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GEMINI RESEARCH

Developing a Short Form of the PGSI

Report to the Gambling Commission

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SUMMARY

The aim of this project is to provide the Gambling Commission and its stakeholders with advice on the feasibility and suitability of a new brief three-item measure for use in tracking the prevalence of problem gambling in the general population. Brief instruments are needed in population research on problem gambling to minimize the burden on respondents, enhance response rates, and reduce survey costs. Several brief screens and short-form measures for problem gambling have been developed for use in population research over the last decade. A significant limitation to all of these short-forms is that they are each derived from a single instrument and validated against this same instrument. Even more critically, all of these short forms are taken from problem gambling measures which themselves have only modest correspondence to classifications obtained in subsequent clinical interviews.

The new brief instrument developed in Britain is made up of three items taken from the nine-item Problem Gambling Severity Index (PGSI). One question assesses the behavioural dimension of the problem gambling construct and the other two questions assess adverse consequences. Data from three separate studies was used to elucidate the performance of the new brief instrument. The Omnibus telephone surveys of adults aged 18 and over serve as a supplement to the British Gambling Prevalence Surveys. The Omnibus surveys use quota sampling, include only landlines, and employ limited contact attempts. Since Omnibus respondents are only asked about gambling participation in the past four weeks, the PGSI Short-Form was administered to all respondents regardless of their past-year gambling status in four waves of data collection in 2009 and 2010. Respondents who endorsed one or more of the items in the brief measure were administered the remaining items that make up the PGSI. In an additional two waves of data collection, one in 2009 and one in 2010, the full PGSI was administered to all respondents.

The British Gambling Prevalence Surveys (BGPS) were undertaken in 1999, 2007 and 2010. These surveys are the primary means for monitoring problem gambling prevalence in Britain. The BGPS use random sampling and face-to-face interviews and provide participants with multiple ways to complete the questionnaire. The PGSI was administered to all participants in the 2007 and 2010 surveys who had gambled in the past year. The Clinically Assessed sample was drawn from two separate studies that included all of the most widely-used problem gambling instruments (SOGS, PGSI, DSM, PPGM) as well as independent clinical assessments of each participant's problem gambling status. The PGSI was administered to all past-year gamblers in both of these studies.

The analysis was carried out separately with each of the three samples. In addition to calculating prevalence rates based on the full PGSI and on the new short form, we assessed the overall performance of the new measure in each sample. This entailed calculating the internal reliability and item-total correlations of the three items as well as overall performance, including sensitivity, specificity, positive predictive value, negative predictive value, and overall classification accuracy. We examined the ratio of the prevalence rates derived from the new short form in relation to problem gambling prevalence based on the full PGSI (using three separate cutoffs). We also looked at how the new measure performed across major demographic groups including gender, age and ethnicity.

The results of this analysis confirm that the new measure is a valid brief assessment instrument for problem gambling. Using a cutoff of 3 or more provides a reasonable approximation of the 'true' rate of problem gambling as determined by both clinical assessment and the full PGSI. Using a cutoff of 1 or more provides an excellent approximation of the 'true' rate of at-risk, problem and pathological gambling as determined by clinical assessment. From a public health perspective, use of a cutoff of 1 or more with the new three-item measure is a desirable approach in monitoring changes in the rate of overall 'harm' associated with gambling in the population.

Although the PGSI Short-Form is quite suitable for population prevalence research, it is not suitable for use in clinical settings due to high rates of false negatives (i.e., true problem gamblers not being identified). The PGSI Short-Form could potentially be used with a cutoff of 1+ as it would capture almost all of the problem gamblers, but it would be a very inefficient screen due to low positive predictive power (i.e., only 31% of people identified would be confirmed as true problem gamblers).

In our view, the new brief assessment can be used in future Omnibus and other surveys as a relatively low-cost means to monitor problem gambling prevalence over time in Britain. However, to minimize false positives, the instrument should only be administered to participants who have gambled in the past four weeks and/or report gambling at least a dozen times in the past year. The new measure should not be used to track changes in the characteristics of problem gamblers in the population. Some additional work is needed to determine if the two 'consequences' items included in the new instrument could be replaced by other PGSI items or items from other problem gambling measures that provide more concrete assessments of gambling-related harm. Work is also needed to assess how the new brief assessment operates in relation to the full PGSI in the upcoming Health Survey for England and Scottish Health Survey.

INTRODUCTION

The gambling field is not unique in its need for brief assessment tools that can be utilized in clinical and population research settings. In the alcohol field, there are now a number of brief screening tools that employ subsets of items from longer, standardized assessments to efficiently filter out most individuals who would not be positively identified using the longer screen, while yielding minimal loss of cases as false negatives (Bush, Kivlahan, McConell, Fihn, & Bradley, 1998; Cherpitel, 2002; Cherpitel, Ye, Moskalewicz, & Swiatkiewicz, 2005; Dawson, Grant, Stinson, & Zhou, 2005; Pokorny, Miller, & Kaplan, 1972). As with alcohol use disorders, there is good evidence that even very short instruments can be as effective as longer measures in the initial identification of depression in clinical and population settings. A recent meta-analysis demonstrated that a 2-item assessment instrument is effective in identifying clinical depression among adults in primary care settings (U. S. Preventive Services Task Force, 2002). In reviewing methods for screening for family and intimate partner violence, Nelson et al. (2004) identified a number of brief screens that have been developed for use in emergency hospital settings.

The aim of the present project is to provide the Gambling Commission and its stakeholders with advice on the feasibility and suitability of a new brief three-item PGSI Short-Form derived from the longer Problem Gambling Severity Index (PGSI) for use in tracking the prevalence of problem gambling in the general population. The present report begins with a summary of the latest developments in the area of problem gambling screening. This is followed by a brief discussion of the problem gambling construct and then a longer consideration of how the performance of different assessment instruments is affected by survey methodology. The next three sections evaluate the performance of the new PGSI Short-Form in the (a) 2009 and 2010 British omnibus surveys, (b) the 2007 and 2010 British Gambling Prevalence Surveys, and (c) in a large sample of English-speaking clinically assessed gamblers. The final section of the report provides a summary of our findings and recommendations for the future.

Review of Existing Screens

Screening for problem gambling takes place in many settings, including health care practices and population research. In population research, the routine administration of lengthy problem gambling instruments poses an unnecessary burden on the large majority of respondents who gamble very little. This in turn, adversely affects survey response rates and the financial costs of administering such surveys.

A number of short screening instruments for problem gambling have been developed over the last decade. A significant limitation of all of these short screens is that they are each derived from a single instrument and validated against this same instrument. Even more critically, all of these short screens are taken from problem gambling measures which themselves have only modest correspondence to classifications obtained in subsequent clinical interviews (Ferris & Wynne, 2001; Grant et al., 2003; Ladouceur et al., 2000; Murray, Ladouceur, & Jacques, 2005; Williams & Volberg, 2010).

In this section, we review several brief problem gambling screens developed for use in population research, presented in chronological order.

Lie-Bet Screen

The Lie-Bet Screen consists of two items extracted from a 12-item DSM-IV-based measure with a dichotomous (yes-no) response format (Johnson et al., 1997). In validating the Lie-Bet Screen, the items were administered to 191 members of Gamblers Anonymous and 171 employees of a Veterans Administration Medical Center. The authors used discriminant analysis to identify the items that best differentiated between the two groups. Further validation with 146 problem gamblers and 277 controls was carried out in a subsequent study (Johnson, Hamer, & Nora, 1998).

Despite impressive psychometric results in its initial development, the Lie-Bet Screen has not been widely used. An exception is the first national prevalence surveys of adolescents and adults conducted in Norway (Götestam, Johansson, Wenzel, & Simonsen, 2004). Noting the need for a rapid screening tool for pathological gambling, the Norwegian researchers examined the performance of the Lie-Bet Screen items in large adult and adolescent general population samples in Norway. While the items performed poorly as a screen for pathological gambling *per se*, a positive response to one or both items did perform well with respect to the detection of individuals with DSM-IV scores of 3 or more. The Lie-Bet Screen correctly detected over 90% of DSM-IV defined problem and pathological gamblers (11 of 12 adults; 180 of 194 adolescents). There were also 146 people incorrectly classified as having problems (false positives). With respect to screening, if administration of the full screen was confined to people in the Norwegian prevalence surveys who scored positive on the Lie-Bet Screen, only 196 people would have needed to be assessed fully at the cost of missing 15 people with problems. Neal, Delfabbro and O'Neil (2005) argue in relation to the Lie-Bet Screen that the search for an efficient surrogate for longer scales is a worthwhile endeavour and that further investigation of the Lie-Bet Screen is warranted.

Reduced SOGS Measures

In a recent review, Abbott and Volberg (2006) concluded that the high level of correlation amongst all of the most widely-used problem gambling measures suggests that consideration should be given to further refinement of the SOGS, including retention of the better performing items and removal of those that have become obsolete or fail to reflect problems in some groups.

One research team in the U.S. has undertaken work in this direction. Strong et al. (2004) used modern test theory to identify a reduced set of items from the SOGS that performs well in both community and clinical samples. These researchers initially identified a subset of 15 items from the original SOGS that demonstrated significant stability across community and clinical samples and a good relationship to the DSM-IV criteria in the clinical sample. In a subsequent study, Strong et al. (2003) again used Rasch modelling to identify a subset of six items from the original SOGS that predicted problem gambling severity equally well in a large sample of U.S. college students and in a separate sample of treatment-seeking pathological gamblers. While potentially quite useful, this shortened version of the SOGS consists of one highly subjective item (Did you ever gamble more than you intended to?) and five items that assess borrowing money to gamble or pay gambling debts. This set of items entirely ignores other personal and social factors that may influence an individual's ability to control their gambling.

The NODS-CLiP

A critical challenge in population studies of problem gambling is the relative infrequency of the disorder in the general population. The NODS-CLiP was developed specifically for use in population research as a screening procedure to minimize respondent burden and reduce the expense of community studies of problem gambling. Toce-Gerstein, Gerstein and Volberg (2009) used data from eight surveys that included the NODS—a DSM-IV-based assessment developed for the U.S. national problem gambling prevalence survey in 1998 (Gerstein, Volberg, Harwood, & Christiansen, 1999)—to identify a subset of three lifetime questions to which 99% of the NODS-classified pathological gamblers (NODS=5 or more) and 94% of NODS-classified problem gamblers (NODS=3 or 4) answered at least one in the affirmative. This new screen was dubbed the NODS-CLiP to remind users of the three criteria assessed using this screen (Loss of **Control**, **Lying** and **Preoccupation**). While almost as sensitive to problem and pathological gambling as the full NODS screen, the NODS-CLiP items alone are not sufficiently specific to be useful as a stand-alone screen in population surveys. Toce-Gerstein and colleagues (2009) suggested that further work was needed to identify a set of NODS items with adequate specificity and sensitivity for use as a stand-alone screen.

In a subsequent analysis of data from the 2006 California prevalence survey (Volberg, Nysse-Carris, & Gerstein, 2006), Volberg identified two additional items (assessing **Escape** and

Chasing) that significantly improved the capture rate of the NODS-CLiP relative to the full battery. Based on the 3,903 respondents who were administered the full NODS in the California survey, the three-item NODS-CLiP captured only 43% of the at-risk gamblers while the five-item NODS-CLiP2 captured 89% of this group. As with the original screen, the five-item screen was not deemed sufficiently specific to be used as a stand-alone screen although it is an efficient filter that reduces the proportion of the sample that must be administered the full screen from 55% to 13%. This efficiency led to the inclusion of the NODS-CLiP2 in the first wave of the Victoria (Australia) Longitudinal Gambling Study as a measure of lifetime gambling problems (Victoria Department of Justice, 2009).

The Brief Biosocial Gambling Screen (BBGS)

Gebauer, LaBrie and Shaffer (2010) analyzed data from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) to develop a brief three-item screen for pathological gambling. The Brief Biosocial Gambling Screen (BBGS) is made up of items that assess past-year experiences of **Withdrawal**, **Deception** (or Lying) and **Bailout**. The brief screen demonstrated high sensitivity and specificity in relation to the longer 15-item screen representing the operationalized DSM-IV criteria for pathological gambling that was included in NESARC (Petry, Stinson, & Grant, 2005). The developers of the BBGS argue that the brevity of the screen and its strong theoretical foundation, including as it does one item from each of the three domains of the addiction syndrome (neuroadaptation, psychosocial characteristics and adverse consequences), should encourage clinicians and epidemiologists to use it alongside screens for other problems.

