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Developing an Improved Measure of Risk and Harm due to Gambling: Characteristics of an Improved Instrument and the Application of Formative and Reflective Constructs

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Introduction

The purpose of this paper is to provide the reader with a general assessment of current measures of gambling risk, and introduce new developments in the design of these instruments. While most existing gambling screens (e.g., SOGS, DSM IV, CPGI and VGS) are designed for measuring problem gambling prevalence or diagnosing pathological gambling in a clinical setting, these tools may not serve to measure risk or to provide sufficient and actionable information for diverse gambling stakeholders. Hence, the authors suggest that the goal of a new gambling risk instrument be broader than that of conventional screens developed in the past. Firstly, we recommend that a new instrument needs to be designed as a self administration screen. It should be suitable for gamblers to identify their level of risk for developing gambling problems, as well as to alert them to the fact that they are suffering harm due to gambling if this is the case. Moreover, for gambling providers designing responsible gambling programs, the new measure should be appropriate for administration to their patrons/customers, and also should be accurate for all gambling environments (e.g., casinos as well as on-line). Finally, the same instrument could be used by policy makers to gage the risk levels in the general population as well as have a better idea of the range of harms that people are experiencing due gambling activities. Such an instrument (or instruments) needs to reflect the gambling habits of the current population, take into account the current offerings, gambling provider practices, vocabulary (terminology, vernacular, language), and technologies for game design and gambling delivery.

As a key weakness of past screens is that most of them have not been clearly formulated as either reflective or formative constructs, this paper also includes a discussion of the nature of formative and reflective constructs and how constructs of each type should be

utilized in developing a new instrument to measure risk for gamblers. In the end, the authors conclude with a brief description of the research currently underway to implement the suggestions outlined in this paper.

Limitations of Existing Problem Gambling Screens

To date, a number of problem gambling instruments have been developed for administration by professionals, for example the South Oaks Gambling Screen (Lesieur & Blume 1987, 1993) and the DSM IV (APA 1980). Given the debate surrounding the issue of pathological versus problem gambling, as well as the utility of existing gambling screens for identifying problem gamblers in the general population, (Dickerson, 1993; Volberg, 1996; Walker and Dickerson, 1996, Lesieur1994), several new screens were developed that could be administered by trained telephone interviewers. These include Ferris and Wynne's (2001) Canadian Problem Gambling Index (CPGI) and the Victorian Gambling Screen (VGS) (Ben-Tovim et al 2001). None of these screens was designed to be self administered, although in practice they are often used this way in the absence of a viable alternative.

Early screens such as the DSM IV (APA, 1980) and South Oaks Gambling Screen (Lesieur & Blume 1987) were designed primarily to be administered by clinicians in a clinical setting. Clinicians or other professionals can use the screen or instrument as a starting point for exploring symptoms and harms being experienced by a client. If a client was confused about the meaning of the questions, they could ask for clarification. Aside from relying on the gambling screen, a clinician could also use other cues to determine the person's risk level (e.g., the fact that the person visited their office and asked for help). Hence, it was less critical that the screen be highly accurate, as it was not the only means by which a patient would be assessed.

The primary goal of most of these gambling screens was to diagnose someone as a pathological gambler or not; ostensibly to differentiate between regular gamblers and those who had lost control and/or were gambling in such a way as to cause harm to themselves and/or those around them. Generally, the screen is comprised of a number of statements (i.e. items) and the responses for each item are summed to yield a total overall score. The overall score indicates the extent to which the gambler is already experiencing and/or exhibiting symptoms of pathological gambling. However, as interest has shifted upstream from treatment to prevention applications the instruments are being used in order to identify risk as well as gambling problems under the assumption that as the overall score for pathological gambling increases so too does one's risk for experiencing gambling problems. This has occurred even though there is no sound theoretical ground for supposing that the screens designed to identify problems are equally successful in assessing risk nor that higher screen scores indicate higher level of risk for developing gambling problems. Conversely, for most of these screens higher scores tend to be indicative of greater probability that one is experiencing problems and as scores go down there is less certainty of correct classification as a problem gamblers

rather than less risk. This suggests existing screens designed to identify problem or pathological gambling may not be suitable as a tool to classify gamblers into different categories of risk based on the number of scored items endorsed.

