky Cognitions: Beliefs Item Responses**

	Frequency	Percent	Cumulative Percent
.00	89	23.8	23.8
1.00	183	48.9	72.7
2.00	69	18.4	91.2
3.00	24	6.4	97.6
4.00	7	1.9	99.5
5.00	2	.5	100.0
Total	374	100.0	

**Figure C10.1 ROC for Risky Cognitions: Beliefs using FLAGS Risky Cognitions: Motives for State Variable Value**



**Table C10.2 Coordinates of the Curve for Risky Cognitions: Beliefs and Risky Cognitions: Motives**

Positive if Greater Than or Equal To	Sensitivity	1 - Specificity
0.0	1.000	1.000
1.0	.875	.739
2.0	.563	.213
3.0	.234	.058
4.0	.094	.010
5.0	.031	.000

## **Appendix D**

### **Phase 1: Original Statement Tables**

Statements with fewer than five responses were excluded from these analyses.

**Table D-1: Risky Cognitions (Beliefs and Motives)**

	Comp. Loading	Freq.	Freq. rank	Hierarchy Score	Hierarchy Rank	Corr. PGSI
<b>Component 1 – Risky Cognitions</b>						
s47 Gambling on the slots is a way I can try to get some money when I need it.	0.74	6.1%	95	24.4	86	0.36
s101 When I need cash it is worth trying to win money playing the slots.	0.65	5.6%	100	17.9	109	0.44
s2 I sometimes play the slots in hopes of paying off my debts/bills.	0.65	11.0%	69	26.5	77	0.53
s187 My best hope of paying off my debt is to win big.	0.61	8.0%	83	19.2	102	0.67
s182 You can sometimes tell when the machine is about to pay out big because the symbols start getting closer to lining up on the pay line (Eg. almost winning).	0.53	6.4%	92	28.2	73	0.41
<b>Component 2 – Risky Cognitions</b>						
s56 I believe it is possible for me to come out ahead in the long run if I gamble on the slots.	0.74	4.5%	107	30.8	56	0.24
s97 I feel that over time I can come out ahead on slot machines.	0.71	8.0%	81	36.7	28	0.34
s8 I believe that in the long run I can win playing slots at the casino.	0.68	5.9%	97	35.1	35	0.44
<b>Component 3 – Risky Cognitions</b>						
s42 I have a strategy to improve my luck with the machines.	0.85	4.8%	106	33.6	40	0.35

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s183 It is important for me to use a system or a strategy when I play the machines.	0.80	9.9%	74	38.9	17	0.26
<b>Component 4 – Risky Cognitions</b>						
s75 If I gamble on the slots after I have had a string of losses I am more likely to win.	0.78	12.0%	65	36.7	27	0.41
s88 If a slot machine hasn't had a big pay out in a long time, it is more likely to do so soon.	0.75	25.4%	25	43.1	5	0.41
s118 After a losing streak, I believe my chances of winning will improve over the next while.	0.58	12.6%	63	32.6	47	0.39
<b>Component 5 – Risky Cognitions</b>						
s174 I feel the machines are fixed sometimes so that you can't win on them.	0.81	67.6%	1	49.8	2	0.39
s61 Some casinos have machines that are more likely to pay out (win) compared to other casinos.	0.67	43.0%	5	46.4	3	0.25
s33 Compared to other things I could do, gambling on slots at a casino is a more risky past time.	0.51	52.4%	3	44.8	4	0.27
<b>Component 6 – Risky Cognitions</b>						
s130 I find playing the slots is a good way to forget about my worries or problems.	0.73	35.3%	10	39.5	14	0.45
s74 I sometimes play the slots when I'm feeling down or depressed.	0.72	19.0%	44	32.3	50	0.36
s35 I can escape by playing the slots whenever I am worried or under stress	0.67	27.0%	18	39.5	13	0.34
s150 I believe I will play the slots more if there are major troubles in my life such as a death of a loved one, divorce or a financial crisis.	0.62	8.6%	79	23.5	89	0.51
s127 I have gambled because I was depressed about something that happened in my life.	0.62	9.4%	76	28.3	71	0.32

**Table D-2: Preoccupation (Desire and Obsession)**

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	Comp. Loading	Freq.	Freq. rank	Hierarchy Score	Hierarchy Rank	Corr. PGSI
<b>Component 1 - Preoccupation</b>						
s29 If I could play the machines all the time I would.	0.83	26.2%	22	35.7	34	0.45
s9 I wish I could gamble on the slots more often.	0.80	28.9%	17	38.8	18	0.39
s3 I like to play the slot machines every chance I get.	0.77	29.1%	16	36.6	30	0.45
s55 I would like to play the slots almost every day.	0.74	20.3%	41	33.0	42	0.49
<b>Component 2 –Preoccupation</b>						
s37 Even for a single day I find it hard to resist playing the slots.	0.79	4.3%	110	10.9	125	0.36
s140b I sometimes dream about playing the slot machines.	0.78	8.0%	83	29.6	63	0.28
s51 I spend more time than I used to thinking about playing the slots.	0.70	9.4%	76	18.5	104	0.42
s64 Gambling on the slots is an important part of my life.	0.51	11.8%	67	30.8	57	0.27