One critical weakness in the development of the BBGS is the lack of published information about the validity or reliability of the longer DSM-IV gambling module developed for NESARC, against which the BBGS is benchmarked. While the research team that carried out NESARC did complete a test-retest study of the reliability of the full instrument used in the survey, the retest sample did not include any pathological gamblers. This precluded any assessment of the performance of the gambling module (Grant et al., 2003). As far as we are aware, there was no effort to validate the pathological gambling module included in the NESARC against a sample of diagnosed individuals as was done in the development of the NODS (Gerstein et al., 1999).

The AGRI Short Screen

The search for a brief problem gambling screen has focused on identifying subsets of items from existing problem gambling assessment instruments that are able to predict scores on the full instrument. In a recent study, Volberg and Williams (2011) used data from a large sample of North American respondents in two separate surveys to identify a subset of items taken from **all** of the most widely-used problem gambling screens that is effective in capturing the large majority of **clinically assessed** at-risk, problem and pathological gamblers.

The first study involved 3,028 adults from southern Ontario in 2008 (Williams & Volberg, 2009, 2010). The second study involved an online gambling survey of 12,521 adults from 105 countries (Wood & Williams, 2009) (see *The Clinically Assessed Sample* on Page 13 for additional information about the samples). The first part of each investigation entailed administration of all of the unique items that comprise the PGSI, the NODS, the SOGS and a new instrument developed by Williams (the Problem and Pathological Gambling Measure; PPGM) to participants in the two studies. The second part of each investigation involved providing two independent clinicians the answers to each of the problem gambling questions for each participant, as well as comprehensive information about the person's reported gambling behaviour, responses to validity questions, and relevant demographic characteristics of the individual (e.g., income, debt). This information was used by the clinicians to provide an independent assessment of the person's problem gambling status, using a set of commonly accepted definitions (Neal et al., 2005).

To identify the most effective subset, the items were sorted into dimensions and candidates for further analysis were identified. Once candidate items were identified, the performance of all two-item, three-item, four-item and five-item combinations was examined to assess capture rates in each study sample. After identifying the best combinations, all eligible combinations were further examined to assess the level of measurement invariance associated with each combination. Based on performance across both surveys and on measurement invariance across major demographic groups, a combination of five items was identified as the best brief screen for clinically assessed at-risk, problem and pathological gambling. The AGRI short screen includes items assessing **Preoccupation**, **Tolerance**, Loss of **Control** and **Financial** Problems.

Coverage of the Problem Gambling Construct

The term **problem gambling** is typically used to refer to individuals with difficulties related to their gambling although it is used in a variety of ways. In some situations (primarily population research), its use is limited to those whose gambling-related difficulties are less serious than those of pathological gamblers. In other situations, this term is used to indicate **all** of the patterns of gambling behaviour that compromise, disrupt or damage personal, family or vocational pursuits (Cox, Lesieur, Rosenthal, & Volberg, 1997; Lesieur, 1998). In the Canadian context, problem gambling has been defined as "gambling behaviour that creates negative consequences for the gambler, others in his or her social network, or for the community" (Ferris & Wynne, 2001: 2). Patton and colleagues (2002) note that this definition is comprehensive in that it applies to others affected as well as to the individual gambler and includes a range of harmful consequences that extend beyond an individual's own difficulties with gambling. An Australian definition of problem gambling as "characterized by difficulties in limiting money and/or time spent on gambling which leads to adverse consequences for the gambler, others, or for the community" incorporates both the notion of an underlying condition as well as its consequences (Neal et al., 2005: 125).

There is empirical evidence that the problem gambling construct is made up of at least two underlying factors with some items reflecting a 'gambling behaviour' dimension while other items reflect a 'gambling-related consequences' dimension (Maitland & Adams, 2005; Orford, Sproston, & Erens, 2003; Orford, Wardle, Griffiths, Sproston, & Erens, 2010; Stinchfield, 2003). Gambling **behaviours** relate to gambling participation, such as needing to gamble with larger amounts to get the same excitement or making attempts to cut down, control or stop gambling. Gambling **consequences** arise from problematic gambling participation and include feeling guilty about one's gambling or borrowing money to gamble or pay gambling debts. As several researchers have noted, it is desirable in developing brief screens for problem gambling to ensure that the items provide coverage of the different dimensions of the construct (Gebauer et al., 2010; Volberg & Williams, 2011). The full PGSI is made up of nine items that provide almost equal coverage of the 'behaviour' and 'consequences' dimensions of the construct.

Table 1: Conceptual Coverage of PGSI

PGSI1: Bet more than can really afford to lose	Behaviour
PGSI2: Needed to gamble with larger amounts for same excitement	Behaviour
PGSI3: Gone back to win money lost	Behaviour
PGSI4: Borrowed money or sold anything to get money to gamble	Consequence
PGSI5: Might have a problem with gambling	Behaviour/ Consequence[1]
PGSI6: Gambling has caused health problems	Consequence
PGSI7: People criticize one's gambling	Consequence
PGSI8: Gambling has caused financial problems	Consequence
PGSI9: Feel guilty about one's gambling	Consequence

The new PGSI Short-Form is made up of three items including one question assessing the 'behaviour' dimension (PGSI1) and two questions assessing the 'consequences' dimension (PGSI7 and PGSI9). Data from the 2007 BGPS were analyzed and items for the PGSI Short-Form were identified based on six performance criteria (Orford, 2009). These included a moderate to high rate of endorsement, high item-total correlation, high loading on the first unrotated factor in a factor analysis, high loading on both of the first two rotated factors in a factor analysis,

[1] Although both Ferris and Wynne (2001) and Maitland and Adams (2005, 2007) note that the nine PGSI items can be divided into the domains of gambling behaviour and adverse consequences, they differ in how they classify this item. While Ferris and Wynne view this item as a gambling **behaviour**, Maitland and Adams classify this item as a **consequence**.

good item response characteristics, and a low to moderate male-to-female endorsement ratio. A further consideration was to include items covering a range of content.

The two 'consequences' items included in the new PGSI Short-Form have been the focus of some concern among gambling researchers, with various commentators arguing that **criticism** of a person's gambling is only indirectly indicative of harm to relationships and is too broad to hold a direct link to problem gambling while **guilt** may not be a reliable indicator of problem gambling because it could arise from cultural differences in attitudes towards gambling rather than from a specific level of gambling involvement (Battersby, Thomas, Tolchard, & Esterman, 2002; Productivity Commission, 1999; Strong, Breen, & Lejuez, 2004; Thomas, Jackson, & Blaszczynski, 2003). Rather than representing precise measures of gambling-related consequences, Svetieva and Walker (2008) suggest that endorsement of these two items could vary significantly depending on the moral acceptance of gambling within different cultures.

The Impact of Survey Methodology

Internationally, problem gambling prevalence surveys are most typically conducted as a telephone interview. However, they are also sometimes administered as a face-to-face interview at the person's residence or as a self-administered survey completed online or mailed in. The question of the impact of survey methodology is important in the present context because the ICM Telephone Omnibus Survey, where the new PGSI Short-Form was trialed, is administered by telephone but the British Gambling Prevalence Surveys are administered face-to-face or completed online or as a self-completion booklet.

Method of Survey Administration

Survey research has generally found that **face-to-face interviews** at people's residences tend to elicit more candid/honest responding relative to **telephone interviewing** because this approach fosters better rapport (de Leeuw & van der Zouwen, 1988; Holbrook, Green, & Krosnick, 2003; Tourangeau & Yan, 2007). Similar results have been found in the field of gambling studies. As noted above, when Williams and Volberg (2009, 2010) administered a gambling survey to a random sample of adults from Ontario, with half the sample receiving a face-to-face residential interview and the other half being interviewed by telephone, the obtained rate of problem gambling was 2.18 times higher in the face-to-face survey compared to the telephone survey. One of the mechanisms for this effect was that face-to-face household sampling resulted in higher participation of certain demographic groups that have higher rates of problem gambling (i.e., more students, young people, males, and single people). These demographic groups are traditionally harder to recruit into telephone surveys because they have higher refusal rates when contacted by telephone and many of them do not have landline telephones (only mobile phones).

Sampling biases are not uncommon in survey research. However, this is typically corrected by weighting the obtained sample so that it matches the age-by-gender distributions established by census results (Williams & Volberg, 2011). Even when this was done, the face-to-face problem gambling prevalence rate in Williams and Volberg (2009, 2010) was still 1.44 times higher. This points to a second mechanism for this effect, which is that face-to-face interviewing tends to produce more honest/candid responding. In addition to reporting higher rates of problem gambling, people in the face-to-face interviews reported significantly lower rates of voting; a higher frequency of driving while intoxicated; a higher frequency of illicit drug use; a higher rate of alcohol use; a lower frequency of exercising; a lower frequency of indicating that their preferred vacation destination would be the Arctic; and lower refusal rates for divulging their income (Williams & Volberg, 2009, 2010).

Self-administered surveys are another method of survey administration that tends to produce more valid reports of sensitive behaviour compared to responses given to an interviewer (Tourangeau & Smith, 1996; van der Heijden, Van Gils, Bouts, & Hox, 2000). This is mostly because of the greater anonymity, but also partly because of the additional time the person has to think about and answer questions. There is very little research on this issue specific to gambling. In a pilot study by Rönnberg and colleagues (1999) no significant difference in problem gambling prevalence rates was found among ~3,000 randomly selected Swedish respondents who were either interviewed by telephone or completed a self-administered postal questionnaire. In the subsequent main study, people who could not be contacted by phone were sent a postal questionnaire. The rate of problem gambling was found to be significantly higher in the postal group (1.6% versus 0.5%), although this was at least partly a function of the higher-risk demographic profile of people who completed mail-in surveys. A similar methodology was used in a Norwegian prevalence study by Lund and Nordlund (2003). These investigators also found that people who could not be contacted by telephone but returned postal surveys had higher problem gambling prevalence rates compared to the telephone sample (0.9% vs. 0.5%). However, here again, the telephone versus the mail-in groups also had significantly different demographic profiles.

How the Survey is Described to Potential Participants

Another important methodological variation that is known to have a significant impact on problem gambling prevalence rates concerns how the survey is described to potential participants prior to their decision to opt in or out. Research in other fields has shown that a primary reason for survey nonparticipation is lack of interest in the topic (Groves, Presser, & Dipko, 2004; Tourangeau & Yan, 2007). Thus, it is reasonable to presume that describing the survey as a 'gambling' survey (as is typically done) creates a sampling bias by causing greater participation by gamblers who are interested in this topic and greater refusal by non-gamblers who are not interested.

This is exactly what Williams and Volberg (2009, 2010) found, with the rate of problem gambling approximately 2.27 times higher when the study was described as a 'gambling survey' compared to an identical survey that was described as a study about 'health and recreational activities.' Demographic weighting did very little to correct this problem, as the prevalence rate was still 1.94 times higher after age-by-gender weighting. These findings were obtained with an overall response rate of 42%. The influence of survey description is likely to be lower with higher response rates and higher with lower response rates.

Threshold used before Administering Questions about Problem Gambling

A final important methodological variation that is known to have a significant impact on problem gambling prevalence rates concerns the threshold for administering problem gambling questions. Engaging in any gambling in the past year is a common criterion used to administer questions about problem gambling. However, Williams and Volberg (2009, 2010) found that this criterion results in too many false positives on problem gambling screening instruments (as assessed by subsequent clinical assessment). These false positives can be significantly reduced by (a) using a higher threshold for the designation of problem gambling (i.e., CPGI 5+ versus CPGI 3+); and/or (b) requiring a minimal **frequency** of gambling in the past year (i.e., at least 10 times on some format) before administering problem gambling screens; and/or (c) resolving these cases of inconsistent gambling behaviour by automatically asking people to explain the discrepancy between their problem gambling classification in the absence of significant gambling behaviour, or intensive gambling involvement in the absence of reports of problems.