The underlying structure and theory for many of the screens in use today tends to be based on forms of gambling that are no longer relevant for most markets or players. More than a decade ago, the primary forms of gambling likely to be associated with problems were casino gambling (slots and table games), horse racing, purchasing lottery tickets, and playing cards for money. The majority of those seeking assistance or treatment and thus most visible to clinician's or treatment providers would typically gamble often by placing a bet, an amount determined by the gambler, wagered on the outcome of an event such as a horse race or the spin of the roulette wheel. This meant that the term "bet" is used in the questions about a person's gambling behaviour. As well, gamblers tend to be asked if they "bet more than they can cover" which is almost impossible to do when playing most of current popular forms of gambling that require the amount wagered to be staked in advance of the bet and outcome. Instead, problem gamblers today can build up gambling debts based on continuous gambling and the acquisition of credit to pay for that activity. A close examination of the wording used in these screen statements finds that most gambling screens currently in use do not apply to the majority of gamblers habit and behaviours today. In particular, the screens were not designed with modern electronic gambling machines and devices in mind, either in the form of casino slots, video lottery terminal (VLT's) or electronic gambling machines (egms) in bars and pubs, although this type of gambling usually accounts for a disproportionate share of expenditure and revenues in most current gaming markets.

Since the late 90's, several new measures were developed to be administered to the general population in order to conduct prevalence studies of the occurrence of problem or pathological gambling. The two main examples of these are the Canadian Problem Gambling Index (CPGI; Ferris and Wynne, 2001) and Victoria Gambling Screen (Ben-Tovim et al 2001). The CPGI was tested in part by comparing the diagnoses of clinicians against the prediction of the CPGI in categorizing people as problem gamblers and it has proven reasonably reliable in this task, but was not developed nor tested as a measure of risk.

The Need for a New Measure

The authors feel there is a need to provide a new instrument that will meet the needs of gamblers, policy makers and gambling providers. The goals of such instrument would be to categorize people in terms of both risk and harms due to gambling. A new instrument is needed that will work with gamblers who are earlier in their gambling experiences so that they can recognise the warning signs of risk before problems develop over time. This means less reliance on symptoms that manifest primarily when the gambler is suffering harms (e.g., suffering financial or personal negative consequences due to their

gambling) and more on factors that indicate the potential for gamblers to experience harms.

The new instrument must incorporate the changes to the gambling environment today, while at the same time minimizing wording that will "date" the indicators. The increased acceptance of gambling by governments and society, the availability of gambling through increased and improved distribution, the increased forms of gambling and the ability to access credit and pay for gambling have all changed the landscape, in which a new instrument will be developed and applied.

Based on recent focus groups conducted on casino gamblers in London Ontario, we found that the new generation of gamblers have a vernacular all their own, that must be considered when designing the instrument. The new generation now includes seniors in communities who gamble regularly at casinos that were unavailable to them previously. They can now join a club of fellow seniors, take a free bus ride to the local casino, receive a $10 voucher for gambling when they walk through the door and eat low cost meals while they gamble. It may be a great way for them to pass time with minimal risk. What motivates them, what tempts them, what effects them may be quite different from the situation faced by seniors only twenty years ago. Conversely, younger people have a whole host of new delivery systems and forms of gambling available, including gambling on their cell phone, on the internet, and playing poker at the casino. This means their play patterns and what are risk factors may be very different indeed from what existed only a few years ago.

Policy makers are now demanding evidence-based research when developing policy. However, theories about who is at-risk due to gambling are distorted because most published research in the past is based on samples of clinical patients or convenience samples of gamblers who volunteered to participate in gambling studies. We know that these people are very different from the average gambler and do not even adequately represent "problem gamblers", 80%-90% of whom never seek professional help (Schellinck, *et al.*, 2002; Clemente and Prochaska, 1998). We therefore used the developmental profile of those gamblers who historically sought help for their gambling "addiction" to shape our current theories of risk and harms associated with gambling. They may provide suitable evidence for policy related to addiction services or treatments provided by health departments and by clinicians working with or looking for pathological gamblers. However, for purposes of general public policy or general public health policy development, these studies should not be considered as evidence-based research.