**FLAGS: Development of an Instrument for Identifying Risk for Problem Gambling among Slot Machine Gamblers in Ontario**

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**Table D-3: Risky Practices (Earlier and Later)**

	Comp. Loading	Freq.	Freq. rank	Hierarchy Score	Hierarchy Rank	Corr. PGSI
<b>Component 1 – Risky Practices</b>						
s32 I sometimes exceed the amount of money I intended to spend in order to win back money I have lost.	0.77	29.7%	14	44.6	40	0.71
s20 I sometimes gamble on the slots to try to win back money I have already lost playing the machines.	0.73	22.7%	34	48.0	58	0.65
s82 I sometimes increase the amount I bet each play to win back money I have lost.	0.71	16.3%	52	50.5	67	0.51
s36a When gambling on the slots I usually use my bank or debit card to get more money so I can keep playing.	0.65	19.8%	43	47.4	54	0.53
s15 I usually withdraw more money from a bank machine/ATM at least once while I am playing the slots.	0.63	23.3%	31	45.6	45	0.56
s96 After losing more money than I wanted on the slots I usually try to win it back by playing again either later that day or on another day.	0.61	14.7%	59	55.8	82	0.56
s36b When gambling on the slots I usually use my credit card to get more money so I can keep playing.	0.51	10.7%	71	56.3	84	0.42
s110 When I gamble with friends or family I sometimes stay and continue to play after they have stopped or left.	0.51	8.0%	84	66.4	103	0.41
<b>Component 2 – Risky Practices</b>						
s34 I have sometimes borrowed money from others so I could go and gamble on the slots.	0.85	4.3%	110	68.4	111	0.34
s69 I have borrowed money from other people at the casino in order to continue gambling.	0.83	4.0%	112	74.5	118	0.35

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s22 I have left the casino to get more money so I can come back and keep on gambling.	0.48	7.8%	88	65.0	97	0.40
s19 I have asked for money from strangers to continue gambling on the slots.		0.5%	131	67.0	106	0.13
<b>Component 3– Risky Practices</b>						
s168 I would play max bet all the time if I could.	0.77	38.0%	7	33.3	8	0.38
s25 I play max bet if I’m on a winning streak.	0.76	29.7%	15	33.2	6	0.28
<b>Component 4 – Risky Practices</b>						
s40 If I win big, I would rather gamble with my winnings than cash out and stop playing.	0.83	18.7%	46	43.5	35	0.33
s165 If I win big I am likely to put the money back into a machine and keep playing.	0.78	17.6%	50	46.7	51	0.40
<b>Component 5 – Risky Practices</b>						
s141 I have started to prefer gambling on higher credit value slot machines.	0.77	7.2%	90	56.2	83	0.31
s93 When gambling on a slot machine I usually play as fast as I can.	0.65	8.3%	80	51.2	69	0.27
<b>Component 6 – Risky Practices</b>						
s129 I have sometimes gambled for more than six hours straight when I was playing the slots.	0.76	15.0%	57	44.4	39	0.36
s1 When I play the slots, I usually gamble for at least three straight hours without taking any breaks.	.63	34.8%	11	34.7	11	0.41

**Table D-4: Impaired Control (Continue and Begin)**

	Comp. Loading	Freq.	Freq. Rank	Hierarchy Score	Hierarchy Rank	Corr PGSI
<b>Component 1 –Impaired Control</b>						
s80 I often spend more money gambling than I intended.	0.86	24.3%	27	28.9	66	0.63

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s113 Even when I intend to spend a few dollars gambling, I often end up spending much more.	0.85	25.9%	23	30.2	58	0.63
s99 I sometimes gamble with money that I can't really afford to lose.	0.78	21.4%	38	28.4	70	0.70
s164 Once I have started gambling on the slots I find it very hard to stop.	0.74	24.1%	29	29.4	65	0.64
s14 I often spend more time gambling than I intend to.	0.71	24.1%	28	29.9	60	0.60
<b>Component 2 – Impaired Control</b>						
s126 I have tried to cut back on my slots play with little success.	0.87	9.1%	77	18.0	107	0.68
s170 I have tried unsuccessfully to stop or reduce my gambling on the slots.	0.85	8.0%	84	16.4	114	0.62
s185 There have been times I have gambled despite my desire not to.	0.74	15.0%	57	26.6	76	0.61