Best Practices in Problem Gambling Assessment

Williams and Volberg (2011) have recently published a list of best practices in the population assessment of problem gambling. Recommendations in this report specific to the above issues are as follows:

1. Face-to-face residential interviewing is the method best able to achieve representative and valid results. However, sensitive parts of the questionnaire (e.g., problem gambling) are best self-administered. Telephone interviews are the next best method of survey administration. Although increasingly popular, online panels do not appear to be truly representative of the population and should not be used to establish prevalence rates.
2. Knowing the survey topic in advance produces a bias in the people who choose to participate and not participate. Thus, the description of the survey to prospective participants needs to be somewhat ambiguous (e.g., 'health and recreation survey', 'recreational activities'). Alternatively, the gambling survey should be inserted as an additional module in a larger multi-topic study. (Note, however, that if the primary goal

is to identify changes since the last prevalence survey, then the procedures of the previous study should be replicated as closely as possible.)

3. For improved efficiency and to minimize false positives, problem gambling questions should not be asked unless the person indicates they have gambled at least once a month on some form of gambling in the past year.

METHODS

In this section, we outline our approach to assessing the performance of the PGSI Short-Form piloted in Britain. We begin with a discussion of how the data for the three studies were obtained. This is followed by a description of our analytic approach.

The Omnibus Surveys

Trialing of the new PGSI Short-Form was done using the ICM Telephone Omnibus Survey. Although this survey of adults aged 18 and over runs continuously, the Gambling Commission adds questions on a quarterly basis as a supplement to the BGPS that permits more regular monitoring of gambling participation. Important features of the telephone omnibus survey are the use of quota sampling (by age, gender and geographic region), the inclusion of landline households only and the fact that interviews are conducted only at mid-week and on weekends. Efforts to contact sampled telephone numbers are limited to three attempts so that the response rate for the survey is quite low. Since the mix of questions included in the omnibus survey varies from one quarter to another, ordering effects are avoided by always presenting the gambling questions first to respondents. While weighting is used to compensate for bias from non-response and under-coverage of some demographic groups, the selection procedure to obtain sufficient interviews with young adults means that the unweighted Omnibus sample includes a proportionately large number of young adults relative to the population (Gambling Commission, 2010).

The three-item PGSI Short-Form was included in the June, September and December 2009 waves and in the March 2010 wave of the telephone omnibus survey. In each wave, all respondents in the “B” wave of the omnibus survey were administered the PGSI Short-Form items and, if a respondent answered anything other than ‘never’ to any of the PGSI Short-Form items, the remaining PGSI items were asked. Additionally, half of the respondents in the December 2009 “A” wave and all of the respondents in the March 2010 “A” wave of the omnibus survey were administered the full PGSI with the three PGSI Short-Form items asked first (rather than in the validated order of the original PGSI). In all, 11,079 respondents were administered either the PGSI Short-Form and the PGSI or the full PGSI.

The following table presents information about the sample size and administration format for the PGSI Short-Form and PGSI obtained in the different waves of the Omnibus survey.

Table 2: Omnibus Survey Sample

	Sample Size	Percent of Total	Screening Format
2009 (June)	2021	18.2	Mini+PGSI
2009 (Sept)	2032	18.3	Mini+PGSI
2009 (Dec A)	1009	9.1	PGSI
2009 (Dec B)	2007	18.1	Mini+PGSI
2010 (March A)	2006	18.1	PGSI
2010 (March B)	2004	18.1	Mini+PGSI
Total	11,079	100.0	

In contrast to conventional practice, the PGSI Short-Form and PGSI were administered to all respondents in the telephone omnibus surveys regardless of whether they had gambled in the past year. This was done because the gambling participation questions included in the survey were all framed in the past four weeks. There was concern that respondents who had gambled in the past year but not in the past four weeks would be missed and that this would compromise comparability with the British Gambling Prevalence Surveys.

The British Gambling Prevalence Surveys

In contrast to the telephone omnibus survey, the British Gambling Prevalence Surveys (BGPS) carried out in 2007 and 2010 both involved face-to-face administration of an initial household interview. The BGPS 2007 was described to respondents as a 'National Study of Gambling Attitudes and Activities' while the BGPS 2010 was described to respondents as a survey of 'Leisure Time: Lottery and Recreation.' The questionnaire collected detailed information about respondents' gambling behaviour, attitudes toward gambling and gambling-related difficulties. The problem gambling items (including the PGSI and a 10-item DSM-IV screen framed in the past 12 months) were administered to all respondents who had gambled in the past year.

In the 2007 BGPS, a random sample of 10,144 addresses from England, Scotland and Wales were selected from the Postcode Address File (PAF). In the 2010 BGPS, a random sample of 9,975 addresses from England, Scotland and Wales was selected from the Postcode Address File (PAF). In both 2007 and 2010, interviewers visited each address and attempted to gain a face-to-face interview with an adult at that address to collect information about the household. All adults aged 16 and over within co-operating households were asked to complete an individual questionnaire. In 2007, the questionnaire could be filled in online or as a self-completion booklet. In 2010, all adults within co-operating households were asked to complete an individual questionnaire using computer-assisted self interviewing. The overall response rate in

2007 was 52% with questionnaires completed by 9,003 respondents. The overall response rate in 2010 was 47% with questionnaires completed by 7,756 respondents.

To provide comparability with the Omnibus sample, only respondents who had gambled in the past year and had therefore been asked the problem gambling questions are included in the present analysis. Two-thirds of the combined BGPS sample of 16,759 participants had gambled in the past year which gave us 11,341 participants for our analysis.

The Clinically Assessed Sample

The clinically assessed sample was drawn from two separate studies that included all of the most widely used problem gambling screens (SOGS, CPGI, NODS and PPGM) as well as clinical assessments of each respondent's problem gambling status. The experimental Best Practices study was conducted to assess the impact of differences in administration modality and survey description on obtained problem gambling prevalence rates (Williams & Volberg, 2009, 2010). The Best Practices sample was selected in one of two ways. The majority of respondents (71%) were randomly selected from Census Dissemination Areas having a higher than average prevalence of people aged 20 – 29, as this is the age group that generally has the highest rate of problem gambling. The remaining respondents came from a random selection of areas of two-kilometer diameter within the Kitchener, Ontario Census Metropolitan Area. Within each of these circumscribed geographic areas, a comprehensive listing of phone numbers and accompanying addresses was compiled. These listings were randomly assigned to either telephone recruitment or door-to-door recruitment. Within each modality, the sample was then randomly assigned to receive either a 'gambling' or 'health and recreational activities' description of the survey (although the surveys were otherwise identical). Respondents were randomly determined using the 'most recent birthday' method. Only three attempts were made to interview someone in each household due to logistical costs. To keep the sampling procedure as similar as possible to the face-to-face protocol, only three contact attempts were made for households reached by telephone.

The primary objective of the Internet Online Survey was to generate a large sample of Internet gamblers for a broader study of Internet gambling.[2] Participants were recruited at a prominent gambling web-portal. Advertising space was purchased on the web-portal and two different banner links were posted on the website over a 6-month span. The banner links contained the University of Lethbridge logo, along with professionally designed graphics and captions that would appeal to gamblers ("Test your gambling knowledge; take the University of Lethbridge

[2] The study of Internet gambling included two separate surveys: a random digit dial telephone survey and the online self-administered survey. Only the Online respondents were clinically adjudicated (Wood & Williams, 2009).

Survey", and "See how your gambling knowledge, attitudes and behaviour compare to other people"). Clicking the link directed participants to a homepage for the online questionnaire. A 'cookie' was built into the survey so that those who attempted to take the survey multiple times were politely denied access and reminded that they had already completed the survey.

For both the Best Practices and the Internet Online studies, the problem gambling classifications were subjected to a clinical validation procedure once data collection was complete. In gambling research, the way in which clinical validation has traditionally been done is to compare classifications of the assessment instruments against classifications obtained in clinical interviews done by telephone some months later (i.e., Ferris & Wynne, 2001; Ladouceur et al., 2000; Murray et al., 2005). However, a growing body of research suggests that, in general, it is a mistake to use unstructured subjective clinical judgment as a 'gold standard' (Dawes, Faust, & Meehl, 1989; White et al., 2006). While clinicians have superior ability to integrate information and to see connections and inconsistencies, this advantage only results in superior diagnostic accuracy when clinicians are required to follow explicit and rigorous assessment procedures that minimize subjectivity and require attention to all relevant information (e.g., Gambrill, 2006).

Clinical adjudication in both studies followed the same protocol. Two experienced clinicians were independently provided with a detailed written profile of each participant's reported past year gambling behaviour (frequency of each type, spending on each type, total frequency, total spending), answers to each of the 30 unique items that make up the CPGI, SOGS, NODS and PPGM (but no summary scores for any of the scales), answers to questions about lifetime history of problem gambling, help-seeking for gambling problems, third-party beliefs about the person's gambling, lifetime history of other addictions, family history of problem gambling and other addictions, answers to an open-ended question for the small group of people with discrepant answers to questions about time and money expenditures vis-à-vis their classification status, answers to reliability and validity questions as well as scores on these scales, and demographic characteristics. The clinicians based their adjudications on explicit definitions of the constructs of 'at-risk gambling,' 'problem gambling' and 'pathological gambling' (Neal et al., 2005). All cases in which the two clinicians disagreed were reviewed jointly to obtain a consensus decision.

To provide comparability with the Omnibus and BGPS samples, only respondents from English-speaking countries were selected from the Clinically Assessed samples. Additionally, only respondents who had gambled in the past year and had therefore been asked the problem gambling questions were included in the analysis. The final sample from the Clinically Assessed studies thus included 6,330 respondents from the U.S. (52%), Canada (45%), UK (2%) and Australia and New Zealand (1%).

Comparing the Samples

The following table provides information about the group sizes and major demographic characteristics of the three samples in the analysis, including the prevalence of problem gambling based on the PGSI. The table shows that the Omnibus and BGPS samples are nearly twice as large as the Best Practices/Internet Online sample. The table also shows that respondents in the Clinically Assessed sample are substantially more likely to be male than either the Omnibus or BGPS samples. The Clinically Assessed sample is also somewhat younger than the two British samples and substantially less likely to be classified as 'White' or Caucasian compared with the two British samples.

Table 3: Sample Sizes and Demographics

	Omnibus	BGPS	BPIO
Total Sample Size	11,079	11,341	6,330
Male	47.3	48.4	58.3
Female	52.7	51.6	41.7
16/18 – 24	8.2	10.6	10.5
25 – 44	31.5	35.0	29.5
45 – 64	38.4	35.4	46.3
65 and over	21.9	19.0	13.7
White	91.8	94.9	77.8
Black	2.0	1.6	n/a
Asian	4.4	2.0	4.7
Other	1.9	1.6	17.5
Non-problem (PGSI = 0)	95.0	90.2	51.1
Low risk (PGSI = 1-2)	2.8	7.1	24.6
Moderate risk (PGSI = 3-7)	1.3	2.1	18.4
Problem (PGSI = 8+)	0.4	0.6	5.9

The most obvious difference between the three samples is the far higher prevalence of problem gambling in the Clinically Assessed sample. As noted above, the Clinically Assessed sample is drawn from two separate studies, one designed to recruit large numbers of young adults and the other designed to recruit a large sample of Internet gamblers. Both young adults and Internet gamblers have high rates of problem gambling compared with other groups in the population and the recruiting strategies for the two studies contributed, as expected, to a higher prevalence rate of problem gambling in the Clinically Assessed sample.

Analytic Approach

The Omnibus data were transmitted in six separate files while the BGPS data and the Best Practices and Internet Online data were each available in two separate files. The first step in the analysis was to merge the datasets from each study and drop extraneous variables. We also dropped all respondents from the BGPS and Best Practices and Internet Online samples who had not gambled in the past year to better align these samples with the Omnibus sample.