Many of the instruments developed for use in a clinical setting or for prevalence surveys have been adapted for use as self-administered instruments by gambling operators and health providers, resulting in a proliferation of responsible gambling information and sel-help materials. However, most of the instruments used in this material were not

specifically designed to be self-administered nor to provide insight for the gambler in supporting responsible play. As well, these screens are rarely tested in the environments in which they are administered.

A self-administered instrument is considerably more complicated to design properly than one that administered in a clinical office or by an interviewer (Schellinck 2006). There are three key factors that must be considered when developing a self-administered instrument. First is that there is no opportunity for feedback on how to properly fill out the instrument if there is confusion. Being confused could lead them to stop filling it out, seeking aid from others to assist in filling it out, filling it out incorrectly and then coming to the wrong conclusion about their actual state of risk and harm. Second, in many cases, the respondent may not be highly motivated to fill out the instrument, so that any barriers such as confusion, the generation of counterarguments, or a lack of credibility may lead the person to stop before they have completed it. Third, the respondents themselves are responsible for adding up the score and then deciding what actions are necessary based on the outcome. The instrument should be designed in such a way that the respondent enjoys the process as much as possible, as well as seeing the benefit of filling it out accurately and then acting on its recommendations.

To be effective then a self-administered instrument must achieve clarity, ease of administration and face validity in the eyes of the respondent. Of course, it still has to be an accurate and reliable measure of the gambler's situation. If an instrument can meet these criteria, it is likely suitable as an instrument to be administered by trained interviewers as well as counsellors. However, the reverse is not true. Screens such as the CPGI have not been developed and tested to meet the criteria for self-administration.

What Needs to be Done

The question is then, what factors need to be considered when designing an improved instrument for identifying At-Risk and Problem Gamblers. Based on our situational analysis of current screens and the needs of gamblers, policy makers, regulators and gambling providers, the following factors should be taken into account when developing a new gambling risk instrument.

1. The concept of formative constructs, as opposed to reflective constructs, has recently been introduced into the measurement literature. This form of construct offers substantial benefits over traditional constructs presently used to identify problem gamblers (Jarvis et al 2003). Constructs need to be designed as either Formative or Reflective which will occur with an improved understanding of epistemic (direction of causality) nature of gambling measures.
2. There is a need to minimize method bias in the instruments, that is, they need to be designed to minimize the error due to how the information is collected as well as what information is collected (Cote & Buckley 1987).

3. The underlying models used to create the instrument should be based on higher order models developed using structural equation modeling. In particular, there is the need for a wider specification (coverage of antecedents and consequences) for such a model in order to provide policy makers a better understanding of causal factors they should influence when formulating policy.
4. A better definition of conditions for labeling someone as at-risk is needed. Existing instruments assume that risk is a function of showing symptoms of problem gambling. Instead we need to thoroughly research the factors that potentially identify those at risk.
5. The instrument needs to be sensitive to changes in a gambler's situation or characteristics that may indicate a higher risk for problem gambling. This is necessary so that gamblers who are going through change can recognize the risk before they suffer significant harms.
6. The indicators presently have very different thresholds of response leading to very different frequencies of response among items. Care must be taken in choosing items that are relatively consistent in their response levels within constructs (see the discussion below for more details on this point).
7. A new instrument must be designed to work for infrequent as well as frequent gamblers. It is our experience that the existing indicators have thresholds for response set too low such that frequent gamblers are very likely to answer in the affirmative to a statement, even though they are not experiencing significant negative consequences due to gambling and may not be at risk.
8. The instrument or instruments need to be appropriate for specific types of gambling. In order to improve on the accuracy of the measures, we believe that a suite of several measures designed for different applications needs to be developed. These instruments would have the same foundation of formative and reflective constructs, improved wording to reflect current and future conditions, and would be low in method biases. They will look similar but be honed to work in a specific environment to achieve specific goals for distinctive forms of gambling (e.g. casino slots) and for different purposes – (e.g., self administered versus prevalence study).
9. The instrument needs to be designed to a standard such that it can be self administered.
10. The new instrument (s) must be appropriate for different player segments. Risk factors are hypothesized to be different by age and by sex. Whether the measure work for all segments of the population also need to be taken into consideration.