**Table D-5: Negative Consequences**

	Comp. Loading	Freq.	Freq. rank	Hierarchy Score	Hierarchy Rank	Corr. PGSI
<b>Component 1 – Negative Consequences</b>						
s81 I have had problems paying off debts accumulated from playing the slots.	0.78	5.1%	102	12.7	121	0.40
s161 Sometimes I have to juggle money and bills to cover the cost of my slot machine gambling.	0.77	5.9%	98	12.3	123	0.42
s140 I often can't sleep because I am worrying about my slot machine gambling .	0.73	2.9%	116	9.4	127	0.31
s18 I sometimes have had difficulties paying my gambling or betting debts.	0.69	34.8%	113	9.0	<b>130</b>	0.35
s178 Since I started playing the slots I don't	0.63	3.7%	114	15.1	118	0.30

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like the type of person I have become.						
s49 My goals in life have been jeopardized by my slot play.	0.58	4.8%	105	12.9	120	0.64
<b>Component 2– Negative Consequences</b>						
s30 On more than one occasion I have spent far more than I wanted when gambling on the slots.	0.81	43.0%	6	39.0	16	0.68
s59 After playing the slots I have had regrets about the amount of money I spent.	0.81	49.2%	4	42.0	10	0.56
s172 I feel it would be better if I played the slots less often.	0.76	32.9%	12	36.1	32	0.67
s91 I have lost too much money because of my gambling.	0.73	22.7%	34	28.8	67	0.66
s176 Sometimes I feel depressed over my slots play.	0.54	13.1%	62	23.1	90	0.55
s21 I wouldn't want anyone to know how much time or money I spend at the casino.	0.54	14.4%	61	25.9	81	0.54
<b>Component 3– Negative Consequences</b>						
s122 Friends or family members complain about my slots play.	0.85	24.6%	91	22.4	<b>92</b>	0.40
s156 I have friends or family who are concerned about my slots play.	0.76	5.1%	103	21.5	95	0.32
s154 I know people who disapprove of my gambling habits.	0.69	14.7%	60	32.7	43	0.42
s87 Others are disappointed in me because of my gambling.	0.68	5.1%	101	19.9	99	0.30
<b>Component 4– Negative Consequences</b>						
s4 When I leave the casino, I have sometimes been short of cash for parking, food, or a ride home.	0.78	1.6%	122	9.3	128	0.22
s71 I have sometimes missed events or neglected family, friends or work in order to play the slots.	0.72	2.7%	118	18.1	106	0.25

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s105 I have become somewhat of a loner because of my slot gambling.	0.59	1.6%	125	15.5	117	0.21
s102 I sometimes have spent time gambling on the slots when I was supposed to be doing something else important.	0.59	5.6%	99	20.5	97	0.35
s145 I have had friends or relatives come looking for me at the casino.	-0.43	16.6%	119	29.6	62	0.17
<b>Component 5 – Negative Consequences</b>						
s84 My gambling has caused me to have a falling out with the people I used to hang out with	0.88	1.6%	121	19.5	100	0.16

**Table D-6: Persistence**

	Comp. Loading	Freq.	Freq. Rank	Hierarchy Score	Hierarchy Rank	Corr PGSI
<b>Component 1- Persistence</b>						
86 I continue to play the machines despite experiencing problems or other negative consequences.	.88	10.2%	72	68.6	111	0.66
s63 I continue to gamble despite the bad things that happen to me.	.85	10.2%	73	65.9	99	0.60
s44 I gamble even though I know it is likely to lead to problems for me.	.79	11.8%	67	60.9	90	0.64
S139 Even if money is tight, I continue to play the slots to get big wins.	.80	8.0%	86	68.3	108	0.59

## **Appendix E**

### **Statements Dropped from FLAGS due to low Correlation with PGSI**

**Table E-1 Statements Dropped from FLAGS due to low Correlation with PGSI**

Statement Number	Pearson Corr with PGSI	Component Title and Statements
		<b>Resources - Cash - has sources of money</b>
s148	0.14	I have a regular source of money with which I can gamble.
s12	-0.12	I have enough money so that I can gamble whenever I want to.
s48	0.31	I have money that comes in so I can gamble on a regular basis.
s111	0.02	I have money each month that I can spend on the slots.
		<b>Resources - Knowledge - Others Teach</b>
s38	0.04	Others help me to go to the casino to play the slots.
s159	-0.04	I know people who can teach me how/where to gamble.
s137	0.16	I have friends or family who will go to the casino with me or help me get to the casino.
		<b>Resources - Access</b>
s109	0.16	There is a casino located near where I work.
s123	0.08	There is a casino located nearby to me.
s147	-0.02	I have the time (opportunity) to go to casinos most days if I want.
S114	0.11	Getting to the casino is not a problem for me.
s43	-0.06	I am able to go to the casino whenever I want to.
		<b>Superstitious - Lucky Charms</b>
s13	0.02	I sometimes bring good luck charms to the casino.
s5	0.17	I prefer to play a particular machine where I play because I feel it is lucky.
		<b>Superstitions - Rituals</b>
s28	0.10	There are things I can do to improve my luck while playing the machines.
s6	0.15	I have several superstitions or rituals I use when I play the slots.
		<b>Motive - Others want to socialize with me at the casino</b>
s179	0.08	Others encourage me to play the slots.
s53	0.00	Others sometimes drag me to the casino with them.
s144	-0.03	I gamble on slots because my friends are there too.