The next step in the analysis consisted of checking the scoring of the PGSI Short-Form in each of the samples. The PGSI includes nine items with four response options that are scored zero for 'never,' 1 for 'sometimes,' 2 for 'most of the time' and 3 for 'almost always.' Since the PGSI Short-Form is made up of three PGSI items with standard response options, scores on the PGSI Short-Form can range from zero to 9. We then examined the distribution of the PGSI Short-Form scores across all three samples to identify the best cutoff scores for separating the samples into groups.

Next, we examined prevalence rates based on the PGSI Short-Form in each merged sample and compared these with prevalence rates derived from the full PGSI. In this and all subsequent analytic steps, unweighted data were used since our interest was in the performance of the screening items and not in generalizing the prevalence rates to one or more populations. In a related analytic step, we examined how scores on the PGSI Short-Form corresponded to the full PGSI typology of non-problem, low risk, moderate risk and problem gamblers. To assess overall performance of the new PGSI Short-Form, we also examined the internal reliability, or consistency, of the new PGSI Short-Form and the item-total correlations of the PGSI Short-Form items in each merged sample.

Finally, we examined the classification accuracy of the new PGSI Short-Form in relation to the full PGSI in all three samples, in relation to the DSM-IV screen used in the BGPS, and in relation to the clinical assessments in the Best Practices and Internet Online study. We used the conventional cutoffs for the full PGSI (3-7 for 'moderate risk gambling' and 8+ for 'problem gambling') as well as a cutoff that best aligns with clinical assessments of problem gambling (5+) in all three samples.[3] In the Best Practices and Internet Online sample, we examined the classification accuracy of the PGSI Short-Form in relation to clinical assessments that included

[3] In a recent peer-reviewed report, Williams and Volberg (2010) discuss the significant improvement in classification accuracy of the PGSI that occurs when a 5+ cutoff is used for the designation of problem gambling.

problem and pathological gamblers as well as in relation to clinical assessments that included at-risk, problem and pathological gamblers. Finally, we examined the classification accuracy of the PGSI Short-Form in relation to a weighted Best Practices and Internet Online sample that artificially reduced the problem gambling prevalence rate to a rate similar to the rates in the Omnibus and BGPS samples. In addition to assessing the classification accuracy of the PGSI Short-Form in the three datasets, we analyzed the classification accuracy of the PGSI Short-Form across gender, age and ethnic groups in each study to appraise the measurement invariance of the PGSI Short-Form across important demographic groups in the population (see Appendix A for these tables).

We chose not to use item-response theory (IRT) modeling of the data to explore the performance of the new PGSI Short-Form. While this is a popular approach in psychometrics, IRT rests on the assumption that problem gambling is a unitary construct with a consistent sequencing of items for all individuals regardless of gender, age, culture/ethnicity and other important sociodemographic variables. However, it is increasingly clear that there are multiple routes to problem gambling, multiple contexts in which it develops, and multiple manifestations of such problems. For example, work problems may precede financial problems for people with higher incomes; interpersonal problems may have more salience than financial problems for Asian gamblers; and female gamblers often have a different profile compared to male gamblers (Maitland & Adams, 2007; Raylu & Oei, 2004). A recent analysis of the DSM-IV criteria for pathological gambling confirmed there to be a different sequential/ hierarchical ordering of items as a function of both age and gender (Strong & Kahler, 2007). While the PGSI has generally been shown to be unifactorial, this is a direct result of the developers' decision to delete all items from the original 45-item pool that did not show strong correspondence to other items in the screen (Ferris & Wynne, 2001). In our view, the best assessment instrument (or screening tool) for problem gambling is not one that requires 'one shoe fit all,' but rather one that is able to capture as much as possible of the different manifestations of the disorder.

RESULTS

In this section, we review the performance of the PGSI PGSI Short-Form in the Omnibus, BGPS and Best Practices/Internet Online (BPIO) samples. We look first at the distribution of scores on the PGSI Short-Form and on the full PGSI in each sample, then at how prevalence rates differ across important demographic groups, and finally at the relationship between the two classifications. After presenting results for each of the three samples, we examine the performance of the PGSI Short-Form in relation to the full PGSI in the Omnibus survey, in relation to the full PGSI and the DSM-IV screen in the BGPS surveys, and in relation to the full PGSI and the clinical assessments in the Best Practices/Internet Online surveys.

Performance of the PGSI Short-Form in the Omnibus Surveys

The first two tables present the distribution of scores on the PGSI Short-Form and on the full PGSI in the full sample of Omnibus respondents. The full sample was included in the analysis because all of the Omnibus respondents were asked the PGSI Short-Form and/or PGSI questions regardless of their status as gamblers or non-gamblers (Gambling Commission, 2011c). Respondents who replied 'Don't Know' or 'Refused' to any item on the PGSI Short-Form or the full PGSI were coded as 'Missing' in the Omnibus data. This resulted in the loss of 59 respondents in the case of the PGSI Short-Form and 67 respondents in the case of the full PGSI.

These tables clearly show that the prevalence of problem gambling based on the full PGSI in the Omnibus sample is identical to the prevalence of scores of 4 or more on the PGSI Short-Form (0.4%). Similarly, the prevalence of moderate risk gambling based on the full PGSI is identical to the prevalence of scores of 2 to 3 on the PGSI Short-Form (1.3%). Prevalence rates of low risk gambling and non-problem gambling based on the full PGSI are also quite similar to the prevalence of scores of 1 or zero on the PGSI Short-Form.

Table 4: PGSI Short-Form Scoring and Prevalence in Omnibus

	Frequency	Score	Prevalence
Zero	10,563	95.8	95.9
1	271	2.5	2.5
2	82	0.7	1.3
3	57	0.5	
4	15	0.1	0.4
5	9	0.1	
6	9	0.1	
7	7	0.1	
9	7	0.1	
Total	11,020	100.0	100.0

Table 5: PGSI Scoring and Prevalence in Omnibus

	Frequency	Score	Prevalence
Zero	10,517	95.4	95.5
1	225	2.1	2.8
2	84	0.8	
3	71	0.6	1.3
4	42	0.4	
5	12	0.1	
6	13	0.1	
7	9	0.1	
8	8	0.1	0.4
9	5	0.0	
10	3	0.0	
11	1	0.0	
12	2	0.0	
13	1	0.0	
14	2	0.0	
15	3	0.0	
16	3	0.0	
17	1	0.0	
20	1	0.0	
21	2	0.0	
22	1	0.0	
25	2	0.0	
27	4	0.0	
Total	11,012	100.0	100.0

In comparing prevalence rates based on the PGSI Short-Form and the full PGSI across important demographic groups in the Omnibus sample, the prevalence of problem gambling based on the full PGSI is very similar to the prevalence of scores of 4 or more on the PGSI Short-Form across all demographic groups, including gender, age and ethnicity, with the exception of respondents classified as 'Other' ethnicity.[4] Across all of the major demographic groups, prevalence rates for low risk gambling (or a score of 1 on the PGSI Short-Form) and moderate risk gambling (or a score of 2 or 3 on the PGSI Short-Form) are consistently higher among respondents who were administered the full PGSI compared with those who were administered the PGSI Short-Form and then the PGSI.

The next table presents capture rates for the PGSI Short-Form in relation to the full PGSI. All of the Omnibus respondents except those with missing responses were included in this analysis. The table shows that, across all of the PGSI Short-Form groups, a small number of respondents

[4] The small size of this group (n=197) suggests that this result could be due to sampling error.

scored higher on the full PGSI although all of the respondents who scored 4 or more on the PGSI Short-Form scored as moderate risk or problem gamblers on the full PGSI. The group with the lowest correspondence to the full PGSI is the group of respondents who scored 2 or 3 on the PGSI Short-Form. While the majority of these respondents scored as moderate risk gamblers on the full PGSI, one-fifth of this group scored as low risk gamblers and a small proportion (4%) scored as problem gamblers on the full PGSI.

Table 6: PGSI Short-Form Classes Compared with PGSI Classes in Omnibus[5]

PGSI Short-Form	0 %	1 %	2-3 %	4+ %
PGSI = 0	99.6	---	---	---
PGSI = 1-2	0.3	91.1	22.5	---
PGSI = 3-7	0.1	8.9	73.9	27.7
PGSI = 8+	---	---	3.6	72.3
Total	10,556	271	138	47

As noted above, all of our analyses are based on unweighted samples since we are interested in the performance of the assessment items rather than in generalizing to one or another population. However, as a check on our results, we examined prevalence rates based on both the PGSI Short-Form and the full PGSI in the weighted Omnibus sample. Differences in the prevalence rates in the weighted and unweighted samples were all quite small. The following table presents these comparisons for the full PGSI.

Table 7: PGSI Groups in Omnibus (Weighted & Unweighted)

	Unweighted %	Weighted %
Non-problem (PGSI = 0)	95.5	95.0
Low risk (PGSI = 1-2)	2.8	3.1
Moderate risk (PGSI = 3-7)	1.3	1.5
Problem (PGSI = 8+)	0.4	0.4

[5] Since 73% of the Omnibus respondents were not administered the full PGSI unless they endorsed one or more items from the PGSI Short-Form, we examined capture rates separately for respondents in the two waves of the survey who were administered the full PGSI. There were two small differences between the two samples of respondents: (1) all of the respondents who scored zero on the PGSI Short-Form but above zero on the PGSI (n=39) were only administered the full PGSI, and (2) all of the respondents (n=5) who scored 2-3 on the PGSI Short-Form but 8 or more on the full PGSI received PGSI Short-Form first and were then administered the full PGSI.

Performance of the PGSI Short-Form in the British Gambling Prevalence Surveys

The next two tables present the distribution of scores on the PGSI Short-Form and on the full PGSI in the BGPS sample. Only respondents who had gambled in the past year were included in the analysis in order to align as closely as possible with the Omnibus sample. These tables show that, as in the Omnibus sample, the prevalence of problem gambling based on the full PGSI in the BGPS sample is identical to the prevalence of scores of 4 or more on the PGSI Short-Form (0.6%). The prevalence of moderate risk gambling based on the full PGSI is slightly higher than the prevalence of scores of 2 to 3 on the PGSI Short-Form (2.1% compared with 1.9%).

Table 8: PGSI Short-Form Scoring and Prevalence in BGPS

	Frequency	Score	Prevalence
Zero	10,641	93.8	93.8
1	425	3.7	3.7
2	131	1.2	1.9
3	76	.7	
4	25	.2	0.6
5	10	.1	
6	11	.1	
7	8	.1	
8	8	.1	
9	6	.1	
Total	11,341	100.0	100.0

Table 9: PGSI Scoring and Prevalence in BGPS

	Frequency	Score	Prevalence
Zero	10,225	90.2	90.2
1	564	5.0	7.1
2	234	2.1	
3	108	1.0	2.1
4	43	.4	
5	41	.4	
6	16	.1	
7	19	.2	
8	16	.1	0.6
9	28	.2	
10	5	.0	
11	5	.0	
12	3	.0	

13	5	.0	
14	1	.0	
15	1	.0	
16	4	.0	
17	4	.0	
20	1	.0	
21	4	.0	
25	1	.0	
27	3	.0	
Total	11,341	100.0	100.0

Comparison of the two foregoing tables also shows that the prevalence of low risk gambling in the BGPS sample (7.1%) is nearly twice the prevalence of scores of 1 on the PGSI Short-Form (3.7%) and the rate of non-problem gambling based on the full PGSI is somewhat lower than the prevalence of scores of zero on the PGSI Short-Form.

In comparing prevalence rates based on the PGSI Short-Form and the full PGSI across important demographic groups in the BGPS sample, the prevalence of problem gambling based on the full PGSI is very similar to the prevalence of scores of 4 or more on the PGSI Short-Form across all demographic groups with the exception of respondents aged 16 – 24 and those classified as 'Asian' ethnicity. Across all of the major demographic groups (gender, age and ethnicity), prevalence rates for low risk gambling compared with scores of 1 and moderate risk gambling compared with scores of 2 or 3 are consistently higher based on the full PGSI compared with the PGSI Short-Form.