Designing a Reflective Construct

Schellinck, T., Schrans, T., and Zou, Y., (2009). Developing an Improved Measure of Risk and Harm due to Gambling: Characteristics of an Improved Instrument and the Application of Formative and Reflective Constructs, the 6th International Conference on Gaming Industry and Public Welfare, pg.169-188, Macau China, December 2009

The most widely used instruments for measuring gambling problems and associated risk are the South Oaks Gambling Screen (SOGS), Diagnostic and Statistical Manual Version IV (DSM IV), and the nine-item Problem Gambling Severity Index (PGSI) of the Canadian Problem Gambling Index (CPGI). Each has been developed and assessed as a *reflective* construct.

Reflective constructs are based on the assumption that the underlying latent construct (e.g. problem gambling) causes the observed variation in the measure (Cote & Buckley, 1988; Nunnally 1978). That is, the construct (e.g. PGSI) assumes a latent variable exists, in this case problem gambling, and that the direction of causality is from the latent variable to the measure comprising the reflective construct (e.g. problem gambling produces the outcomes for the PGSI). While this approach is valid in relation to many constructs, it may not be the most appropriate for measuring gambling problems and associated risk. This is particularly true for measures outside of clinical or treatment populations (e.g. in the general population and for survey applications).

A landmark essay in 1979 by Churchill (Churchill 1979), editor of the Journal of Marketing Research dramatically influenced the way that social scientists measure and categorize humans using constructs. In particular, he was critical of researchers for not paying enough attention to construct validity and reliability. Up to that time many researchers simply asked a series of questions regarding a subject and did not necessarily test to ensure the measure was reliable and valid. Churchill advocated a systematic approach to developing these constructs (a multi-item measure is generally referred to a construct) that would ensure they could be used for purposes of developing theory. That is, these constructs could be taken off the shelf and applied in any situation as a valid measure of an underlying characteristic of people. This would help ensure that science advanced based on a building block of accurate and recognized constructs. He presented an eight step approach for developing better constructs when developing theory. The steps were to specify the domain of construct via a literature search; generate a sample of items; collect the data and purify the measure through factor analysis; collect data again (after re-specifying the domain of the construct if necessary); assess reliability and validity; and develop norms.

Inherent in his discussion was the assumption that these measures were reflective constructs. A reflective construct is designed to measure something within the person that causes an observable variance. That is, people are different on this dimension and we want to know why. We assume it is some inherent characteristic of the person and we design a construct to measure this latent characteristic and explain the variance. In the field of gambling a commonly measured latent characteristic of people is the degree to which they are suffering harmful effects due to gambling. At its simplest level we could simply ask people if they are suffering harmful effects due to gambling. This would be a reflective measure where a positive response may suggest they are suffering harmful effects. However, a single item measure such as this would lack reliability and validity.

In terms of reliability, if we ask the same question again, or in a slightly different way, we might receive a different answer from some people indicating the question is not totally reliable. A common way to increase reliability is to ask the person the same basic question in three or more different ways. If the person answers all or most of the questions in the affirmative, we can have greater assurance when classifying the person. Thus we expect the answers to these questions to be highly correlated with each other if we are measuring a single underlying (latent) characteristic of the person. Three or more items are required in a reflective construct because we need at least three statements in order to calculate inter-item reliability using the standard approaches (e.g., Cronbach's Alpha).

