Gambling Problems in the General Danish Population:

Survey Evidence

by

Glenn W. Harrison, Lasse J. Jessen, Morten Lau and Don Ross †

June 2016

ABSTRACT.

We compare several popular survey instruments for measuring gambling behavior and gambling propensity to assess if they differ in their classification of individuals in the general adult Danish population. We also examine correlations with standard survey instruments for alcohol use, anxiety, depression and impulsivity. A feature of our design is that nobody was excluded on the basis of their response to a "trigger," "gateway" or "diagnostic item" question about previous gambling history. Our sample consists of 8,405 adult Danes. We administered the Focal Adult Gambling Screen to all subjects and estimate prevalence of gambling problems using sample weights and controlling for sample selection. We find that 95.4% of the population has no detectable risk, 2.9% has an early risk, 0.8% has an intermediate risk, 0.7% has an advanced risk, and 0.2% can be classified as problem gamblers. There is a significant correlation with the scores of other gambling risk instruments and the instruments measuring alcohol use, anxiety, depression and impulsivity. Using sample weights and controlling for sample selection has a significant effect on prevalence rates: we observe a significant decrease in prevalence rates of detectable gambling risk groups, since gambling behavior is positively correlated with the decision to participate in gambling surveys. We also find that imposing a threshold gambling history leads to underestimation of the prevalence of gambling problems.

† Department of Risk Management & Insurance and Center for the Economic Analysis of Risk, Robinson College of Business, Georgia State University, USA (Harrison); Copenhagen Business School, Denmark (Jessen and Lau); Durham University Business School, Durham University, UK (Lau); School of Economics, University of Cape Town, South Africa, and Center for the Economic Analysis of Risk, Robinson College of Business, Georgia State University, USA (Ross). Harrison is also affiliated with the School of Economics, University of Cape Town. E-mail contacts: gharrison@gsu.edu, lj.eco@cbs.dk, mla.eco@cbs.dk, don.ross@uct.ac.za. We are grateful to the Danish Social Science Research Council (Project #12-130950) for financial support.

Table of Contents

Gambling surveys have provided measures of the extent of disordered gambling in the general population, but have proven to be controversial. Several concerns with these surveys derive from the goal of mimicking prevalence estimates obtained from "face to face" assessments by trained clinicians. Indeed, these concerns motivated, in part, the revisions to the Diagnostic and Statistical Manual of Mental Disorders (DSM) between editions III, III-R, IV and 5, to emphasize the criteria for clinically significant distress or impairment. Many of the survey instruments of mental health to come out of the period before DSM 5 reflected those criteria.[1]

It is worthwhile listing the DSM-IV criteria, to get a sense of the type of gambling problems that these survey instruments seek to identify:

1. Have you found yourself thinking about gambling (e.g. reliving past gambling experiences, planning the next time you will play or thinking of ways to get money for gambling)?
2. Have you needed to gamble with more and more money to get the amount of excitement you are looking for?
3. Have you become restless or irritable when trying to cut down or stop gambling?
4. Have you gambled to escape from problems or when you are feeling depressed, anxious or bad about yourself?
5. After losing money gambling, have you returned another day in order to get even?
6. Have you lied to your family, or others, to hide the extent of your gambling?
7. Have you made repeated unsuccessful attempts to control, cut back or stop gambling?
8. Have you been forced to go beyond what is strictly legal, in order to finance gambling or to pay gambling debts?
9. Have you risked or lost a significant relationship, job, educational or career opportunity because of gambling?
10. Have you sought help from others to provide money to relieve a desperate financial situation caused by gambling?

If someone met 5 or more of these 10 criteria they were deemed under the DSM-IV standard to be a "pathological gambler." A pathological gambler was clinically conceptualized as someone one might expect to be seeking help from gambling outcomes, and who might be expected to exhibit some other

[1] As Kessler et al. [2004; p. 123] noted, in explanations of the extensive efforts they undertook to clinically calibrate the instruments used in NCS-R, "The initial reaction to these results among health policy analysts was one of disbelief. The most obvious interpretation was that the lay administered diagnostic interviews [...] were upwardly biased."

psychiatric disorders, such as anxiety, panic attacks, depression, or substance dependence.[2] All gambling survey instruments, as far as we are aware, employ a "screener," "gateway" or "diagnostic stem" question to filter out individuals who have never engaged in gambling behavior beyond some pre-specified threshold. In many cases the filter is whether a respondent has ever lost a certain amount of money in any one day of gambling, and in other cases it is whether they have ever gambled more than a certain number of times in any year.[3]

Before we consider the soundness of the criteria for measuring the prevalence of gambling problems, as opposed to the expected frequency of demand for clinical assistance with such problems, we must address issues of terminology and conceptualization that that have evolved through the various editions of the DSM. The term "pathological gambler" was introduced in DSM-III. There, and in DSM-IV, pathological gambling was classified among "Impulse Control Disorders Not Elsewhere Classified." Other disorders in this category were Compulsive Hair Pulling (Trichotillomania), Intermittent Explosive Disorder, Kleptomania, and Pyromania. By the time of DSM 5, growing evidence of behavioral, etiological, and clinical response similarities between pathological gambling and addictive substance dependencies had been documented in the scientific literature: Ross et al. [2008] survey this evidence. Consequently the disorder that had been referred to as pathological gambling was reclassified in DSM 5 among "Substance-Related and Addictive Disorders." All other disorders in that category are dependencies on addictive substances. At the same time, pathological gambling was re-named "Gambling Disorder." This change partly reflected concerns among clinicians that the retired name was associated

[2] The DSM-IV explicitly excludes someone whose gambling behavior might be better diagnosed as due to a Manic Episode.

[3] For example, the NCS-R has gateway questions that ask if the individual has gambled 11 or more times ever in any one of a wide range of activities *and* ever lost $365 or more in a year; the NESARC has a gateway question that asks if the individual has ever gambled in any organized form 5 times in one year; and the CCHS Cycle 1.2 survey asked, *inter alia*, "In the past 12 months, how often have you bet or spent more money than you wanted on gambling?" and excluded anyone that responded "I am not a gambler."

gratuitously with social stigmatization (Petry et al. [2014; p.494]). The new terminology was also motivated by historical inconsistency in use of the term "pathological gambling" as sometimes contrasted with "problem gambling" (Committee on the Social and Economic Impact of Pathological Gambling [1999]). Sometimes, as in screens for measurement of gambling problems that directly applied the DSM-IV criteria, "problem gambling" was used to refer to the presence of pathological gambling at pre-clinical levels. Often, "problem gambling" was viewed as denoting an early or warning precursor stage to full-blown "pathological gambling". However, a number of other commonly used measurement screens, such as the Canadian Problem Gambling Inventory (CPGI), used the term "problem gambling" to group together all gamblers within the highest severity category. In general, there was no consensus in either the research or the clinical literature as to whether "problem" and "pathological" gambling represented stages along a severity continuum, or described two distinct populations.

In light of this history, we need to stipulate terminology for discussing studies conducted and diagnostic instruments designed before DSM 5 established the new, unified, "gambling disorder" classification. Henceforth, where we refer to the clinical phenomenon *ex cathedra* we will use "gambling disorder", or, equivalently, where sentence construction makes it more stylistically pleasing, "disordered gambling". Where we refer to previous work set in clinical contexts that used either "pathological" or "problem" gambling without distinguishing them or intending that they be distinguished (for example, in screening instruments not directly applying the DSM-IV criteria) we will anachronistically use the terms "gambling disorder" or "disordered gambling". Where we are talking about a context in which problem and pathological gambling have historically been distinguished (e.g. DSM screens) we retain the distinction and use these older terms. Finally, when we talk about harmful consequences of gambling outside the clinical context we use "gambling problems" as a non-technical term of everyday English.

With this background, we consider several critical issues that arise with the DSM-IV criteria. The first is that they place emphasis solely on meeting clinical criteria, in effect predicting whether someone is likely to "present" for treatment or should "present" for treatment. This is certainly not wrong *per se*, but it is only one criterion for deciding whether to regard someone as having a gambling disorder.

A second issue is that these measures could easily skip someone whom one might reasonably view as having a gambling problem. Imagine, for example, a person who builds up a considerable debt from gambling that burdens them for years, but who is not in denial or wanting to get back into the casino in the optimistic hope of winning the money back. A psychiatrist might judge that this person does not suffer from a clinical disorder associated with gambling. However, public policy intended to reduce negative consequences of gambling availability might well want to take this hypothetical person into account.