The next table presents capture rates for the PGSI Short-Form in relation to the full PGSI in the BGPS sample. The table shows that, across all of the PGSI Short-Form groups, a small number of respondents scored higher on the full PGSI although all of the respondents who scored 4 or more on the PGSI Short-Form scored as moderate risk or problem gamblers on the full PGSI. As in the Omnibus sample, the group with the lowest correspondence to the full PGSI is the group of respondents who scored 2 or 3 on the PGSI Short-Form. While the majority of these respondents scored as moderate risk gamblers on the full PGSI, one-fifth of this group scored as low risk gamblers. A somewhat larger proportion in this sample (13%) compared with the Omnibus sample (4%) scored as problem gamblers on the full PGSI.

Table 10: PGSI Short-Form Classes Compared with PGSI Classes in BGPS

PGSI Short-Form	0 %	1 %	2-3 %	4+ %
PGSI = 0	96.1	---	---	---
PGSI = 1-2	3.7	86.1	20.1	---
PGSI = 3-7	0.2	13.6	67.2	11.5
PGSI = 8+	---	0.2	12.7	88.5
Total	10,641	425	207	68

Performance of the PGSI Short-Form in the Clinically Assessed Sample

The next two tables present the distribution of scores on the PGSI Short-Form and on the full PGSI in the clinically assessed sample from the Best Practices and Internet Online surveys. As with the BGPS, only respondents who had gambled in the past year were included in the analysis. As with the other two samples, these tables show that the prevalence of problem gambling in the Clinically Assessed sample based on the full PGSI (5.9%) is quite similar to the prevalence of scores of 4 or more on the PGSI Short-Form (5.5%).The prevalence of moderate risk gambling based on the full PGSI is, again, quite close to the prevalence of scores of 2 to 3 on the PGSI Short-Form (18.4% compared with 17.7%).

Table 11: PGSI Short-Form Scoring and Prevalence in BPIO

	Frequency	Score	Prevalence
Zero	3,765	59.5	59.5
1	1,097	17.3	17.3
2	769	12.1	17.7
3	350	5.5	
4	147	2.3	5.5
5	70	1.1	
6	52	0.8	
7	41	0.6	
8	12	0.2	
9	26	0.4	
Total	6,330	100.0	100.0

Table 12: PGSI Scoring and Prevalence in BPIO

	Frequency	Score	Prevalence
Zero	3,233	51.1	51.1
1	948	15.0	24.6
2	610	9.6	
3	461	7.3	18.4
4	251	4.0	
5	187	3.0	

6	151	2.4	
7	113	1.8	
8	68	1.1	5.9
9	55	0.9	
10	50	0.8	
11	33	0.5	
12	23	0.4	
13	25	0.4	
14	21	0.3	
15	16	0.3	
16	14	0.2	
17	11	0.2	
18	10	0.2	
19	5	0.1	
20	7	0.1	
21	5	0.1	
22	4	0.1	
23	2	0.0	
24	4	0.1	
25	8	0.1	
26	3	0.0	
27	11	0.2	
Total	6330	100.0	100.0

In contrast to the Omnibus sample but like the BGPS, the prevalence of low risk gambling in the Clinically Assessed sample based on the full PGSI is much higher than the prevalence of scores of 1 on the PGSI Short-Form (24.6% compared with 17.3%) while the prevalence of non-problem gambling based on the full PGSI is much lower than the prevalence of zero scores on the PGSI Short-Form.

In contrast to the Omnibus and BGPS samples, both the PGSI Short-Form and the full PGSI yield higher rates of problem gambling among women and among adults aged 25 – 44 in the Clinically Assessed sample. As in the other two samples, the rate of problem gambling is lower among 'White' respondents compared with those from other ethnic/racial backgrounds. Rates of moderate risk gambling are similar to rates based on scores of 2 or 3 on the PGSI Short-Form across all of the demographic groups. Rates of low risk gambling are substantially higher among all demographic groups compared with rates based on a score of 1 on the PGSI Short-Form.

The next table presents capture rates for the PGSI Short-Form in relation to the full PGSI in the Clinically Assessed sample. This table demonstrates that, across all of the PGSI Short-Form groups, a substantial proportion of respondents score higher on the full PGSI. Approximately one in seven respondents who score zero on the PGSI Short-Form score 1 or more on the PGSI. One-fifth of respondents who score 1 on the PGSI Short-Form score 3 or more on the PGSI. As with the Omnibus and BGPS sample, the group of respondents who score 2 or 3 on the PGSI Short-Form has the lowest correspondence to the full PGSI.

Table 13: PGSI Short-Form Classes Compared with PGSI Classes in BPIO

PGSI Short-Form	0 %	1 %	2-3 %	4+ %
PGSI = 0	85.9	---	---	---
PGSI = 1-2	13.3	80.1	16.0	---
PGSI = 3-7	0.8	19.7	76.2	17.8
PGSI = 8+	---	0.2	7.8	82.2
Total	3,765	1,097	1,119	348

Comparing Classification Accuracy of the PGSI Short-Form Within the Samples

In this section, we assess the classification accuracy of the PGSI Short-Form within each of the three samples. In assessing classification accuracy, we have employed the conventional cutoffs of 3 or more and 8 or more for the PGSI as well as a cutoff of 5 or more that better aligns with the performance of the PGSI in relation to clinical assessments (Williams & Volberg, 2010).

Classification Accuracy in the Omnibus Sample

The next tables present information on the performance of the PGSI Short-Form in relation to the full PGSI in the Omnibus sample. Measures of performance include sensitivity, specificity, positive predictive power, negative predictive power, overall classification accuracy, kappa and the ratio of identified problem gamblers relative to a pre-determined cutoff on the PGSI (see the *Glossary* on Page 41 for definitions of these terms). The first table presents the performance of the PGSI Short-Form using a cutoff score of 3 or more on the full PGSI (to include moderate risk and problem gamblers).

Table 14: Classification Accuracy of PGSI Short-Form in Relation to PGSI 3+ in Omnibus

PGSI SHORT-FORM	1+	**2+**	3+
Sensitivity	95.24	**82.54**	55.56
Specificity	97.41	**99.71**	100.00
Positive Predictive Value (PPV)	39.13	**83.42**	100.00
Negative Predictive Value (NPV)	99.91	**99.70**	99.23
Classification Accuracy	97.38	**99.42**	99.24
Kappa	0.54	**0.83**	0.71
Prevalence Ratio to PGSI 3+	2.43	**0.99**	0.56

The foregoing table shows that a cutoff of 2 or more on the PGSI PGSI Short-Form performs best in relation to a cutoff for the full PGSI that includes moderate risk and problem gamblers. This cutoff for the PGSI Short-Form achieves good sensitivity and specificity and yields the highest rate of classification accuracy, the highest kappa and the best ratio to the PGSI prevalence rate. Based on these results, only a minimal adjustment would be necessary to align a prevalence rate based on the PGSI Short-Form with what would be obtained using the full PGSI.[6]

The next table presents the performance of the PGSI Short-Form using a cutoff of 5 or more on the full PGSI. This is not a standard cutoff for the full PGSI but is based on work assessing the best cutoff to use with the PGSI to achieve the best match between obtained prevalence rates and true prevalence rates, based on clinical adjudication (Williams & Volberg, 2010). This table shows that a cutoff of 3 or more on the PGSI Short-Form performs best in relation to a cutoff of 5 or more on the full PGSI, the level that would perform best in relation to clinical assessments of problem and pathological gambling. This cutoff for the PGSI Short-Form has a high rate of classification accuracy and a substantial kappa. A somewhat greater adjustment is needed to align a prevalence rate based on the PGSI Short-Form with what would be obtained using the full PGSI aligned with clinical adjudication.

Table 15: Classification Accuracy of PGSI Short-Form in Relation to PGSI 5+ in Omnibus

PGSI SHORT-FORM	1+	2+	**3+**	4+
Sensitivity	97.33	92.00	**74.67**	56.00
Specificity	96.46	98.92	**99.55**	99.95
Positive Predictive Value (PPV)	15.87	36.90	**53.33**	87.50
Negative Predictive Value (NPV)	99.98	99.94	**99.83**	99.70
Classification Accuracy	96.47	98.87	**99.38**	99.65
Kappa	0.26	0.52	**0.62**	0.68
Prevalence Ratio to PGSI 5+	6.13	2.49	**1.40**	0.64

Finally, the next table presents the performance of the PGSI Short-Form using a cutoff of 8 or more on the full PGSI (to include only problem gamblers). This table shows that a cutoff of 4 or more on the PGSI Short-Form performs best in relation to a cutoff of 8 or more on the full PGSI. While this cutoff for the PGSI Short-Form has a high rate of classification accuracy and an acceptable kappa, the adjustment needed to align a prevalence rate based on the PGSI Short-

[6] As noted in the Glossary, the Prevalence Ratio is derived by dividing the PGSI Short-Form prevalence rate by the prevalence rate obtained using a specific cutoff from the full PGSI (or some other measure). It is possible to align the PGSI Short-Form with what would be obtained using the full PGSI (or other measure) by multiplying the PGSI Short-Form rate by the Prevalence Ratio. However, the imprecision of the Omnibus surveys due to a low response rate and compounded by the use of only a subset of PGSI items suggests the need for caution in making such adjustments.

Form with what would be obtained using the full PGSI is still somewhat greater than the adjustment required to align the PGSI Short-Form with a PGSI cutoff of 3 or more.

Table 16: Classification Accuracy of PGSI Short-Form in Relation to PGSI 8+ in Omnibus

PGSI SHORT-FORM	1+	2+	3+	**4+**
Sensitivity	100.00	100.00	97.44	**87.18**
Specificity	96.20	98.67	99.41	**99.88**
Positive Predictive Value (PPV)	8.55	21.08	36.89	**72.34**
Negative Predictive Value (NPV)	100.00	100.00	99.99	**99.95**
Classification Accuracy	96.21	98.67	99.40	**99.84**
Kappa	0.15	0.34	0.53	**0.79**
Prevalence Ratio to PGSI 8+	11.69	4.74	2.67	**1.21**

Classification Accuracy in the BGPS

The next tables present information on the performance of the PGSI Short-Form in relation to the full PGSI in the BGPS sample. As with the Omnibus sample, we first present the performance of the PGSI Short-Form using a cutoff of 3 or more on the full PGSI, then the performance of the PGSI Short-Form using a cutoff of 5 or more on the full PGSI that is aligned with the prevalence rate that would be obtained using clinical adjudication, and finally the performance of the PGSI Short-Form using a cutoff of 8 or more on the full PGSI.

The following table shows that a cutoff of 2 or more on the PGSI Short-Form performs best in relation to a cutoff for the full PGSI that includes moderate risk and problem gamblers. As in the Omnibus sample, this cutoff achieves acceptable sensitivity and good specificity and yields the highest rate of classification accuracy, the highest kappa and the best ratio to the PGSI. A somewhat larger adjustment is necessary to align a prevalence rate based on the PGSI Short-Form with what would be obtained using the full PGSI in the BGPS.

Table 17: Classification Accuracy of PGSI Short-Form in Relation to PGSI 3+ in BGPS

PGSI SHORT-FORM	1+	**2+**	3+
Sensitivity	92.14	**73.58**	45.28
Specificity	96.31	**99.63**	100.00
Positive Predictive Power	41.86	**85.09**	100.00
Negative Predictive Power	99.77	**99.24**	98.45
Classification Accuracy	96.19	**98.90**	98.47
Kappa	0.56	**0.78**	0.62
Prevalence Ratio to PGSI 3+	2.20	**0.86**	0.45

The next table shows that a cutoff of 3 or more on the PGSI Short-Form performs well in relation to a cutoff for the full PGSI of 5 or more, the level that aligns best with clinical assessments of problem and pathological gambling. As with the PGSI Short-Form cutoff of 2 or more in relation to the full PGSI cutoff of 3 or more, the cutoff of 3 or more on the PGSI Short-Form achieves the highest rate of classification accuracy, the highest kappa and the best ratio to the PGSI cutoff of 5 or more. The same relatively small adjustment is needed to align a prevalence rate based on the PGSI Short-Form with what would be obtained using clinical adjudication.