A typical reflective construct used to measure harmful impacts of gambling might look like:

1. ***My gambling causes me to suffer negative consequences.***
2. ***I continue to gamble despite the problems it causes.***
3. ***Gambling has become a curse for me.***
4. ***There have been unfortunate consequences because of my gambling***

The example above has four questions or items which ask whether a person is suffering negative consequences because of their gambling. If a person is in fact suffering any harm due to gambling, he/she should answer yes to the first question and also to all subsequent questions. The more items a gambler endorse, the greater certainty we would have that he/she is experiencing difficulties with gambling.

A reflective measure such as the example has certain characteristics then:

- A reflective construct is viewed as measuring a single latent variable, in our example, whether the person is suffering harm due to gambling.

- Items in the measure therefore are interchangeable, that is, all items are measuring the same thing, whether a person is suffering harm due to gambling.

- Since all the questions are tapping the same underling latent variable, reducing or adding items does not change what is measured (i.e., whether you are suffering harm or not).

- When following Churchill's recommended approach to developing a reflective construct, factor analysis is used to decide what items are retained in the final construct rather than theory (i.e., only high loading items are selected). In other words, only those items that are very highly correlated with each other are retained.

This has certain implications for the value and use of reflective constructs. First of all, they are excellent for measuring an underlying characteristic of a person, such as whether they are suffering harm due to gambling. However, answering in the affirmative to more than one question does not imply that you are suffering more harms, or more severe consequences due to gambling. As noted above, taking out an item does not change the measure. Therefore whether a person scores on four or eight of the items, we should still assign them to the same category. We just have more confidence if they respond yes to all the questions. Therefore, we cannot use the summated score of a reflective measure to assign individuals to different categories of harm. Therefore, we cannot create a continuum of harm severity and assign people to categories such as low harm, medium harm and severe harm using a reflective measure.

Use of Reflective Measures for Prevalence Studies

These instruments are commonly used in prevalence studies, but a reflective construct designed using Churchill's recommended approach may not be an appropriate application for such an instrument. Since items should be interchangeable in a reflective construct, a person designated as suffering harm in one question should also receive the same designation in all other items if they are consistent and reliable. That means that if 30% of a sample is designated as suffering harm using one question, then the same 30% should be identified as suffering harm using all the statements. Thus, to be a true reflective measure, the same percentage (in fact the same people) should answer in the affirmative for each item. Unfortunately, if the standard approach is used to derive items for a construct then this criterion may not be met. All that is required is that the items be highly correlated and the absolute percent of people answering in the affirmative is not considered.

If we take the example below we see that four measures, A, B, C and D are correlated (loaded) highly with our harm measure.

- **Item A R = 0.62**
- **Item B R = 0.65**
- **Item C R = 0.60**
- **Item D R = 0.59**

Normally the researcher would select the three highest loading items, in this case A, B and C for inclusion in the construct. However, the percent of people responding positively to test items may vary substantially. That is, the threshold for positive responses may be different among the items. This would happen, for example if one statement was "*I frequently have sleepless nights thinking about my gambling*." and a second statement was "*I sometimes feel bad about how much I spend on gambling*." Only a small percentage of gamblers (say 10%) may agree to the first statement while many more (say 70%) may agree to the second statement. For the four statements above we could therefore have the following level of agreement.

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- **Item A 10% agree**
- **Item B 30% agree**
- **Item C 50% agree**
- **Item D 70% agree**

We know that the degree to which items load onto a factor is sensitive to the particular sample, so it is possible that any combination of three out of the four items could be picked for inclusion in the construct if there is a slight shift in factor loading values. However, if the threshold for a positive response is radically different among the items, the percent of those who may be identified as suffering harms due to gambling may increase in our example by two thirds (50% versus 30%) as illustrated below.

- **If items A, B & C are in the measure then 30% of gamblers might be deemed to be suffering harm**
- **If items B, C & C are in the measure then 50% of gamblers might be deemed to be suffering harm**

If this measure is to be used in prevalence surveys, our results will be very much a function of the thresholds of the items chosen to be in the construct. Theory should be used to determine what represents a harmful impact, and then the construct should be able to identify those people suffering harm at that level. If there are distinctive harms that are more severe, these should be grouped into separate constructs.