A third issue is that there could be someone with serious symptoms of 4 of these criteria, but not 5. This is more a criticism of the binary threshold applied to the criteria than of the criteria themselves, and of the fact that the criteria are unweighted. The DSM 5 has removed the 8th criterion to do with illegal activities associated with gambling, and lowered the threshold to 4 of 9 positive responses, but the point we make is a more general one. One might imagine a clinician being able to apply weights to the criteria, even if this might be frowned on by some (e.g., insurance companies covering reimbursable psychiatric expenses).[4]

A fourth issue is the fact that according to the criteria someone has to have *engaged* in gambling in order to have a *potential* gambling problem. It is not self-evident that everyone with the potential for a

[4] There have been evaluations of "subclinical" sets of criteria, which means individuals meeting between 1 and 4 of the DSM-IV criteria other than the threshold defining pathological gambling: see Blanco et al. [2006], for example, who stress gender differences in comorbidities when comparing subclinical and clinical gambling problems.

gambling disorder has necessarily had the opportunity to legally exercise that opportunity. This concern is particularly important for policy evolutions of proposed liberalizations of gambling regulations.

A fifth issue has to do with the gateway question. One of the *possible* DSM-IV criteria for the disorder is that the respondent has lied to family or others to hide the extent of their gambling, but the respondent is assumed not to do this when asked if they gamble in a survey, particularly in response to the gateway question. The possibility that someone might lie in response to the gateway question, to avoid being asked questions about their gambling behavior, is well documented in clinical test-retest interview settings: see Kessler et al. [2004; p.125]. One simply does not know *a priori* if this applies to survey instruments.[5]

A final issue is that clinical criteria can fuel political battles when applied in general population surveys. It is not hard to discern from discussions of revisions to the DSM criteria for pathological gambling and clinically-based instruments that a major concern has been that prevalence estimates cannot be allowed to get "too high," because that would imply a shortage of funding for mental health treatment. Clear (enough) statements of this "tail wags dog" problem can be easily found, and the issue is well known in the research folklore.[6]

Another dimension to this final issue is that the operators in the gambling industry welcome prevalence measures for pathological gambling or gambling disorders that are very low. For instance, the

[5] There exist econometric methods for evaluating "sample selection" issues such as these. Harrison, Lau and Ross [2016] show that correction for sample selection makes a significant difference to inferences drawn from large-scale surveys of gambling disorders of the general population in the United States and Canada.

[6] For example, Regier et al. [1998; p. 110] comment that "Both the scientific and political implications of these high prevalence rates were highlighted by the timing of this release during the national debate on health reform. Major policy questions were raised about the need for mental health services that were implied by these high rates, along with concerns about possible insurance cost-benefit consequences. Some major media commentators identified such high rates as indicating a bottomless pit of possible demand for mental health services." More recently, from Petry et al. [2014; p.497]: "The American Psychiatric Association requires strong empirical data in support of changes to DSM-5 that would substantially increase the base rate of a disorder." But the only motivation then mentioned is the circular argument that reducing the number of threshold criteria would empirically make the base rate increase.

lobbying association The American Gambling Association notes that "Although the vast majority of Americans are able to gamble responsibly, a small percentage of people – approximately 1 percent of the adult population – cannot."[7] These prevalence estimates come from measures of gambling disorders as defined by clinical criteria. The thrust of the industry's comments on responsible gambling is that 99 out of 100 gamblers are just having fun, and should be left alone, and regulators should only worry about the 1-in-a-100 who is not gambling responsibly.

Again, we stress that these concerns arise for a simple reason: the general purpose survey instruments were intended, by design, to mimic and correlate with the screening that would occur in a clinical setting. Whether that setting is a "gold standard" for some mental health screening purposes or not, it simply differs from other reasons for wanting to measure gambling problems. Society may take a broader view of what constitutes a gambling problem, and economists certainly take a broader view.

Our primary objective is to estimate prevalence of gambling problems in a general population and evaluate surveys of gambling problems that did not restrict themselves to clinical criteria for gambling disorders. We want to see how well these measures correlate with traditional clinically-oriented surveys, of course, if for no other reason than to build a bridge to the type of instrument that has dominated the scene. We stress that we do not see any problem in finding low correlations between a non-clinical instrument and a clinical instrument, and indeed this would be informative.

Our secondary objective is to have a "wide screen" for subjects to be recruited to subsequent experiments to evaluate gambling behavior in controlled gambling tasks. Our view is that the "proof of the pudding" for these instruments is whether they can predict, or be reweighted or calibrated to predict, actual gambling problems. In effect, we agree with the thrust of the movement to have psychiatric disorders measured by clinical tests (e.g., Kapur, Phillips and Insel [2012]), but differ in what we regard as

[7] On http://www.americangaming.org/social-responsibility/responsible-gaming, accessed on 9/21/2014.

a test in general. For us as behavioral scientists, any controlled experiment, whether it is the evaluation of a physical tissue specimen in a laboratory setting or the evaluation of gambling choice behavior in a laboratory setting, can potentially serve as an appropriate measure of the presence or extent of gambling problems.

In Section 1 we review several instruments for measuring gambling problems, with an eye to widening the screens beyond *ex post* evaluation of clinical metrics of gambling behavior to consider *ex ante* measures of propensity to gamble and of propensity to experience gambling problems. We also build some bridges to clinically-motivated measures of gambling disorders. In Section 2 we review several instruments for detecting psychiatric disorders that are widely linked to gambling disorders through numerous comorbidity studies. In our case we focus on alcohol abuse, anxiety, depression and impulsiveness.

Our overall survey design is intended to evaluate several methodological questions. One, as noted, is the extent of correlation between different survey instruments of gambling behavior, particularly instruments designed to identify different latent factors relevant to gambling behavior. Another methodological issue is the use of randomization of question order, and in some cases instrument order. Another methodological issue is whether one uses lifetime gambling behavior or the last year's gambling behavior as the time frame for responses. A final methodological issue is the role of the "trigger" or "gateway" question. We discuss this design in Section 3, along with specifics of our sample frame and procedures. Section 4 reviews the survey results, and Section 5 presents implications and conclusions.

1. Survey Instruments for Disordered Gambling

We examine several survey instruments designed to measure gambling problems. We focus on the Focal Adult Gambling Screen (FLAGS) designed by Schellinck et al. [2015a][2015b] to span both

reflective and formative constructs. A reflective construct is an instrument that seeks to reflect the effects and consequences of some latent variable, and a formative construct is an instrument that seeks to detect the presence of the latent variable. In this case the latent variable is "disordered gambling." The idea from psychometrics is that these two types of constructs provide insights into two different types of causal statements. In the one case gambling disorders cause certain behaviors and attributes, and in the other case certain attributes cause gambling disorders to arise. The attributes in each case are the traits and beliefs probed by the survey instruments.

Most of the major surveys of gambling behavior based on clinical criteria rely solely on reflective constructs. There have been surveys of gambling propensity building on formative constructs, most notably Breen and Zuckerman [1999]. They administered their own Gambling Beliefs and Attitudes Survey (GABS) to college students, and then studied their actual gambling behavior in a laboratory card-game. A formal psychometric evaluation of the reflective construct of GABS was undertaken by Strong et al. [2004a], boiling the original 35-item instrument down to a preferred 15-item instrument.[8]

The latest version of FLAGS contains 64 questions designed to measure 10 latent constructs. As applied to machine gambling, these constructs are:

1. **Risky Cognitions: Beliefs (RCB)**, such as irrational or inaccurate beliefs about machine gambling.
2. **Risky Cognitions: Motives (RCM)**, such as risky reasons for gambling (e.g., to pay off bills, to escape problems, for self-esteem or status).
3. **Preoccupation: Desire (POD)**, such as a strong drive to play the machines as much as possible.
4. **Impaired Control: Continue (ICC)**, such as the inability to stop playing slots/machines once started.

[8] The same general psychometric methods can in principle be used to re-tool clinically based instruments to identify a continuum of gambling types rather than just the binary classification into disordered gamblers and others: see Strong et al. [2003][2004b] for an application to the South Oaks Gambling Screen (SOGS), Strong and Kahler [2007] for an application to the Alcohol Use Disorder and Associated Disability Interview Schedule – DSM-IV (AUDADIS-IV), and Sharp et al. [2012] for an application to the PGSI. The efforts for SOGS and AUDADIS-IV did not met with great success, suggesting that more fundamental *ex ante* survey design methods are needed as a complement to *ex post* statistical forensics.

5. **Risky Practices: Earlier (RBE)**, such as less extreme types of risky practices that usually precede more harmful practices (e.g., using bank card to get more money to play).
6. **Risky Practices: Later (RBL)**, such as more extreme or harmful types of risky practices (e.g., using credit to finance play).
7. **Impaired Control: Begin (ICB)**, such as an inability to resist or stop oneself from going to play slots/machines.
8. **Preoccupation: Obsessed (POO)**, such as excessive preoccupation, constantly thinking about slot gambling or finding ways to gamble on machines.
9. **Negative Consequences (NGC)**, such as negative impacts in at least 3 of 14 different areas of life including financial, personal, family, work, health, social.
10. **Persistence (PST)**: such as continuing to gamble, over an extended period, in a risky manner that leads to harms.