Table 18: Classification Accuracy of PGSI Short-Form in Relation to PGSI 5+ in BGPS

PGSI SHORT-FORM	1+	2+	**3+**	4+
Sensitivity	98.80	92.22	**71.26**	40.72
Specificity	95.21	98.92	**99.78**	100.00
Positive Predictive Power	23.57	56.00	**82.64**	100.00
Negative Predictive Power	99.98	99.88	**99.57**	99.12
Classification Accuracy	95.26	98.82	**99.36**	99.13
Kappa	0.37	0.69	**0.76**	0.58
Prevalence Ratio to PGSI 5+	4.19	1.65	**0.86**	.41

Finally, the next table shows that a cutoff of 3 or more on the PGSI Short-Form performs best in relation to a cutoff of 8 or more on the full PGSI. While this cutoff for the PGSI Short-Form in the BGPS has a high rate of classification accuracy and an acceptable kappa, the adjustment needed to align a prevalence rate based on the PGSI Short-Form with what would be obtained using the full PGSI is greater than the adjustment required to align the PGSI Short-Form with a PGSI cutoff of 3 or more or with a PGSI cutoff of 5 or more.

Table 19: Classification Accuracy of PGSI Short-Form in Relation to PGSI 8+ in BGPS

PGSI SHORT-FORM	1+	2+	**3+**	4+
Sensitivity	100.00	98.90	**91.21**	67.03
Specificity	94.59	98.36	**99.46**	99.94
Positive Predictive Value (PPV)	13.00	32.73	**57.64**	89.71
Negative Predictive Value (NPV)	100.00	99.99	**99.93**	99.73
Classification Accuracy	94.63	98.36	**99.39**	99.67
Kappa	0.37	0.69	**0.76**	0.58
Prevalence Ratio to PGSI 8+	7.69	3.02	**1.58**	0.75

In the BGPS, we are also able to assess the classification accuracy of the PGSI Short-Form in relation to the DSM-IV screen that was included in that survey. The following table presents information on the performance of the PGSI Short-Form in relation to the DSM-IV screen included in the BGPS. In this case, we have used a cutoff of 3 or more for the DSM-IV which provides the best alignment with the prevalence rate that would be obtained using clinical adjudication (Williams & Volberg, 2010).

Table 20: Classification Accuracy of PGSI Short-Form in Relation to DSM 3+ in BGPS

PGSI SHORT-FORM	1+	2+	**3+**	4+
Sensitivity	87.39	77.48	**60.36**	43.24
Specificity	94.59	98.28	**99.28**	99.79
Positive Predictive Power	13.80	30.82	**45.27**	66.67
Negative Predictive Power	99.87	99.77	**99.61**	99.44
Classification Accuracy	94.52	98.07	**98.89**	99.23
Kappa	0.23	0.43	**0.51**	0.52
Prevalence Ratio to DSM 3+	6.33	2.51	**1.33**	0.65

This table shows that a cutoff of 3 or more on the PGSI Short-Form performs best in relation to a cutoff of 3 or more on the DSM-IV screen. While the cutoff of 3 or more on the PGSI Short-Form does not achieve the highest rate of classification accuracy or the highest kappa, it does have the best ratio to the DSM-IV cutoff of 3 or more. A somewhat larger adjustment is needed to align a prevalence rate based on the PGSI Short-Form with what would be obtained using the past-year DSM-IV screen used in the BGPS.

Classification Accuracy in the Clinically Assessed Sample

The next tables present information on the performance of the PGSI Short-Form in relation to the full PGSI in the Clinically Assessed sample. The following table shows that, as with the Omnibus and BGPS samples, a cutoff of 2 or more on the PGSI Short-Form performs best in relation to a cutoff for the full PGSI that includes moderate risk and problem gamblers. As with the other two samples, this cutoff achieves acceptable sensitivity and good specificity and yields the highest rate of classification accuracy, the highest kappa and the best ratio to the PGSI. A relatively small adjustment is necessary to align a prevalence rate based on the PGSI Short-Form with what would be obtained using the full PGSI in the Clinically Assessed sample.

Table 21: Classification Accuracy of PGSI Short-Form in Relation to PGSI 3+ in BPIO

PGSI SHORT-FORM	1+	**2+**	3+
Sensitivity	97.92	**83.78**	45.49
Specificity	77.92	**96.26**	100.00
Positive Predictive Value (PPV)	58.78	**87.82**	100.00
Negative Predictive Value (NPV)	99.15	**94.86**	85.09
Classification Accuracy	82.79	**93.23**	86.74
Kappa	0.62	**0.81**	0.56
Prevalence Ratio to PGSI 3+	1.67	**0.95**	0.45

The next table presents the performance of the PGSI PGSI Short-Form using a cutoff of 5 or more on the full PGSI. As in the other two samples, this table shows that a cutoff of 3 or more on the PGSI Short-Form performs best in relation to a cutoff of 5 or more on the full PGSI. This cutoff for the PGSI Short-Form has the highest rate of classification accuracy and kappa. A somewhat greater adjustment is needed to align a prevalence rate based on the PGSI Short-Form with what would be obtained using the full PGSI aligned with clinical adjudication.

Table 22: Classification Accuracy of PGSI Short-Form in Relation to PGSI 5+ in BPIO

PGSI SHORT-FORM	1+	2+	**3+**	4+
Sensitivity	99.88	96.38	**72.10**	41.55
Specificity	68.39	87.79	**98.11**	99.91
Positive Predictive Value (PPV)	32.22	54.29	**85.16**	98.57
Negative Predictive Value (NPV)	99.97	99.37	**95.90**	91.91
Classification Accuracy	72.51	88.92	**94.71**	92.28
Kappa	0.36	0.63	**0.75**	0.55
Prevalence Ratio to PGSI 5+	3.10	1.78	**0.85**	0.42

Finally, the next table shows that a cutoff of 4 or more on the PGSI Short-Form performs best in relation to a cutoff of 8 or more on the full PGSI. This cutoff for the PGSI Short-Form in the Clinically Assessed sample has a high rate of classification accuracy and a good kappa and the adjustment needed to align a prevalence rate based on the PGSI Short-Form with what would be obtained using the full PGSI is quite small.

Table 23: Classification Accuracy of PGSI Short-Form in Relation to PGSI 8+ in BPIO

PGSI SHORT-FORM	1+	2+	3+	**4+**
Sensitivity	100.00	99.47	94.41	**76.27**
Specificity	63.23	81.63	94.22	**98.96**
Positive Predictive Value (PPV)	14.63	25.43	50.72	**82.18**
Negative Predictive Value (NPV)	100.00	99.96	99.63	**98.51**
Classification Accuracy	65.41	82.68	94.23	**97.61**
Kappa	0.17	0.34	0.63	**0.78**
Prevalence Ratio to PGSI 8+	6.84	3.91	1.86	**0.93**

With the Clinically Assessed sample, we are also able to assess the classification accuracy of the PGSI Short-Form in relation to different cutoffs in the clinical assessments. The next table presents information on the performance of the PGSI Short-Form in relation to a cutoff that captures all of the problem and pathological gamblers in the Clinically Assessed sample. This table shows that a cutoff of 3 or more on the PGSI Short-Form performs best in relation to this cutoff in the Clinically Assessed sample, achieving the highest classification accuracy, kappa and alignment with the clinical assessments.

Table 24: Classification Accuracy of PGSI Short-Form in Relation to Clinical Assessment in BPIO (Problem & Pathological)

PGSI SHORT-FORM	1+	2+	**3+**	4+
Sensitivity	96.14	84.68	**57.89**	35.09
Specificity	67.53	85.79	**95.87**	98.98
Positive Predictive Value (PPV)	31.08	47.57	**68.09**	84.03
Negative Predictive Value (NPV)	99.14	97.35	**93.73**	90.92
Classification Accuracy	71.31	85.64	**90.85**	90.54
Kappa	0.34	0.53	**0.57**	0.45
Prevalence Ratio to Clinical Assessments	3.09	1.78	**0.85**	0.42

The next table presents information on the performance of the PGSI Short-Form in relation to a cutoff that includes all of the at-risk gamblers as well as the problem and pathological gamblers in the Clinically Assessed sample. This table shows that a cutoff of 1 or more on the PGSI Short-Form performs best in relation to this cutoff in the Clinically Assessed sample, achieving the highest classification accuracy and kappa as well as the best alignment with the clinical assessments.

Table 25: Classification Accuracy of PGSI Short-Form in Relation to Clinical Assessment in BPIO (At-Risk, Problem & Pathological)

PGSI SHORT-FORM	**1+**	2+	3+
Sensitivity	**74.07**	49.83	25.71
Specificity	**83.11**	95.50	99.23
Positive Predictive Value (PPV)	**76.03**	88.90	96.01
Negative Predictive Value (NPV)	**81.59**	72.47	64.87
Classification Accuracy	**79.32**	76.33	68.37
Kappa	**0.57**	0.48	0.28
Prevalence Ratio to Clinical Assessments	**0.97**	0.56	0.27

Finally, given the substantially higher rate of problem and pathological gambling in the Clinically Assessed sample compared with the Omnibus and BGPS samples, we elected to statistically reduce the prevalence rate to a rate comparable to what was obtained in the BGPS and the Omnibus surveys to assess whether the higher base rate of problem gambling influenced the results of our analysis of the Clinically Assessed sample. The following table compares the classification accuracy of the PGSI Short-Form using a cutoff of 3 or more in the Clinically Assessed sample using the obtained prevalence rate of problem gambling and the artificially reduced prevalence rate. The table shows that the PGSI Short-Form performs slightly better in the Clinically Assessed sample when the prevalence rate is artificially reduced, obtaining better classification accuracy and a higher kappa. The correction to align the PGSI Short-Form prevalence rate with the clinical assessments of problem and pathological gambling remains the same in the two samples.

Table 26: Classification Accuracy of PGSI Short-Form 3+ in Relation to Clinical Assessment in BPIO (Controlled for Prevalence Rate)

	With 13% PG Prevalence	With 1.5% PG Prevalence
Sensitivity	57.89	57.89
Specificity	95.87	99.52
Positive Predictive Value (PPV)	68.09	67.90
Negative Predictive Value (NPV)	93.73	99.26
Classification Accuracy	90.85	98.80
Kappa	0.57	0.62
Prevalence Ratio to Clinical Assessments	0.85	0.85

Note: The second column examines the impact of artificially reducing the PG prevalence from 13% to something comparable to what was obtained in the BGPS and the Omnibus surveys (~1.5%).

Comparing Performance of the PGSI Short-Form Across Three Samples

In this section, we assess the performance of the PGSI Short-Form across all three of the samples. We look first at the internal consistency of the PGSI Short-Form and then at the inter-item correlations and factor loadings. We then compare the best candidates for classification accuracy of the PGSI Short-Form in relation to the full PGSI in each of the samples.

Internal Consistency

Cronbach's alpha is a commonly used test to determine whether items in a questionnaire measure the same construct. Internal consistency is generally deemed excellent if Cronbach's alpha is above .9 and questionable or poor if Cronbach's alpha is below .7. The following table shows that the internal consistency of the PGSI PGSI Short-Form is in the acceptable range in the BGPS and Clinically Assessed samples but questionable in the Omnibus sample.

Table 27: Comparing Cronbach's Alpha of PGSI Short-Form as a Function of Data Set

Omnibus (PGSI Short-Form) (n=11,079)	.603
BGPS 2007 & 2010 (PGSI Short-Form) (n=11,341)	.758
Best Practices/Internet Online (PGSI Short-Form) (n=6,330)	.755

Inter-item Correlations and Factor Analysis

The next table provides further information about the performance of the PGSI Short-Form items in the three samples. The first column presents the proportion of each sample that gave a positive answer to each of the three PGSI Short-Form items. It is clear from this column that endorsement rates are far higher for the Clinically Assessed sample than for either the Omnibus or BGPS samples. This is to be expected, given the purposes of the original Best Practices and Internet Online surveys. The next column presents the correlation between each item and the entire three-item measure. The item-total correlation is useful in assessing whether endorsement of an individual item is consistent with the behaviour of the other items in a measure. A correlation value of less than 0.3 generally indicates that the item does not correlate well with the overall scale. From this column, it is clear that the item-total correlations of the PGSI Short-Form items are all quite good although performance is better in the BGPS and Clinically Assessed samples compared with the Omnibus sample. The final column presents information from a Principal Components Analysis (PCA) of the PGSI Short-Form in the three samples. PCA is useful in assessing whether the items in a measure form a single structure or are unrelated to each other. Based on PCA values in each of the samples, the three items that make up the PGSI Short-Form appear to assess a single factor in each of the surveys. This is not surprising given the development procedures of the original PGSI (Ferris & Wynne, 2001).