Designing a Formative Construct

The concept of formative constructs has recently gained interest in the social sciences and health literature, the most influential paper being the article by Jarvis, Mackenzie & Podsakoff (2003). These authors examined over 1146 published constructs in the marketing literature and found that only 4% (n=46) were designed as formative measures (Jarvis et al 2003; Diamantopoulos & Winklhofer, 2001). Following evaluation of the full set of measures, they concluded that 17 of the 46 formative constructs should have been reflective. More significantly, however, 365 of all of the constructs (31%) were reflective measures that should have been formative in nature. Accordingly, a large proportion of the constructs were found to be designed incorrectly, a finding that has major implications for the effectiveness of such constructs as useful measures (Diamantopoulos & Winklhofer, 2001; Jarvis et al 2003; Mackenzie 2003).

This finding underscores the need for research to examine the nature of the constructs and to ensure that gambling problems/risk are being appropriately measured and specified for general population use. This would entail a more detailed analysis of the construct's validity and a more rigorous assessment of its measurement properties. If these measures can be considered formative constructs, there would be less reliance on estimates of internal consistency, reliability (e.g., Cronbach's alpha) and factor analysis, in order to assess validity. Reliance on these methods of assessment can lead to misspecification of the construct in that they focus on single measures whereas the actual construct may be

considerably more complicated. In addition, key components of gambling risk may be missing from the constructs due to an over-reliance on classical testing theory as described by Churchill (1979).

The use of reflective constructs is good for theory development, but may not be appropriate for policy research due the lack of detail provided in these constructs and for identification and categorization of people into risk categories since they cannot be summed to arrive at different categories of risk. If we wish to know whether a person is a pathological gambler, we can use a reflective construct and they will essentially tell us whether they are a one or not. However, if we wish to use a set of symptoms or characteristics of the person to categorize them, we are no longer using a reflective measure. Instead, we are using a formative construct that must have specific characteristics in order for it to be an appropriate and effective measure.

Almost all instruments for identifying gambling problems/risk have been assessed according to classical test theory, which assumes the construct is reflective in nature. In reality, however, such measures could be either *reflective* or *formative* in nature. In contrast to a reflective measure, a formative construct is said to cause the latent variable (e.g. endorsement of items produces a measure of gambling problems/risk). Here, the items represent different dimensions of the latent variable and the construct is therefore a summation of the observed variables with which it is associated (Bollen & Lennox, 1991; Gefen, Straub & Boudreau, 2000).

Formative constructs are more inclusive in nature and, consequently, may have more construct validity. Below are four items that might form a formative construct to measure the extent to which a gambler suffers harm due to gambling.

1. ***I have had trouble repaying gambling debts.***
2. ***My relationship with my family is strained because of my gambling.***
3. ***I have nightmares due to my gambling.***
4. ***My social life suffers due to my gambling.***

We say in this case that a person is suffering harms if these things are happening to them. Note that we have categorized this person as suffering harms because they answered in the affirmative to some of the items on this list. That is, the causality goes from the list to the categorization.

We could have another list such as:

1. ***I get sick to my stomach when I play the slots.***
2. ***I max out my credit cards in order to gamble.***
3. ***I have gone hungry because of my gambling.***
4. ***I usually feel really stupid after losing at gambling.***

The same person who answered positively to some of the items in the first list may not do so for the second list. If our formative construct were comprised of the second list of items then we would conclude that the person is not suffering harm. What a formative statement measures is therefore very sensitive to its composition. It is critical that the construct be relatively comprehensive in its coverage of relevant factors. However, formative constructs have characteristics that make them very useful (desirable to use) for policy research and for self administered instruments.