Five of these constructs are formative (items 1, 2 5, 6 and 9), and the other five are reflective. The complete list of statements can be found in Appendix A.

We consider two other popular survey instruments for existing gambling problems. One is the 9-item scored component of the 12-item CPGI developed by Ferris and Wynne [2001], and known as the Problem Gambling Severity Index (PGSI). The other is based on the DSM-IV criteria. Both the PGSI and DSM-IV reflectively construct gambling disorders.

Whether a construct should be regarded as formative or reflective is not independent of theory. This issue arises when one considers visceral cravings or urges to gamble. In a proximate sense cravings are formative, in that their occurrence predicts gambling. However, on the current standard general model of addiction (Ross et al. [2008], Redish et al.[2008]), the fact that a person experiences cravings at all is a very strong indicator , probably the most reliable indicator of all, that gambling has become addictive for that person (Redish [2009]). In this *distal* sense, cravings are a reflective construct. Closely related to the cravings construct is that of *preoccupation* with gambling, that is, the extent to which thoughts about gambling tend to crowd out efforts to devote attention to other activities. Our study incorporates two survey instruments aimed at cravings, the Gambling Craving Scale (GACS) developed by Young and Wohl [2009], and the Gambling Urge Screen (GUS) developed by Raylu and Oei [2004a]. We additionally use one instrument aimed at detecting preoccupation, the Gambling Related Cognitions

Scale (GRCS) developed by Raylu and Oei [2004b]. Appendix B explains how each instrument was scored. In most cases the scores follow the standard algorithms, but in some instances the scoring is not obvious.

To evaluate the effects of order we only evaluated one instrument along with FLAGS for any one person, and randomized the order of presentation. Thus one randomly selected subject received FLAGS and then PGSI, another received PGSI then FLAGS, another received FLAGS and then DSM-IV, and another received DSM-IV then FLAGS, *etc.*

In addition, we asked several questions to identify past gambling behavior, since we did not use these as a "trigger" question. Subjects were separately asked, in the lifetime frame, if they had ever lost more than 40 kroner or 500 kroner on gambling in a single day. The lower amount corresponds to the amount of a common state lottery ticket, and the larger amount to a naturally larger denomination that a Dane would likely recall. We also asked these questions for 50% of the sample in the time frame that spanned the last 12 months.

2. Survey Instruments for Other Problems

There is a long history of interest in comorbidities of gambling disorders. Indeed, some research points to virtually *every* measured psychiatric disorder as being correlated with gambling disorder.[9] The implication of much of this research is to focus attention on common causes of several psychiatric

[9] For instance, evaluating data from the NESARC Petry et al. [2005; Table 3, p. 570; model 3] report lower bounds of 95% confidence intervals of Odds Ratio in excess of 1 for alcohol dependence, any drug abuse, any drug dependence, nicotine dependence, major depressive episodes, dysthymic disorders, manic episodes, panic disorders, social phobia, specific phobia, generalized anxiety, and every personality disorder considered (avoidant, dependent, obsessive-compulsive, paranoid, schizoid, histrionic and antisocial). Kessler et al. [2008; Table 2, p.1357] report a similar list from the NCS-R.

disorders. Our evaluation cannot be that exhaustive, but we do consider instruments to measure certain other psychiatric disorders.

These survey instrument are the Beck Anxiety Index (BAI) developed by Beck, Epstein, Brown and Steer [1988] and Beck and Steer [1990], the Beck Depression Inventory (BDI) developed by Beck et al. [1961], and the Barratt Impulsivity Scale (BIS) developed by Patton, Stanford and Barratt [1995]. Because alcohol is often highly correlated with gambling, and of particular concern in Denmark, we implemented the Alcohol Use Disorders Identification Test (AUDIT) of Babor, Higgins-Biddle, Saunders and Monteiro [2001]. We also asked if the individual currently smoked, and if so how many cigarettes per day.

To allow for the effects of recent life events, we asked if the individual had experienced the death of an immediate family member (partner, child, parent or sibling) in the past 12 months, or been hospitalized for a major medical problem during the past 12 months.

3. Survey Design

A. Treatments

We split our sample into 10 treatments:

1. **FLAGS**, PGSI, BIS
2. PGSI, **FLAGS**, BIS
3. **FLAGS**, DSM-IV, BAI, AUDIT
4. DSM-IV, **FLAGS**, BAI, AUDIT
5. **FLAGS**, GACS, AUDIT
6. GACS, **FLAGS**, AUDIT
7. **FLAGS**, GUS, BDI, AUDIT
8. GUS, **FLAGS**, BDI, AUDIT
9. **FLAGS**, GRCS, AUDIT
10. GRCS, **FLAGS**, AUDIT

The only difference between the odd and even treatments here is the order of the gambling instrument, to assess if comparisons of FLAGS with the other instruments are affected by subjects having already completed the more expansive FLAGS.[10]

We further split each treatment equally into cases in which the timeframe for the gambling instruments FLAGS, PGSI and DSM are lifetime or just the past 12 months. This only affects the introductory text to each instrument.

Finally, for 50% of the subjects we randomize within each block, when possible, and otherwise present the questions in the standard order. The software used to implement the survey did not allow randomization within a block unless the responses were all the same, so we could not randomize the order for AUDIT, the BDI, and our few concluding questions.

B. Sample Frame

We contracted with *Analyse Danmark* (http://www.analysedanmark.dk/english) to obtain 10,000 completed survey responses from the adult population of Denmark between 18 and 75 years of age. This sample was to be assigned equally to all treatments. Our completed sample consisted of 8,405, which is 12.8% of the sample frame of 65,592 Danes contacted. Of those contacted that did not complete the survey, 3,331 started but gave up. The cost of these surveys was 272,425 DKK, which was just over $45,400 at the time they were implemented.

The sample was stratified according to sex and age across three regions in Denmark: (i) greater Copenhagen, (ii) Jutland, and (iii) Funen and Zealand. We assigned different weights to the three regions,

[10] We do not randomize the order of the sub-blocks of questions for each of the 10 constructs within FLAGS. There is a natural aggregation of these 10 sub-blocks into three groupings, often used in the field implementation of FLAGS (§1: RCB, RCM and POD, §2: ICC, RBE and RBL, and §3: ICB, POO, NGC and PST), and we do not randomize across those groupings either.

with a 50% weight on the sample from greater Copenhagen and a 25% weight on each sample from the two other regions. This design allows us to recruit subjects for later experiments from a relatively large sample in greater Copenhagen. The respondents in our survey were recruited from two internet-based panels with 165,000 active members.[11] Invitations were sent out by email and the respondents could answer the survey questions on the internet using personal computers, mobile phones or tablets. They were told in the invitation letter that 40 respondents who completed the survey would be randomly chosen to receive a gift card of 500 kroner.[12] Summary statistics for all participants and non-participants are provided in Appendix C.

4. Results

We are interested in answering several questions with these data. First, what is the distribution over the Danish adult population of gambling risk as assessed using the FLAGS instrument? The answer to this question provides the sampling frame for subsequent experimental evaluation of actual gambling behavior by individuals who were recruited into incentivized experiments. We want to evaluate the raw distribution, based on the sample that completed our surveys, since that is the basis that is typically used to assess population gambling risk.

Second, what is the inferred population distribution after correcting for sample weights and sample selection? The correction for sample weights, based on observable differences in the demographic mix of the sample and the population, is familiar in many survey settings, but is not always applied in assessments of gambling risk. The correction for sample selection, based on unobservable differences of

[11] *Analyse Danmark* have a panel of 25,000 active members, and *Userneeds* have a panel of 140,000 members. The two internet panels are regularly updated and member are recruited via the internet (banners, newsgroups, etc.), email, and by phone.

[12] The gift cards were issued by www.gavekortet.dk, an internet based portal for gift cards.

the sampled and non-sampled population, has never been applied in published assessments of gambling risk.

Third, how is the distribution of gambling risks affected by the treatments we considered? Does it matter if FLAGS comes first or second, or if we randomize question order? And how does the lifetime frame affect the distribution of gambling risk?

Fourth, what is the effect on inferences about the distribution of gambling risks of applying a threshold trigger question based on past gambling history? These trigger questions are usually applied *ex ante* the administration of the survey, and some gambling status then assumed for the individual. Our design deliberately avoided such assumptions, allowing us to impose them *ex post* the administration of the survey to study their effect.

Finally, what are the correlates of gambling risk, as assessed by FLAGS? We examine the correlation between different instruments, and when possible the partial correlation holding constant the effect of a third instrument.