Table 28: Comparing PGSI Short-Form Item Characteristics as a Function of Dataset

	Item Endorsement Rate	Item-Total Correlation	Loading on 1st Unrotated Component
Omnibus (n=11,079)			
PGSI1: Bet more than can really afford to lose	2.3	.454	.780
PGSI7: People criticize one's gambling	1.1	.387	.717
PGSI9: Feel guilty about one's gambling	2.4	.430	.755
BGPS 2007 & 2010 (n=11,341)			
PGSI1: Bet more than can really afford to lose	4.2	.831	.804
PGSI7: People criticize one's gambling	2.4	.791	.809
PGSI9: Feel guilty about one's gambling	2.7	.846	.857
Best Practices/Internet Online (n=6,330)			
PGSI1: Bet more than can really afford to lose	23.7	.660	.862
PGSI7: People criticize one's gambling	12.9	.488	.742
PGSI9: Feel guilty about one's gambling	33.6	.646	.854

Classification Accuracy

The next two tables present information provided earlier in the report but allow for direct comparisons across the three samples. The following table presents information about the classification accuracy of the PGSI Short-Form using a cutoff of 2 or more in relation to the full PGSI using a cutoff of 3 or more which captures the groups of moderate and problem gamblers in the three samples. Based on this table, it is clear that the PGSI Short-Form with a cutoff of 2 or more performs best in the Omnibus sample where classification accuracy, kappa and the ratio to the PGSI prevalence rate are highest. A slightly greater adjustment is required to align the PGSI Short-Form prevalence rate and the PGSI prevalence rate in the Clinically Assessed sample and an even larger adjustment is required in the BGPS sample.

Table 29: Comparing Classification Accuracy as a Function of Dataset (PGSI Short-Form 2+ / PGSI 3+)

	Omnibus	BGPS	BPIO
Sensitivity	82.54	73.58	83.78
Specificity	99.71	99.63	96.26
Positive Predictive Value (PPV)	83.42	85.09	87.82
Negative Predictive Value (NPV)	99.70	99.24	94.86
Classification Accuracy	99.42	98.90	93.23
Kappa	0.83	0.78	0.81
Prevalence Ratio to PGSI 3+	0.99	0.86	0.95

The next table presents the classification accuracy of the PGSI Short-Form across the three samples using a cutoff of 3 or more in relation to the full PGSI using a cutoff of 5 or more which best aligns the PGSI with clinically adjudicated problem and pathological gamblers. This table shows that the PGSI Short-Form with a cutoff of 3 or more performs best in the BGPS sample where the ratio to the clinically aligned PGSI prevalence rate is highest. The adjustment in the Best Practices/Internet Online sample is nearly identical to the BGPS adjustment. The adjustment required in the Omnibus sample to align the PGSI Short-Form 3+ result with clinical assessments is higher than the adjustments necessary in the other two studies.

Table 30: Comparing Classification Accuracy as a Function of Dataset (PGSI Short-Form 3+ / PGSI 5+)

	Omnibus	BGPS	BPIO
Sensitivity	74.67	71.26	72.10
Specificity	99.55	99.78	98.11
Positive Predictive Value (PPV)	53.33	82.64	85.16
Negative Predictive Value (NPV)	99.83	99.57	95.90
Classification Accuracy	99.38	99.36	94.71
Kappa	0.62	0.76	0.75
Prevalence Ratio to PGSI 5+	1.40	0.86	0.85

Finally, the next table presents the classification accuracy of the PGSI Short-Form across the three samples using a cutoff of 4 or more in relation to the full PGSI using a cutoff of 8 or more which captures the problem gamblers in all three samples. For comparability, we present the cutoff of 4 or more on the PGSI Short-Form for the BGPS sample. However, as Table 19 on Page 29 shows, the optimal cutoff for the PGSI Short-Form in relation to this PGSI cutoff is 3 or more. This table shows that the PGSI Short-Form with a cutoff of 4 or more performs best in the Clinically Assessed sample where the ratio to the PGSI prevalence rate is highest. The adjustments required in the Omnibus and BGPS samples to align the PGSI Short-Form 4+ result with the full PGSI cutoff of 8 or more are substantially greater than the adjustment necessary in the Clinically Assessed sample.

Table 31: Comparing Classification Accuracy as a Function of Dataset (PGSI Short-Form 4+ / PGSI 8+)

	Omnibus	BGPS	BPIO
Sensitivity	87.18	67.03	76.27
Specificity	99.88	99.94	98.96
Positive Predictive Value (PPV)	72.34	89.71	82.18
Negative Predictive Value (NPV)	99.95	99.73	98.51
Classification Accuracy	99.84	99.67	97.61
Kappa	0.79	0.58	0.78
Prevalence Ratio to PGSI 5+	1.21	0.75	0.93

CONCLUSION AND RECOMMENDATIONS

The goal of this report is to assess the performance and suitability of a new brief screen as a method for tracking problem gambling prevalence rates in the general population. The report begins with a review of the growing number of brief screens for problem gambling that have been developed for use in population surveys. This is followed by a brief consideration of the problem gambling construct and by a discussion of best practices in the population assessment of problem gambling. In the Methods section, key methodological features of the three surveys analyzed in this report are reviewed and our analytic approach is described.

In presenting the results of our analyses, we first provide information about the distribution of scores on the PGSI Short-Form and on the full PGSI in each of the three samples followed by information about the correspondence between scores on the PGSI Short-Form and the PGSI typology. We then present an assessment of the performance and classification accuracy of the PGSI Short-Form within each of the three samples employing both the conventional cutoffs recommended by the developers of the PGSI as well as a different cutoff that aligns more precisely with the performance of the full PGSI in relation to clinical assessments. In the case of the BGPS and our Clinically Assessed samples, we provide additional information about the performance and classification accuracy of the PGSI Short-Form in relation to the DSM-IV (in the BGPS sample) and in relation to an alternative cutoff in the clinical assessments that includes at-risk gamblers as well as problem and pathological gamblers (in the Clinically Assessed sample). We also present information about possible differences in the performance of the PGSI Short-Form relative to the base rate of problem gambling in the population. Finally, we compare the performance and classification accuracy of the PGSI Short-Form across the three samples, giving consideration to internal consistency, item-total correlations and overall classification accuracy in relation to the full PGSI.

De-coupling Gambling Participation and Problem Gambling Measures

In September 2010, the Gambling Commission undertook a formal consultation with stakeholders and experts to review the ways in which gambling prevalence data were being collected. Gambling prevalence data includes information on gambling participation as well as on the overall rate of problem gambling in the British population and these data have been collected primarily through the British Gambling Prevalence Surveys (BGPS). This survey series has been supplemented by inclusion of gambling participation questions in the more frequent Omnibus surveys. In seeking a more regular, flexible method of data collection to that afforded by the BGPS, the Gambling Commission proposed three main options. These included maintaining the status quo, changing to a continuous survey with a similar sampling approach and survey mode as the BGPS to provide more frequent reporting, and moving entirely over to a telephone survey mode (Gambling Commission, 2010).

Several respondents to the consultation raised the possibility of separating the collection of gambling participation and problem gambling data with the former continuing through the Omnibus surveys and the latter via the inclusion of a problem gambling screen in a wider social/health survey (Gambling Commission, 2011a). This approach has a number of potential benefits, including addressing the dichotomy in sample sizes required to accurately measure gambling participation compared with problem gambling prevalence, possibly lowering data collection costs, and permitting other research priorities to be funded. However, the Commission also pointed to some additional considerations, including challenges to the continuity of both the BGPS and the Omnibus series, and the need to maintain maximum comparability in problem gambling measures used across different data collection formats (Gambling Commission, 2011b).

We have been advised that the full PGSI and the DSM-IV screen will be added to the 2012 Health Survey of England (HSE) (n ~ 8,000) and the Scottish Health Survey (SHS) (n ~ 4,000) to provide an updated national measure of problem gambling prevalence. Given the limited space available on such national surveys, it will likely be impossible to include detailed questions about participants' gambling participation in the 2012 HSE and SHS.[7] Based on our Best Practices study, we recommend that the PGSI and DSM-IV questions only be administered to participants who have gambled once a month or more often in the past year. Secondary analysis of the BGPS data from 2007 and 2010 will be needed to determine what the likely impact of such a change would be on the obtained problem gambling prevalence rate. Work will also be needed to assess how the different methodological approaches embodied in the HSE and SHS and the Omnibus telephone surveys affect identified gambling participation rates and prevalence rates of problem gambling.

Is the PGSI Short-Form a Viable Measure of Problem Gambling Prevalence?

The results of our analysis confirm that the PGSI Short-Form is a valid brief problem gambling assessment instrument that performs well across different datasets and different base rates of problem gambling. The main reason for this conclusion is that the cutoff of 3 or more on the PGSI Short-Form provides a reasonable approximation of the 'true' rate of problem and pathological gambling as determined by direct clinical assessment (in the Clinically Assessed sample). The cutoff of 3 or more on the PGSI Short-Form also provides a reasonable

[7] We have been advised that the HSE and SHS will include a single gambling participation question assessing past-year involvement with all of the major forms of gambling followed by the full PGSI and the DSM-IV screen used in the BGPS series.

approximation of the ‘true’ rate of problem and pathological gambling as determined by a cutoff of 5 or more on the full PGSI (in the Clinically Assessed and BGPS samples). As noted, a cutoff of 5 or more on the PGSI has been found to be the best demarcation of problem and pathological gambling in relation to direct clinical assessment (Williams & Volberg, 2010).

Another reason for this conclusion is that the cutoff of 1 or more on the PGSI Short-Form provides an excellent approximation of the ‘true’ rate of at-risk, problem and pathological gambling as determined by direct clinical assessment (in the Clinically Assessed sample). If the Gambling Commission is primarily interested in a reliable measure of gambling ‘harm,’ regular deployment of the PGSI Short-Form with a cutoff of 1 or more would provide an excellent tracking measure of the proportion of the adult population that is negatively affected by their gambling.

The one exception to our conclusion about the utility of the PGSI Short-Form relates to the Omnibus sample where the prevalence rate based on the PGSI Short-Form with a cutoff of 3 or more is 40% higher than the prevalence rate based on a cutoff of 5 or more on the PGSI. This overestimate is due to the imprecision of the PGSI Short-Form in predicting a score on the full PGSI. While the problem of false positives is substantially reduced if the cutoff for the PGSI Short-Form is increased to 4 or more, this increases the number of false negatives and results in little overall improvement in the accuracy of the measure or in its relationship to the prevalence rate derived from the full PGSI in the Omnibus survey.

If the Gambling Commission is primarily interested in a reliable measure of the likely rate of moderate risk and problem gambling in the adult population (i.e., PGSI of 3 or more), regular deployment of the PGSI Short-Form with a cutoff of 2 or more would provide a means to track this rate. However, several researchers have criticized the 3+ cutoff in the PGSI, arguing that it does not align well with clinical assessments and that individuals in the low risk and moderate risk gambling groups (PGSI 1 to 7) should be split differently to better capture the severity gradient of problem gambling and to create distinct subgroups across the spectrum of PGSI scores (Currie, Casey, & Hodgins, 2010; McCready & Adlaf, 2006; Williams & Volberg, 2010).

While the PGSI Short-Form has utility in approximating the true rate of problem gambling in the population, it is not appropriate for clinical assessment or screening. A PGSI Short-Form 3+ cut-off misses too many ‘true’ problem gamblers. A PGSI Short-Form 1+ cut-off could act as screen for problem gambling, as it would identify almost all the ‘true’ problem gamblers. However, it would be a very inefficient screen, as only 31% of people identified would be subsequently confirmed by clinical assessment. The main limitation of the PGSI Short-Form is that it has below-average sensitivity. Consequently, we do not recommend that the PGSI Short-

Form be utilized in clinical settings. We also do not recommend that the PGSI Short-Form be used to identify or track changes in the sociodemographic characteristics of problem gamblers in the population because of its imprecision.