Formative constructs have the following characteristics:

- The construct is viewed as a list of items relevant to the topic.
- The construct is defined by the list itself.
- The direction of causality flows in the opposite direction compared to reflective constructs in that the construct defines the variable.
- Items in the measure are not interchangeable. We cannot replace an item that measures whether a person is suffering health problems with one that measures financial problems.
- The items in the list should not be too highly correlated with each other so that their scores can be added together without double counting some items. (e.g. adding together the score from two highly correlated items such as “I suffer head aches after I gamble” and “My head often hurts after I gamble” would be doubling the count for the harm “headaches” compared to other harms.)
- Reducing or adding items changes what is measured.
- The item list should therefore be exhaustive in terms of defining the phenomenon of interest (we need to identify a reasonable range of harms so that major ones at least are not missing from our list).

A well designed formative construct offers several advantages over a reflective construct that are useful for certain applications.

1. Knowing exactly what harms the person is experiencing helps us formulate a policy or corrective measures. A reflective construct will not provide an indication of what harms are experienced by gamblers as it is not a list. For example, whether the harms experienced by gamblers are primarily financial or health related in nature may dictate what kind of assistance programs are provided to harmed gamblers.
2. The formative construct relies less on the individuals to assess their own condition (I am suffering harms.) and more on cues that the individuals may not know are associated with harms (I kick and swear at the machines sometimes.). It thus provides more value to the respondents in that they may learn something about themselves.

3. It is possible that formative constructs are more accurate than reflective constructs, as reflective constructs depend more on the individual's assessment of their own condition (e.g., I am suffering harms due to gambling), while well designed formative constructs rely on a reasonably exhaustive set of objective criteria (e.g., I am unable to pay debts accumulated due to gambling) to arrive at a score.
4. Formative constructs can be aggregated in some way to arrive at a continuum. If a person suffers harm more often or suffers a greater variety of harms it is reasonable to place this person on a continuum that may be the number/extent or severity of harms experienced due to gambling.

Formative constructs have some limitations in comparison to reflective constructs:

1. A formative construct generally requires a larger set of items in order to have an exhaustive (or at least representative) coverage of the variable being measured.
2. Greater judgement is required on the part of those designing the construct as to what items should be included in the construct (i.e., they cannot rely on factor analysis to make the final selection of items). As in the case when reflective measures are being designed, it is very important to consult the literature to ensure key causal factors are identified. In the end, the knowledge and skill of the designers is a key determinant of the validity of the measure.
3. It is more difficult to arrive at an estimate of the construct's reliability, as we cannot rely on inter-item covariance measures such as Cronbach's Alpha. We are left with techniques such as test re-test or split sample testing to determine reliability.
4. The formative constructs may be less portable than reflective constructs. A list of items such as harms or symptoms will always be context specific to some extent. For example, if a formative construct contains an item that asks gamblers if they use on-site ATM machines to obtain money in order to continue gambling it will be useless in jurisdictions where ATMs have been removed from all gambling establishments. If a construct is to be used in a variety of jurisdictions then the designers should keep this in mind when creating the construct.

When to Use Reflective and/or Formative Constructs to Create an Instrument

The main problem with existing constructs related to gambling has been that construct designers have not paid enough attention to whether they are forming a reflective or a formative construct. The result has been that many of the constructs are really formative in nature but have been designed using the criteria for forming a reflective construct. As factor analysis is applied to select the items, the items in the construct are highly correlated with each other and therefore are interchangeable. However, the items such as a list of cues or symptoms are generally more appropriate for a formative construct.

A reflective construct is appropriate for identifying someone who is a pathological gambler in a counsellor's office. It could also be used in prevalence studies, if the goal is to determine how many people in the adult population are pathological gamblers. However, since a reflective construct is designed to measure a particular latent variable (e.g. pathological gambling), it is not appropriate to use the same construct to measure another latent variable such as risk of becoming a pathological gambler. The factors associated with risk can be different from those that are associated with being a pathological gambler. They are obviously not the same subset of people since those at risk do not necessarily all become pathological gamblers. In particular, when using a reflective measure, we cannot create a continuum in order to determine the severity of harm or the degree of risk associated with gambling. Properly designed formative constructs can be used for these purposes however.