A. Disordered Gambling Risk in the Danish Sample

Table 1 shows the distribution of gambling risks in the Danish sample based on the FLAGS instrument. We do not apply here any gambling history threshold, which was in fact asked after the individual had completed all instruments. We find that 79.7% of the sample has no detectable risk for a gambling disorder, 12% has an early risk, 3.9% has an intermediate risk, 3.3% has an advanced risk, and 1.1% is classified as disordered gamblers. Out of 8,405 in the sample, we detect 95 disordered gamblers with this instrument.

Table 1 also shows the distribution of FLAGS risk levels broken down by comparison with the risk levels implied by the DSM and PGSI instruments. It is important in interpreting these comparisons

to appreciate that the intended concepts of "risk" modeled by the PGSI and DSM-based screens on the one hand, and by FLAGS, on the other hand, are not the same. The PGSI and DSM-based screens, relying exclusively on reflective constructs, are intended to assess the risk that a given person is already a disordered gambler and would be diagnosed as such in a full clinical assessment. Due to its mixture of reflective and formative constructs, FLAGS also seeks to evaluate the risk that a person will develop a gambling disorder.

The PGSI and DSM-based screen samples shown in Table 1 are smaller, at 1,671 and 1,757 respectively, than the FLAGS sample, but the former were assigned at random within the complete sample. For the DSM comparison, the biggest difference in classification in percentage terms is for those that FLAGS classifies as disordered gamblers. Although the sample of 12 is small, DSM classifies 5 of these as non-gamblers and 6 as problem gamblers, and only 1 of the 12 is classified by DSM as a pathological gambler. The other DSM mismatch is for those that FLAGS classifies as being at advanced risk: DSM classifies 86% of those 56 individuals as being non-gamblers. The PGSI has a better match with FLAGS for the highest risk level, but a significant difference in classification for those that FLAGS classifies as being at advanced risk. In that case 27.7% and 25.5% of the 47 are classified by PGSI as being non-gamblers or low risk, respectively. Similarly, for those 62 individuals that FLAGS classifies as being an intermediate risk, the PGSI classifies 43.6% (27 individuals) as being non-gamblers.

B. Disordered Gambling Risk in Denmark

We focus next on gambling risk in Denmark and address two questions. Are individual characteristics correlated with gambling risk? What is the inferred distribution of gambling risk in the population after using sample weights and controlling for endogenous sample selection into the survey?

We estimate an Ordered Probit model with and without sample weights and controls for sample selection. Sample weights are constructed from administrative data at Statistics Denmark on the population size of men and women in various age groups and regions in Denmark and correct estimates for overrepresentation of respondents by age, sex and region in the sample relative to the population. We control for endogenous sample selection bias using full information maximum likelihood estimation of the Ordered Probit model, and follow the direct likelihood approach due to Heckman [1976], Hausman and Wise [1979] and Diggle and Kenward [1994]. The statistical model is documented in Appendix D.

Table 2 shows the estimated parameter values that generate the predicted distributions of gambling risk in Table 3. The Ordered Probit models control for treatment variables and demographic characteristics such as sex, age, income and smoking behavior. Indicators for trigger questions and subcontractor are also added as control variables in the models.

In the first model we estimate gambling risk without using sample weights and without controls for sample selection. The four cut points are values along a cumulative standard normal distribution and reflect thresholds for the five FLAGS risk levels. Values below the first cut point indicate no detectable risk, values between the first and second cut point indicate an early risk, values between the second and third cut point indicate an intermediate risk, values between between the third and fourth cut points indicate an advanced risk, and values above the fourth cut point indicate disordered gambling. The cut points on their own reflect the predicted cumulative probabilities for gambling risk levels when all covariates are equal to 0.[13] The predicted probability of having no detectable risk when all covariates are equal to 0 is 79.7% (the value of the cumulative normal distribution at 0.829), the predicted probability

[13] A male non-smoker between 30 and 39 who is silent about his income, who was invited by the main contractor to participate in the survey, who answered "No" to both trigger questions and who was not in one of the three treatment groups with respect lifetime framing, randomization, or where FLAGS was administered first, would be a participant where all included covariates are equal to 0.

of having no or an early detectable risk is 93% (the value of the cumulative normal distribution at the second cut point of 1.479), etc. The coefficients describe the marginal effect of the covariates on the latent index along the cumulative normal distribution, and thus the effect of covariates on gambling risk. For example, the marginal effect of being female is negative and equal to -0.28 (p-value < 0.001), which indicates that women are *less* likely to have a *higher* level of gambling risk. We also confirm the conventional findings that young people are more likely to have a detectable gambling risk than older age groups, and those with low income are more likely to have a detectable gambling risk than people with higher income. The results also show that smokers are more likely to be classified in a detectable risk group than non-smokers. The predicted distribution of gambling risk in the adult Danish population in the first column of Table 3 without using sample weights and controls for sample selection, but controlling for demographic characteristics and treatments, corresponds to the distribution reported in Table 1: 79.7% has no detectable risk, 12% has an early risk, 3.9% has an intermediate risk, 3.3% has an advanced risk, and 1.1% are classified as disordered gamblers.[15]

The second model in Table 2 *with sample weights* shows similar cut points along a cumulative normal distribution and similar marginal effects of the treatment variables and demographic characteristics. However, the estimated coefficients for medium and high income groups are smaller and no longer statistically significant. Adding sample weights *increases* the predicted prevalence of detectable risk as opposed to no detectable risk in the population.[16] The second column in Table 3 shows that

[15] We predict the probability of each gambling risk level for all participants in the survey using estimated coefficients from the Ordered Probit model. The predicted prevalence of *No Risk* is the average value of $\phi(\text{Cut } 1 - x_i\beta)$ for the 8,405 participants, where ϕ is the cumulative standard normal distribution, Cut 1 is the first cut point, and $x_i\beta$ is the latent index for each participant based on the values of covariates x_i and estimated coefficients β. The predicted prevalence of *Early Risk* is the average value of $[\phi(\text{Cut } 2 - x_i\beta) - \phi(\text{Cut } 1 - x_i\beta)]$, etc.

[16] We predict the probability for each gambling risk level for all participants using the estimated coefficients from the Ordered Probit model with sample weights in Table 2 Column 2. The predictions are weighted with the sample weights for the participants.

roughly 76% has no detectable risk, 13.2% has an early risk, 4.2% has an intermediate risk, 4.6% has an advanced risk, and 1.9% are classified as disordered gamblers.[17] We thus observe an increase from 1.1% to 1.9% in the prevalence of gambling disorder when sample weights are added to the model. Men younger than 30 are underrepresented in the sample, and being young and male are both associated with a higher gambling risk. Hence, sample weights lead to higher predicted prevalence of detectable risk.

The third model in Table 2 controls for endogenous sample selection as well as sample weights. We estimate the Ordered Probit model jointly with a Probit model for selection into the survey as a function of age, sex, region, and subcontractor. Estimated coefficients in the selection equation are reported in Panel B of Table 2, and we find a significant association between response rates and age groups: subjects younger than 30 have significantly lower response rates than middle aged subjects between 30 and 39; middle aged subjects have significantly lower response rates than ripe aged subjects between 40 and 49; and subjects older than 50 have significantly higher response rates than ripe aged subjects. We also find a significant positive correlation between the error terms in the main equation and in the selection equation: the estimated correlation coefficient, ϱ, is equal to 0.77 and is significantly different from 0 (p-value < 0.001). This result indicates that people with higher gambling risk are also more likely to participate in the survey, and this selection effect is due to unobservable characteristics that are not captured by the demographic variables in the selection equation and the main equation.

We continue to observe significant marginal effects of being a female and a smoker on gambling risk in the Ordered Probit model when controlling for sample selection. However, we do not find a significant effect on gambling risk of being young or old compared to the omitted age group of

[17] The predictions without sample weights from the first column in Table 3 lie outside the 95% confidence intervals of the predictions with sample weights.

respondents between 30 and 39.[18] Low income continues to be associated with significantly higher gambling risk than other income groups. Figure 1 shows the marginal effect of being female on inferred probabilities for each FLAGS risk level, controlling for sample weights and sample selection. The dots in Figure 1 show the point estimates of the effect, and the shaded bars show the 95% confidence interval, so one can quickly ascertain if the effect is statistically significant. The vertical axis is the change in probability, so a value of +0.02 indicates a change of 2 percentage points. The probability of having no detectable gambling risk is 2 percentage points higher for women than for men, and women are significantly less likely than men to be classified in one of the detectable risk groups. Figure 2 shows the marginal effect on inferred probabilities for each FLAGS risk level of reporting low income compared to those who did not report their income. The probability of having no detectable gambling risk decreases by 1 percentage point for respondents in the low income group compared to the control group that did not report any income, and the probability of having a detectable gambling risk consequently increases for the low income group compared to the control group. We present additional figures in Appendix F that show marginal effects on gambling risk for the remaining demographic characteristics.