Finally, we recommend that this instrument be dubbed the 'PGSI short-form' or 'mini-PGSI' and not be called a 'screen' which might lead potential users to misunderstand its intended purpose and utility. The purpose of a 'screen' is to cast a wide net to ensure that any and all legitimate problem gamblers are captured, whereas this instrument is intended to be a brief version of the full PGSI which closely approximates the prevalence rate of problem gambling that would be obtained with the full instrument.

Maintaining Continuity in Assessing Problem Gambling Prevalence

The main interest of the Gambling Commission in developing the PGSI Short-Form is to establish a method to assess problem gambling prevalence that will maintain continuity with the BGPS but occur more regularly and at a lower cost. There are two important obstacles to achieving this goal: first, the known impacts that administration modality (telephone vs. face-to-face) and survey topic (gambling vs. health or recreation) have on identified prevalence rates (Williams & Volberg, 2009, 2010), and, second, the added imprecision associated with using only a subset of items from a longer, validated problem gambling screen. An additional concern related to telephone surveys more generally is that telephone survey response rates and sample representativeness continue to decline. These declines will eventually compromise the validity of all of the data obtained from this type of survey. The likelihood is that the Omnibus telephone survey series will increasingly be unrepresentative of the population with implications for the utility of both the gambling participation data and any measure of problem gambling.

Given the differences in modality and survey topic, significant differences in problem gambling prevalence between the BGPS, the Omnibus surveys and the proposed Health Survey of England/Scottish Health Survey are highly likely. However, we have recently completed work that suggests the magnitude of these differences (as a function of modality and survey description) is fairly constant over different time periods. Hence, the conversion factor required to convert a prevalence rate obtained with a certain modality and survey description to a prevalence rate obtained with a different modality and survey description is likely to remain robust over time (Williams, Volberg, & Stevens, 2011).

In considering the utility of the Omnibus survey series, we would argue that it is the change in *Omnibus* rates over time—rather than trying to extrapolate to a 'true' prevalence rate—that represents the best use of this data (see Appendix B for an illustration using the existing

Omnibus data). The best approach going forward, in our view, is to use the HSE/SHS to obtain the most accurate measure of problem gambling prevalence and to use the ongoing Omnibus telephone surveys to measure change in prevalence over time.

Of final note, while a cutoff of 3+ on the PGSI Short-Form is optimal in assessing the 'true' rate of problem gambling (based on the latest research), there is likely value in tracking change in all of the scores on the PGSI Short-Form within the Omnibus series of telephone surveys, including a 4+ cutoff on the PGSI Short-Form that equates most closely with the widely-recognized cutoff of 8 or more on the PGSI.

Recommendations

1. The new brief assessment instrument should be fielded in the Omnibus and potentially other surveys as a relatively low-cost means to monitor problem gambling prevalence.
2. However, the instrument should only be administered to participants who have gambled at least once a month in the past year. This may require adding a single question to the Omnibus survey to determine whether respondents who have gambled in the past 4 weeks have gambled 10 or more times in the past year.
3. The new instrument should not be used to track changes in the sociodemographic characteristics of problem gamblers in the population.
4. The new instrument should be dubbed the 'PGSI short-form' or the 'mini-PGSI.'
5. Additional work is needed to determine if the two 'consequences' items included in the new instrument could be replaced by other PGSI items that provide more concrete assessments of gambling-related harm.[8] We would also recommend looking at level of gambling involvement to obtain a less-stigmatizing measure of gambling-related difficulties.
6. Work is needed to assess how gambling participation rates and problem gambling prevalence rates 'read across' the HSE and SHS and the Omnibus surveys.
7. In fielding the full PGSI in the 2012 HSE and SHS, it will be important to determine how the brief assessment items operate in relation to the full PGSI in that survey.
8. The new instrument is not suitable for use in clinical settings.

[8] Based on the BGPS 2007 data, Orford (2009) recommends DSM-IV items 5 (Escape), 6 (Lying), and 7 (Loss of Control) for a 3-item PGSI Short-Form based on the DSM-IV. For a PGSI Short-Form based on the 19 items that make up both the DSM-IV and the PGSI, he additionally recommends consideration of DSM-IV item 4 (Withdrawal) and PGSI item 5 (Have Problem). Based on work we have done with the Clinically Assessed sample (Volberg & Williams, 2011), we would recommend DSM-IV item 2 (Preoccupation), PGSI item 2 (Needing to gamble with larger amounts to get same excitement), PGSI item 4 (Borrowed money or sold anything to get money to gamble) and a SOGS item (Often gamble more than intended).

GLOSSARY

	Condition		
Test Outcome	True	False	
Positive	True Positive (TP)	False Positive (FP)	Positive Predictive Value
Negative	False Negative (FN)	True Negative (TN)	Negative Predictive Value
	Sensitivity	Specificity	Accuracy

Sensitivity	TP / TP + FN	% of problem gamblers that also receive this designation on the assessment instrument
Specificity	TN / TN + FP	% of non-problem gamblers that also receive this designation on the assessment instrument
Positive Predictive Value (PPV)	TP / TP + FP	% of individuals that are designated as problem gamblers by the assessment instrument that are confirmed as problem gamblers
Negative Predictive Value (NPV)	TN / TN + FN	% of individuals that are designated as non-problem gamblers by the assessment instrument that are confirmed as non-problem gamblers
Classification Accuracy	$\frac{TP + TN}{TP + FP + TN + FN}$	Number of true positives (correctly identified as problem gamblers) + true negatives (correctly identified as non-problem gamblers) divided by the total sample size

Kappa		A quantitative measure of overall agreement after taking chance agreement into account. A kappa of 1 indicates complete agreement while a kappa of zero indicates no agreement beyond what would be expected by chance
Prevalence Ratio to PGSI/Clinical Assessments	$\frac{TP + FP / Sample}{TP + FN / Sample}$	The prevalence rate of problem gambling as determined by the PGSI Short-Form divided by the prevalence rate of problem gambling as determined by clinical or instrument assessment

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APPENDIX A: ADDITIONAL TABLES

Table A1: Classification Accuracy of PGSI Short-Form 3+ in Relation to PGSI 5+ by Gender in Omnibus

	Male (n = 5204)	Female (n = 5814)
Sensitivity	58.59	49.18
Specificity	100.00	100.00
Positive Predictive Value (PPV)	100.00	100.00
Negative Predictive Value (NPV)	98.97	99.46
Classification Accuracy	98.98	99.47
Kappa	0.73	0.66
Prevalence Ratio to PGSI 5+	0.59	0.49

Table A2: Classification Accuracy of PGSI Short-Form 3+ in Relation to PGSI 5+ by Age in Omnibus

	16-24 (n = 908)	25-44 (n = 3470)	45-64 (n = 4228)	65+ (n = 2412)
Sensitivity	48.72	61.54	56.60	44.44
Specificity	100.00	100.00	100.00	100.00
Positive Predictive Value (PPV)	100.00	100.00	100.00	100.00
Negative Predictive Value (NPV)	97.75	99.12	99.45	99.58
Classification Accuracy	97.79	99.14	99.46	99.59
Kappa	0.65	0.76	0.72	0.61
Prevalence Ratio to PGSI 5+	0.49	0.62	0.57	0.44

Table A3: Classification Accuracy of PGSI Short-Form 3+ in Relation to PGSI 5+ by Ethnicity in Omnibus

	White (n = 9771)	Black (n = 210)	Asian (n = 462)	Other (n = 197)
Sensitivity	52.48	55.56	54.55	75.00
Specificity	100.00	100.00	100.00	100.00
Positive Predictive Value (PPV)	100.00	100.00	100.00	100.00
Negative Predictive Value (NPV)	99.31	98.05	97.78	98.95
Classification Accuracy	99.31	98.10	97.84	98.98
Kappa	0.69	0.71	0.70	0.85
Prevalence Ratio to PGSI 5+	0.52	0.56	0.55	0.75

Table A4: Classification Accuracy of PGSI Short-Form 3+ in Relation to PGSI 5+ by Gender in BGPS

	Male (n = 5,492)	Female (n = 5,849)
Sensitivity	70.29	75.86
Specificity	99.68	99.86
Positive Predictive Value (PPV)	85.09	73.33
Negative Predictive Value (NPV)	99.24	99.88
Classification Accuracy	98.94	99.74
Kappa	0.76	0.74
Prevalence Ratio to PGSI 5+	0.83	1.03

Table A5: Classification Accuracy of PGSI Short-Form 3+ in Relation to PGSI 5+ by Age in BGPS

	16-24 (n = 1,197)	25-44 (n = 3,972)	45-64 (n = 4,014)	65+ (n =2,152)
Sensitivity	63.41	74.42	72.97	66.67
Specificity	99.31	99.72	99.85	100.00
Positive Predictive Value (PPV)	76.47	85.33	81.82	100.00
Negative Predictive Value (NPV)	98.71	99.44	99.75	99.95
Classification Accuracy	98.08	99.17	99.60	99.95
Kappa	0.68	0.79	0.77	0.80
Prevalence Ratio to PGSI 5+	0.83	0.87	0.89	0.67

Table A6: Classification Accuracy of PGSI Short-Form 3+ in Relation to PGSI 5+ by Ethnicity in BGPS

	White (n = 10,699)	Black (n = 178)	Asian (n = 226)	Other (n = 175)
Sensitivity	69.70	100.00	70.59	62.50
Specificity	99.77	100.00	99.52	100.00
Positive Predictive Value (PPV)	79.31	100.00	92.31	100.00
Negative Predictive Value (NPV)	99.62	100.00	97.65	98.24
Classification Accuracy	99.40	100.00	97.35	98.29
Kappa	0.74	1.00	0.80	0.79
Prevalence Ratio to PGSI 5+	0.88	1.00	0.76	0.63

Table A7: Classification Accuracy of PGSI Short-Form 3+ in Relation to Clinical Assessment by Gender (Problem & Pathological)

	Male (n = 3770)	Female (n = 2699)
Sensitivity	51.76	67.06
Specificity	96.38	95.16
Positive Predictive Value (PPV)	69.19	66.86
Negative Predictive Value (NPV)	92.71	95.20
Classification Accuracy	90.32	91.59
Kappa	0.54	0.62
Prevalence Ratio to Clinical Assessment	0.75	1.00

Table A8: Classification Accuracy of PGSI Short-Form 3+ in Relation to Clinical Assessment by Age (Problem & Pathological)

	18-24 (n = 676)	25-44 (n = 1899)	45-64 (n = 3003)	65+ (n = 891)
Sensitivity	50.53	61.07	57.96	55.13
Specificity	96.90	95.37	95.73	96.56
Positive Predictive Value (PPV)	72.73	69.51	67.73	60.56
Negative Predictive Value (NPV)	92.30	93.41	93.64	95.73
Classification Accuracy	90.38	90.31	90.68	92.93
Kappa	0.54	0.59	0.57	0.54
Prevalence Ratio to Clinical Assessment	0.69	0.88	0.86	0.91

Table A9: Classification Accuracy of PGSI Short-Form 3+ in Relation to Clinical Assessment by Ethnicity (Problem & Pathological)

	White (n = 4992)	Asian (n = 304)	Other (n = 1132)
Sensitivity	53.51	57.14	68.05
Specificity	96.46	97.18	91.86
Positive Predictive Value (PPV)	65.42	82.05	69.20
Negative Predictive Value (NPV)	94.31	90.94	91.45
Classification Accuracy	91.69	89.80	86.82
Kappa	0.54	0.62	0.60
Prevalence Ratio to Clinical Assessment	0.82	0.70	0.98

APPENDIX B: CHANGES IN PGSI SHORT-FORM PREVALENCE RATES OVER TIME

The following two charts present changes in the prevalence of different scores on the PGSI Short-Form over the six waves of the Omnibus telephone survey. The first chart presents data from each of the six waves while the second chart presents a three-wave rolling average for each of the different scores on the PGSI Short-Form.