If we are designing an instrument to measure the incidence of at-risk and harmed gamblers as well as the factors that influence the incidence levels in the population, it would need to be composed of more than one construct. Whether these constructs are formative or reflective depends on what their intended goal of the construct is. For example, there could be a formative construct for risky behaviours so that we have a clear understanding of the nature and degree of these behaviours exhibited by gamblers. A reflective measure for persistence may be appropriate if we are basing the construct on a latent variable clearly defined in the psychology literature which is hypothesised to be a component of Problem Gambling. There could be several other constructs that are either reflective or formative that measure the prevalence of factors that influence the incidence of those at risk or suffering harms. What is important is that the correct form of construct be used in achieving those goals.

Current Instrument Development Activities

In 1998, we concluded that while existing instruments were able to identify problem gambling, relatively sparse information was produced for those at risk of developing problems (Schellinck and Schrans, 1998). Using structural equation modeling with data gathered during the 1998 Nova Scotia Video Lottery Players Study, Schellinck and Schrans developed a hierarchical model of the antecedents of problem gambling. Based on this new information they designed a risk assessment instrument that included measurable precursors of gambling harm including beliefs, motivations, and behaviours (***F***oca***L*** ***A***dult ***G***ambling ***S***creen ***(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.

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 the screen could be easily administered and that it had high face validity in categorizing active gamblers into three groups: "no 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.

Recent work in Australia (Delfabbro et al., 2007) based on Schellinck and Schrans' (2004b) on-site venue research also provided an updated and expanded list of observable behaviours for Video Lottery Terminal (VLT) and slot machine gamblers that were highly correlated with problem gambling. The additional items offer a wider focus in alerting gamblers to cues associated with gambling problems, assisting them in recognizing a broader array of problematic behaviours and practices, and/or encouraging them to initiate self-change or seek assistance. These cues were added to our existing set of indicators to arrive at an overall total of 190 potential indicators of risk cognitions (e.g., beliefs, motives) and risk practices (i.e., behaviours) that might place individuals at risk for harm from slot machine gambling were generated for testing in the study.

As the first step in modifying the screen for use with slot machine gamblers, conducted two detailed literature searches surrounding recent developments in the area of construct design and method bias[1]. This information was used to develop a methodology for developing an expanded and up-dated list of items for testing among slot machines gamblers in Ontario. The authors reviewed the 'at risk' and 'problem gambling' literature including 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 examination of the various components comprising the OPGRC Framework including risk elements (risk cognitions, risk behaviours and preoccupation) and problem gambling elements (impaired control, negative consequences, persistence (Dickerson, Hinchy, England, Fabre, & Cunningham, 1992; Ozga & Brown, 2002; Toneatto & Millar, 2004; West, 2008). The findings suggested that the new gambling risk assessment instrument might be strengthened by including additional behavioural items as well as sub-screens associated with risk: situational and personal factors, and impaired control. For example, it was hypothesized situations conducive to gambling such as living with another regular gambler (Shepherd & Dickerson, 2001) and impaired personal control (Dickerson & O'Connor, 2006) could increase the risk of harm for slot machine gamblers.

The authors are currently analysing a larger sample of Ontario casino gamblers with an improved list of indicators using a structural equation modeling technique called Partial

[1] These two studies were supported by two level I Grants from the Ontario Problem Gambling Research Centre (OPGRC).

Least Squares analysis (Chin and Newell 1999) in order to derive a hierarchical, multi-construct instrument that is composed of both formative and reflective constructs[2].

As underage gambling is recognized as an important area of research in public health, the authors are in the process of analysing data containing in excess of 150 indicators from a sample of 85 Nova Scotia adolescents using PLS analysis to derive a model of adolescent gambling behaviour and from there refine an instrument designed to measure risk factors, harms and problem gambling among adolescents To date we have created thirty formative and reflective constructs that capture the wide range of variables associated with gambling and have developed a tentative map the relationship among these constructs in order to derive a model of adolescent problem gambling behaviour[3].

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[3] This research data was collected from 2007 Nova Scotia Gambling Collection Project commissioned by Nova Scotia Health Promotion and Protection.

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