We observe a significant increase in the gambling risk thresholds that are given by the cut points along the cumulative standard normal distribution when we use sample weights *and* correct for endogenous sample selection. Since we find that people with higher gambling risk are *more likely* to participate in the survey, we predict lower prevalence of gambling risk in the population in the third column of Table 3.[19] The results show that 95.4% has no detectable risk, 2.9% has an early risk, 0.8% has an intermediate risk, 0.7% has an advanced risk, and only 0.2% are classified as disordered gamblers.

---

[18] The estimated coefficient of being young is equal to 0.068 and has a *p*-value of 0.184, and the estimated coefficient of being older is positive and equal to 0.107 with a *p*-value of 0.142.

[19] We predict the probability for each gambling risk level for all participants using the estimated coefficients from the sample selection model. The predictions are weighted with the sample weights for the participants to infer predictions for the population.

These predicted prevalence rates are significantly lower than those reported in the first column of Table 3 that are uncorrected, and they are significantly lower than the predicted prevalence rates in the second column of Table 3 that are corrected for sample weights.[20]

We can compare our results to previous Danish gambling prevalence studies by Bonke and Borregard [2006][2009] and Ekholm et al. [2012]. These two gambling prevalence studies do not control for sample weights and sample selection bias, and we therefore compare our *uncorrected* prevalence rates of gambling risk with the prevalence rates they report.

The predicted uncorrected prevalence rates of gambling in our study are significantly higher than those reported for Denmark by Bonke and Borregard [2006][2009]. They use the National Opinion Research Center DSM (NODS) screen to estimate prevalence of gambling risk in a sample of 8,153 Adult Danes between 18 and 74 years of age.[21] Their sample frame of 11,737 people was randomly drawn from the Danish Central National Register and stratified according to sex, age, geographical information and marital status. Their survey was conducted mainly by telephone and in some cases by face-to-face interviews, and the overall response rate was 69.5%. Bonke and Borregard [2006][2009] ask the respondents to consider their lifetime (past-year) gambling behavior and identify 0.26% (0.14%) of the sample as being pathological gamblers, 0.42% (0.23%) of the sample as being problem gamblers, and 3.14% (1.85%) as having some gambling risk.[22] All respondents were first asked a trigger question on whether they had ever lost 35 kroner in a single day. They were classified as non-gamblers without

[20] Both the uncorrected predictions and the predictions with sample weights lie outside the 95% confidence intervals of the predictions with sample weights and sample selection correction.

[21] The NODS was developed by Gerstein et al. [1999] and builds on the DSM-IV gambling screen. It is a reflective construct with 17 questions that measure lifetime and past-year prevalence of gambling risk. Bonke and Borregard [2006] compare the NODS instrument with the SOGS in a pre-test with 1,232 subjects and find that the NODS detects a lower prevalence of gambling risk.

[22] Lifetime gambling behavior in the NODS is identified via follow up questions about lifetime experiences if and only if a respondent has answered "Yes" when asked about past-year experiences.

administering the full survey if they answered "No." Bonke and Borregard [2006][2009] report higher prevalence rates of gambling risk for men than for women, lower prevalence rates for respondents older than 45, and lower prevalence rates for respondents in the highest income quartile than in lower quartiles. They find no significant effect of using sample weights calculated for sex, age, region, and marital status on estimated prevalence rates. Despite having access to administrative data for the full sample frame, the estimated coefficients by Bonke and Borregard [2006][2009] are not corrected for endogenous sample selection, hence the actual prevalence rates for the population may be smaller than those they estimate for the sample.

Ekholm et al. [2012] use data from the Danish Health Interview Survey in 2005 and the Danish Health and Morbidity Survey in 2010. The two samples are randomly drawn from the Danish Central National Register and include 10,916 respondents in 2005 and 23,405 respondents in 2010. After the main face-to-face interview the respondents were asked to complete a self-administered questionnaire that, among other things, included two questions that are related to gambling behavior. The so-called lie/bet questionnaire, which consists of two questions from the DSM-IV screen, was used in the survey, and those respondents who answered yes to at least one of the two questions are classified as disordered gamblers.[24] The final sample contains 5,686 respondents in 2005 and 14,670 respondents in 2010. Ekholm et al. [2012] find that the prevalence rate of lifetime (past-year) disordered gambling is 2.6% (0.9%) in 2005, and falls to 2.0% (0.8%) in 2010. Prevalence rates are higher among men than women and decrease with age. They do not report any estimates that use sample weights or correct for

[24] The two questions are: "Have you ever lied to people important to you about how much you gambled?" and "Have you ever felt the need to bet more and more money?" The possible answers were: Yes, in the past 12 months; Yes, previously; No, I never gamble.

endogenous sample selection, but mention that they find no evidence of selection bias in unreported estimates.[25]

C. Effects of Treatments

The effects of treatments on gambling risk levels determined by FLAGS can be gauged by standard measures of association applied to a 5×2 contingency table, but for more informative analysis we use the Ordered Probit statistical model. The statistical model allows us to estimate the size and significance of the effect of a variable on the probability of each gambling risk level. It also allows us to examine the marginal effect of the treatment, controlling for other correlated effects. For some inferential purposes we want to know the total (unconditional) effect, but typically we are interested in the marginal effect. The first column of Table 2 documents the estimation results.

Figure 3 shows the marginal effect of FLAGS being the first survey instrument on the inferred probabilities of different gambling risk levels. We find that when FLAGS is presented first it does increase the likelihood of someone being classified as having a detectable risk, particularly an early risk.[26]

The opposite qualitative effect occurs when we randomize question order within the FLAGS instrument. Figure 4 shows that randomization significantly lowers the likelihood of being classified with a detectable risk, again with the biggest effect on the early risk level.[27]

Perhaps the most surprising treatment effect comes from using a lifetime gambling frame rather than just the past year, shown in Figure 5. Here one might have expected *a priori* to find greater gambling risk, since no one can have revealed fewer indications of gambling problems over their lifetime than they

[25] Ekholm et al. [2012, p. 8] discuss whether differences in response rates between 2005 and 2010 may affect the results. They mention that "non-response adjusted prevalence estimates did not indicate that non-response bias affects the conclusion of the present study (data not shown)."

[26] A Pearson χ^2 test of the hypothesis of no association has a *p*-value less than 0.001.

[27] A Pearson χ^2 test of the hypothesis of no association has a *p*-value less than 0.001.

have over the past year alone. However, we find a significant and large *reduction* in detectable risk using the statistical model.[28] We implement the lifetime gambling frame by asking the respondents to "…think about your lifetime gambling experiences," as opposed to "…think about your gambling experiences in the last year." It is likely that some respondents answered "yes" to a question when they were asked to consider their behavior in the last year and "no" when they were asked to consider their lifetime behavior. For example, respondents were asked to consider the following question "I would like to gamble almost every day" and answer "yes" or "no." It is possible that respondents interpreted the lifetime frame ambiguously, as excluding the very recent past (and in particular the past year). Thus someone who recently has developed a gambling problem might answer "yes" when the question is framed over the past year and answer "no" when the question is framed over the lifetime. It is also possible that a serious, episodic gambling experience is recalled when asked to reflect on the previous year, but not when asked to reflect over a lifetime. Predicted gambling prevalence rates could therefore be lower when respondents are asked to consider their lifetime behavior instead of their most recent behavior.

D. Effects of Trigger Questions Based on Gambling History

Our design allows an immediate data-only comparison of the effects of using trigger questions based on gambling *history* to make inferences about *future* gambling risk. The usual tabulations do not do justice to the careful language used in scoring FLAGS when gambling history is used. An individual is classified as a Non-Gambler in FLAGS if the threshold gambling history is applied, with this explanation of that category:

[28] A Pearson χ^2 test of the hypothesis of no association has a p-value less than 0.001. This is a two-sided test, but the direction of the effect is in the opposite of the alternative hypothesis that lifetime risks can be no smaller than recent risks.

> FLAGS instrument categorizes a person's risk based on their perceptions about and behaviors associated with gambling. It cannot therefore categorize a person's risk if they do not have gambling experience within the last year. There is a long list of correlates that have been shown to be associated with risk of problem gambling that we have left out of FLAGS that if possessed by an individual could indicate risk for problem gambling should they start to gamble. It was decided that in order to keep the instrument to a reasonable size its constructs would only be gambling specific; from the point of view of FLAGS these risk factors are therefore latent or unobservable. (Schellinck et al. [2011])

This is saying that one *could* develop a different instrument if the intention was to ignore gambling history as a determining factor of future gambling risk, as we do here. On the other hand, FLAGS contains many more formative constructs for detecting latent risk than the popular alternative instruments (DSM and PGSI) for detecting future gambling risk. Thus the above statement is exactly correct, and well-stated in terms of latent and unobservable tendencies. But we know how readers of measures of disordered gambling prevalence will often slide over this statement, particularly if they are conditioned by other reflective-construct instruments to just assume outright that historical non-gamblers must have no clinical risk of "presenting."