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		<b>Motive - The friends I like gamble</b>
s171	0.02	I have friends who play the slots regularly.
s149	0.05	I prefer being with other people who like to play the slots.
s94	0.02	I have friends or relatives who go to the casino regularly/frequently.
s128	-0.02	I have family members who gamble on the slots regularly.
		<b>Motive - Casino is my social life</b>
s160	0.22	Gambling/betting is an important part of me and my friends' activities.
s41	-0.11	Gambling on slots is as much a way to socialize with others as it is to win money.
		<b>Motive – I gamble with friends and relatives</b>
s16	0.31	I often suggest the idea of going to the slots to my friends or family.
s68	-0.03	I gamble with friends and relatives at the casino slots.
		<b>Play Behaviours</b> (These statements are grouped together as the first two statements loaded on a single component [s188 and s189] and the remaining 5 [s26-s152] all loaded on single item component.)
s188	0.20	I often choose the right moment to stop the spin on a slot machine.
s189	0.07	I like to stop the spin before it is finished.
s26	0.15	I sometimes gamble after having several drinks of alcohol.
s134	0.11	I now spend most of the time while at the casino playing the slots.
s52	0.11	I like to cover all the lines when I play the slots.
s50	0.08	When I play the slots I do not talk to others.
s152	0.08	I sometimes play more than one machine at a time.

## Appendix F

### Results of Partial Least Squares (PLS) Analysis for Nova Scotia Canada (1998) and Victoria Australia (2006)

Figure F-1: Results of PLS Analysis Using Nova Scotia 1998 data for Machine Gamblers

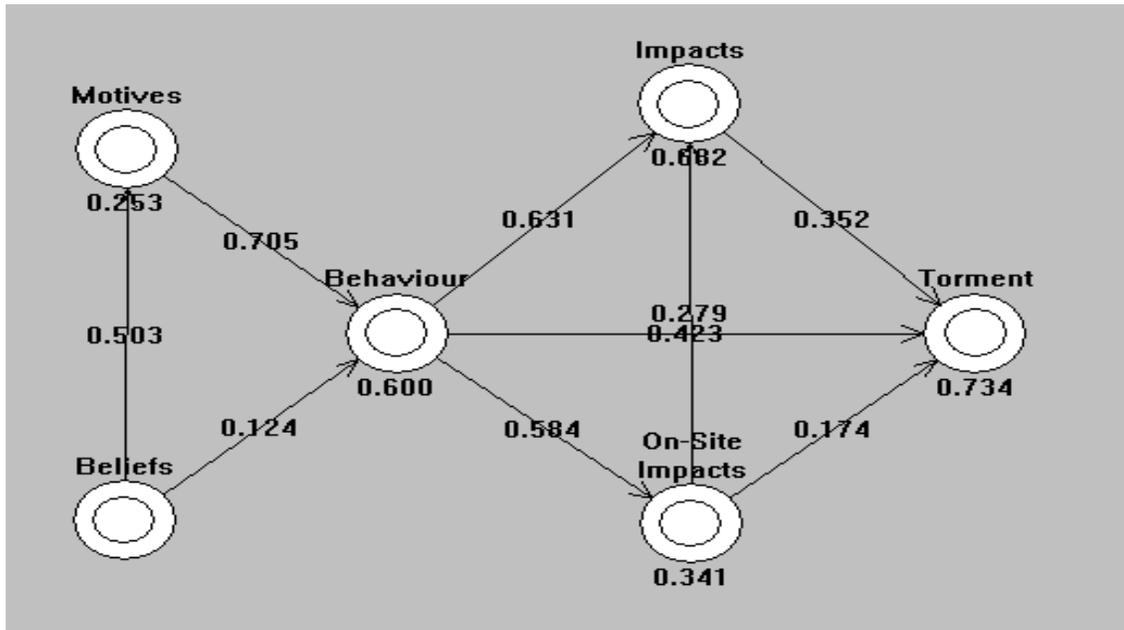


Figure F-2: Results of PLS Analysis Using Australian Data for Machine Gamblers