The same qualifications apply to the lowest FLAGS "risk" level, "No Detectable Risk." This is defined as follows:

> Those at No Detectable Risk do not flag on any of the risk indicators although it is possible that they answered yes to one or more statements making up some of the constructs. For those who answered yes to at least one statement there was insufficient certainty for us to say there was an indication on one of the dimensions. These people may still have unobservable or latent characteristics that would make them susceptible to becoming a problem gambler should the right conditions exist. (Schellinck et al. [2011])

Again, the emphasis is on latent tendencies to exhibit gambling risk, which we seek to measure.

The tabulations we present below are unfair to these nuanced statements, and follow the standard approach by just assuming that historical non-gamblers are not at future risk. In effect, in terms of FLAGS categories, we assume that individuals that *should* be classified as non-gamblers are in fact classified as having no detectable risk.

With these qualifications, Table 4 and Figure 6 shows the dramatic effects of imposing a threshold gambling history on the classification of gambling risk. With the 500 kroner and 40 kroner threshold applied, we overstate the fraction of Danes that have no detectable risk, and understate those that have detectable gambling risk levels. Hence the standard practice in surveys of using these thresholds leads to an underestimate of the prevalence of gambling problems in the general population. The bottom panel of Figure 5 rescales just on the detectable gambling risks, to provide more information on these effects.

Table 4 shows that 95% of the sample had *not* lost 500 kroner in gambling in one day, and that 18.1% (= 100% - 81.9% = 11.5% + 3.5% + 2.3% + 0.6%) of those 7,991 had *some* detectable risk. Certainly those that had lost 500 kroner from gambling had a higher likelihood of exhibiting some gambling risk according to FLAGS, as one would expect. But the crucial point is that it is not the case that individuals with *no* historical gambling losses of 500 kroner can be safely assigned to have no risk, nor can those individuals *with* these losses be assumed to have some detectable risk. We stress again that the FLAGS classifications, when read in full, are clear on this point. Out of the complete sample, 46 individuals are deemed by the FLAGS instrument to be problem gamblers, but did *not* say that they had lost 500 kroner in the past year. In terms of numbers, this is almost exactly the same number of individuals (49) deemed to be disordered gamblers but who *did* say that they had lost 500 kroner.

The 40 kroner threshold has a predictably smaller effect, since many Danes would have met this threshold compared to the 500 kroner threshold. In fact, 3,206 of the sample say that they had lost 40 kroner, compared to only 414 saying that they had lost 500 kroner. The fraction is less than a majority in the sample: 38% in fact.

Figure 7 and 8 show the effect of the thresholds for the classification of risk levels using the DSM and PGSI instruments, respectively. Since the DSM instrument assigns so many people to the

lowest risk non-gambler category, and is very conservative compared to FLAGS about assigning any higher risk, there is a smaller effect than with FLAGS. This could be mitigated if one adopted a more "continuous" scoring of the DSM, as proposed in the British Gambling Prevalence Study of 2007 (p. 135) and 2010 (p. 154). The PGSI instrument shows more effect from the threshold.

E. Correlates of Disordered Gambling Risk

Figure 9 shows the unconditional correlations of the FLAGS gambling risk levels with the levels of other gambling risk instruments (DSM and PGSI), related instruments measuring formative gambling risk (GACS, GRCS and GUS), an instrument measuring alcohol use (AUDIT), and instruments measuring anxiety, depression and impulsiveness (BAI, BDI and BIS, respectively). All correlations are statistically significantly different than zero at *p*-values less than 0.001, except the correlation with the BIS which has a *p*-value of 0.094.

In terms of the popular instruments for gambling risk, FLAGS is more correlated with PGSI than DSM, although both have positive and large correlation coefficients. The correlation of FLAGS with GACS and GUS, respectively, is very high, but the correlation with GRCS is quite low. The correlation coefficient between FLAGS and the substance abuse instrument for alcohol is very low, as are the pairwise correlation coefficients with the measures of anxiety, depression and impulsiveness.

We find a different pattern of correlation when we examine each of the instruments in the context of our statistical model of the determinants of FLAGS gambling risk levels. This model controls for all the observable demographics and treatments considered earlier: we just add the score or level of the instrument being studied and re-estimate. In each case the detailed impact varies with the FLAGS risk level, but the pattern is by now familiar from other marginal effects considered. The impact on the "no

detectable risk" level is the opposite sign as the impact on the 4 detectable risk levels, and the largest impact on a detectable risk is for early risk.

Detailed results for these marginal effects from the statistical model are shown in Appendix F. In summary, they show the predicted effects in terms of direction: someone that scores more highly on DSM or PGSI also scores more highly on FLAGS. They also show much higher connections between the formative constructs and personality instruments for anxiety, depression and impulsiveness than the unconditional correlations discussed above, and there is now a positive association between gambling risk and the measure of impulsivity.

5. Summary and Conclusions

We compare several popular survey instruments of gambling behavior and gambling propensity to assess whether they differ in their classification of individuals in the general adult Danish population. We also examine correlations with standard survey instruments for alcohol use, anxiety, depression and impulsivity. A feature of our design is that nobody was excluded on the basis of their response to a "trigger," "gateway" or "diagnostic item" question about previous gambling history.

We find that 79.7% of the realized sample has no detectable risk for disordered gambling as measured by the FLAGS, 12% has an early risk, 3.9% has an intermediate risk, 3.3% has an advanced risk, and 1.1% of the sample is classified as suffering from gambling disorder. Using sample weights and controlling for sample selection has a significant *negative* effect on prevalence rates, and the corrected estimates of gambling risk show that more than 95.7% of the population has no detectable risk, 2.7% has an early risk, 0.8% has an intermediate risk, 0.6% has an advanced risk, and only 0.2% is classified as a problem gambler. There are significant (unconditional and conditional) correlations of the FLAGS gambling risk levels with the levels of other gambling risk instruments (DSM and PGSI), related

instruments measuring extent of gambling cravings and preoccupation with gambling (GACS, GRCS and GUS), an instrument measuring alcohol dependence and abuse (AUDIT), and instruments measuring anxiety, depression and impulsivity (BAI, BDI and BIS). All correlations are positive and statistically significantly different than zero: for example, someone that scores more highly on DSM or PGSI also scores more highly on FLAGS.

In interpreting the relationships among the gambling screens, attention must be given to the different methodologies that informed the designs of the instruments. The correlation reported above is telling us more than that the instruments are tracking, with somewhat different measures, the same underlying phenomena. The FLAGS was designed, through its mixture of reflective and formative constructs, to measure the risk that a given person will develop a gambling disorder, whereas the other screens are intended to measure the risk that applicability of a given cluster of reflective constructs indicates a *current* gambling disorder. It is hardly surprising that risk conceived in these two ways should be correlated. Equally, however, given the fact that the conceptions are different, it would be surprising and indeed somewhat troubling if the approaches yielded almost identical results. The relationship between observable formation of gambling disorders and frequency estimation of already existing disorders is directly relevant to design of public health intervention policies, which to date has not been pursued in the research literature.

We administered two "trigger" questions based on past gambling history that asked subjects if they had ever lost more than 40 kroner or 500 kroner on gambling in a single day. These questions are common in gambling prevalence studies, and those survey instruments only administered if the answer is affirmative. We find significant effects of imposing a threshold gambling history on the classification of gambling risk. When 500 kroner and 40 kroner loss thresholds are imposed as filters, the consequence is a significant understatement of the fraction of Danes with detectable gambling risk levels. Hence the

standard practice in surveys of using these thresholds leads to an underestimate of the prevalence of gambling problems in the general population.

Taken together, these results remind us that qualitative effects of using sample weights and correcting for sample selection bias are inherently unpredictable *a priori*, reinforcing the importance of eliciting responses using methods that allow such bias to be corrected. There may often be correlations between subjects' motivation to furnish full information, from which they can opt out by answering "no" to a trigger or gateway question, and the dependent variable of interest. It might be conjectured on an intuitive basis that such correlation would always underestimate prevalence because disordered gamblers might prefer to conceal their condition. However, there is also anecdotal evidence, including some from our own experience in other populations, that disordered gamblers are more interested in focusing attention on gambling than are people for whom gambling is an activity of casual and slight importance. However, among such people are the disordered gamblers of the future. To the extent that their risk can be detected before they themselves, or their families or associates, become aware of it, public health policies could have enhanced beneficial impact.

Table 1: Sample Tabulations of FLAGS Risk Levels

(A) FLAGS Risk Level	N	Percent
No Detectable Risk	6,698	79.7%
Early Risk	1,010	12.0%
Intermediate Risk	328	3.9%
Advanced Risk	274	3.3%
Problem Gambler	95	1.1%
Total	8,405	100%

			DSM Risk Level		
(B) FLAGS Risk Level	N	Percent	Non-Gambler	Problem Gambler	Pathological Gambler
No Detectable Risk	1,360	81.4%	1,353	7	0
Early Risk	177	10.6%	174	3	0
Intermediate Risk	66	3.9%	64	2	0
Advanced Risk	56	3.4%	48	7	1
Problem Gambler	12	0.7%	5	6	1
Total	1,671	100%	1,644	25	2

			PGSI Risk Level			
(C) FLAGS Risk Level	N	Percent	Non-Gambler	Low Risk	Moderate Risk	Problem Gambler
No Detectable Risk	1,399	79.6%	1,291	93	14	1
Early Risk	229	13.0%	161	53	15	0
Intermediate Risk	62	3.5%	27	25	10	0
Advanced Risk	47	2.7%	13	12	19	3
Problem Gambler	20	1.1%	0	0	2	18
Total	1,757	100%	1,492	183	60	22

Table 2: Ordered Probit With and Without Sample Selection Correction

	(1) No Sample Weights			(2) Sample Weights			(3) Sample Weights and Sample Selection Correction		
	Coef.	Std. Err.	*p*-value	Coef.	Std. Err.	*p*-value	Coef.	Std. Err.	*p*-value
A. FLAGS Level									
Lifetime	-0.208	0.033	0.000	-0.208	0.044	0.000	-0.172	0.037	0.000
Randomized	-0.098	0.031	0.002	-0.129	0.044	0.004	-0.090	0.031	0.003
FLAGS first	0.162	0.032	0.000	0.125	0.044	0.004	0.134	0.029	0.000
Female	-0.280	0.036	0.000	-0.311	0.045	0.000	-0.200	0.043	0.000
Young	0.194	0.057	0.001	0.257	0.076	0.001	0.068	0.051	0.184
Ripe Aged	-0.237	0.052	0.000	-0.206	0.060	0.001	-0.107	0.055	0.051
Older	-0.358	0.047	0.000	-0.292	0.054	0.000	0.107	0.073	0.142
Low Inc.	0.108	0.049	0.028	0.168	0.066	0.011	0.103	0.047	0.029
Medium Inc.	-0.089	0.051	0.084	-0.007	0.068	0.921	-0.034	0.050	0.498
High Inc.	-0.134	0.063	0.034	-0.054	0.086	0.526	-0.060	0.059	0.309
Very High Inc.	-0.042	0.107	0.693	-0.082	0.130	0.529	-0.033	0.098	0.739
40 DKK Trigger	0.671	0.035	0.000	0.655	0.050	0.000	0.513	0.049	0.000
500 DKK Trigger	1.032	0.059	0.000	1.007	0.077	0.000	0.786	0.080	0.000
Smoker	0.169	0.038	0.000	0.151	0.048	0.002	0.108	0.036	0.003
Subcontractor	0.015	0.033	0.640	0.085	0.046	0.066	0.021	0.033	0.521
Cut 1	0.829	0.075	0.000	0.892	0.097	0.000	2.021	0.129	0.000
Cut 2	1.479	0.076	0.000	1.541	0.100	0.000	2.501	0.104	0.000
Cut 3	1.868	0.078	0.000	1.880	0.104	0.000	2.782	0.093	0.000
Cut 4	2.571	0.086	0.000	2.598	0.128	0.000	3.354	0.094	0.000
B. Selection									
Constant							-1.348	0.025	0.000
Female							0.002	0.016	0.906
Young							-0.135	0.025	0.000
Ripe Aged							0.115	0.022	0.000
Older							0.606	0.021	0.000
Subcontractor							-0.002	0.016	0.911
Midtjyylland							-0.023	0.021	0.267
Nordjyland							-0.037	0.030	0.219
Sjælland							-0.038	0.023	0.107
Syddanmark							-0.018	0.021	0.391
ϱ							0.766	0.075	

Note: We estimate an Ordered Probit model in (1), an Ordered Probit model with sample weights in (2), and an Ordered Probit model with sample weights and sample selection correction in (3). The omitted age category is *Middle Aged* (those between 30 and 39 years of age); the omitted income category is *Silent About Income* (those who did not report annual income); and the omitted region is *Hovedstaden* (those living in the Greater Copenhagen area). The four cut points refer to the thresholds along the cumulative standard normal distribution that distinguish the five ordered outcomes of gambling risk. The first cut point refers to the probability threshold between no detectable risk and early risk, the second cut point refers to the probability threshold between early risk and intermediate risk, and so on.

Table 3: Predicted FLAGS Level

	(1) No Sample Weights		(2) Sample Weights		(3) Sample Weights and Sample Selection Correction	
	Prediction	95% Confidence Interval	Prediction	95% Confidence Interval	Prediction	95% Confidence Interval
No Risk	79.7%	(78.9%, 80.5%)	76.0%	(74.9%, 77.2%)	95.4%	(93.8%, 97.0%)
Early Risk	12.0%	(11.3%, 12.7%)	13.2%	(12.3%, 14.2%)	2.9%	(1.8%, 3.9%)
Intermediate Risk	3.9%	(3.5%, 4.3%)	4.2%	(3.6%, 4.8%)	0.8%	(0.5%, 1.1%)
Advanced Risk	3.3%	(2.9%, 3.6%)	4.6%	(3.9%, 5.3%)	0.7%	(0.5%, 0.9%)
Problem Gambler	1.1%	(0.9%, 1.3%)	1.9%	(1.3%, 2.4%)	0.2%	(0.1%, 0.3%)

Note: The predicted distributions of gambling risk are based on the estimated parameters that are reported in the corresponding column in Table 2. Standard errors of the predicted gambling risk distribution and details on the estimation are reported in Appendix E. All predictions are made for the 8,405 participants, in column (1) unweighted and in columns (2) and (3) weighted with the sample weights for the participants.

Figure 1: Marginal Effect of Being Female
on Probability of FLAGS Gambling Risk Level
Ordered Probit Model with sample weights and sample selection correction
Point estimate of effect and 95% confidence interval

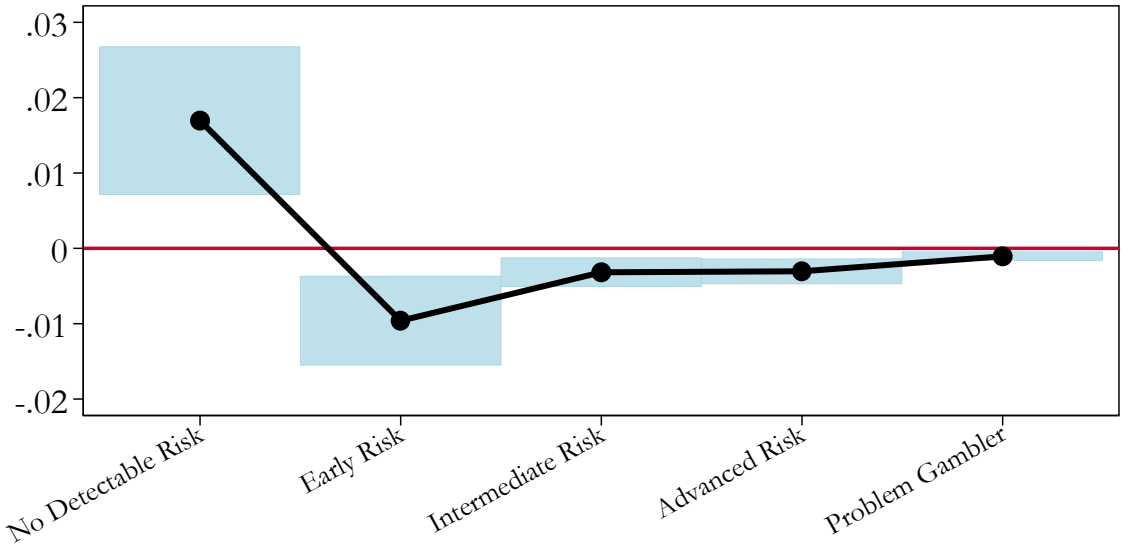


Figure 2: Marginal Effect of Having Low Income
on Probability of FLAGS Gambling Risk Level

Ordered Probit Model with sample weights and sample selection correction
Point estimate of effect and 95% confidence interval

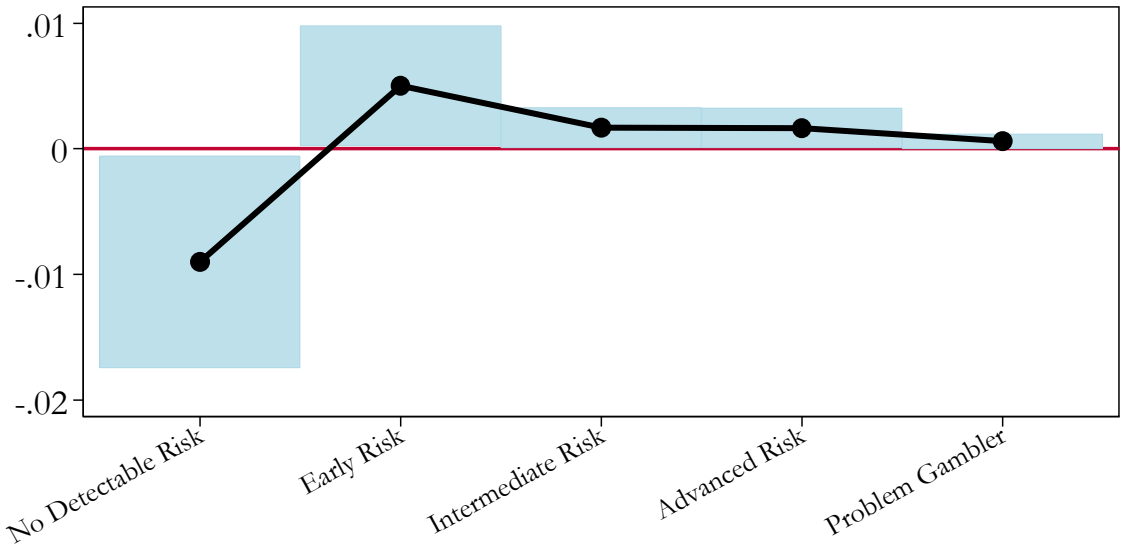


Figure 3: Marginal Effect of FLAGS Being First
on Probability of FLAGS Gambling Risk Level

Ordered Probit Model with no sample weights and no sample selection correction
Point estimate of effect and 95% confidence interval

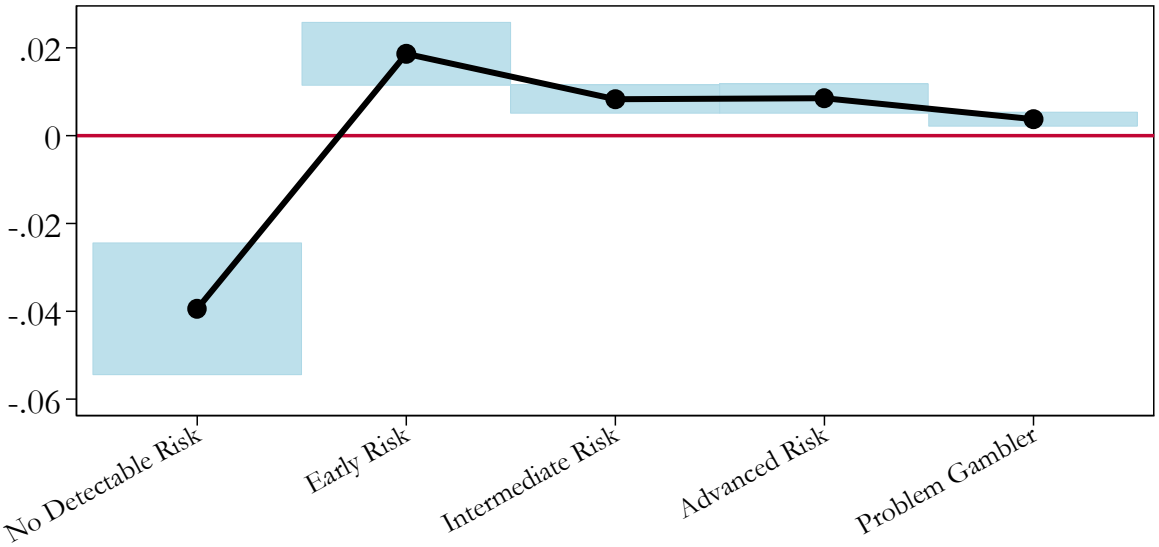
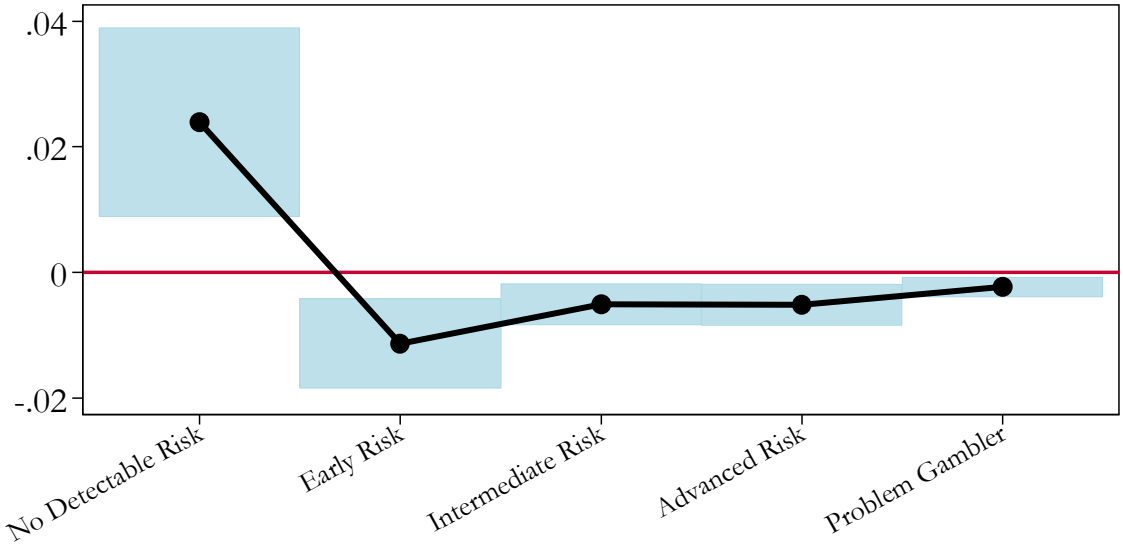


Figure 4: Marginal Effect of Randomized Questions
on Probability of FLAGS Gambling Risk Level

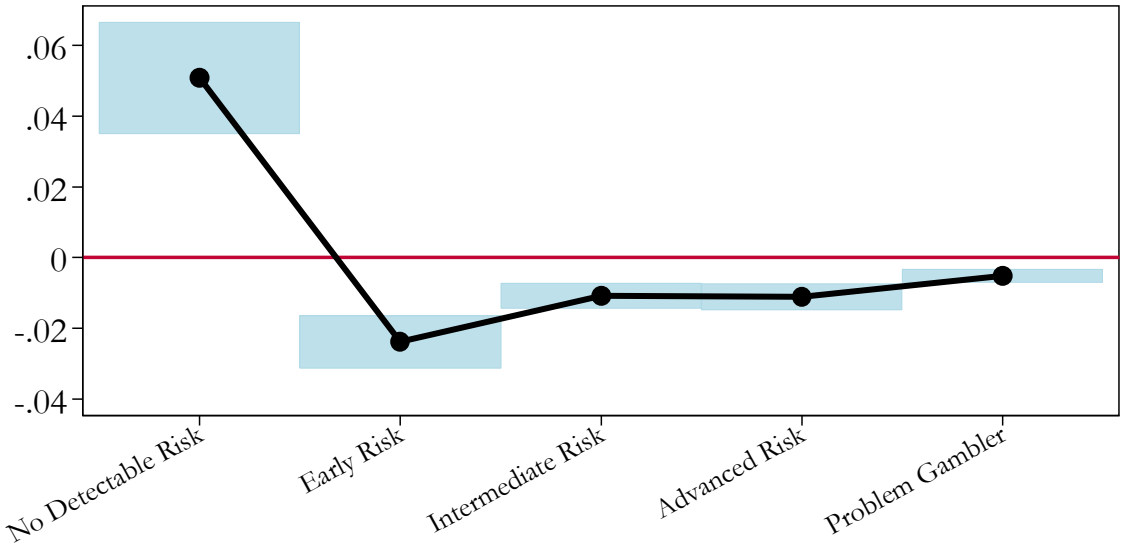
Ordered Probit Model with no sample weights and no sample selection correction
Point estimate of effect and 95% confidence interval



FLAGS Risk Levels

Figure 5: Marginal Effect of Lifetime Frame
on Probability of FLAGS Gambling Risk Level

Ordered Probit Model with no sample weights and no sample selection correction
Point estimate of effect and 95% confidence interval



FLAGS Risk Levels

Table 4: Effect of Gambling History Thresholds on FLAGS Risk Levels

(A) Have you ever lost more than 500 DKK in one day?

	No		Yes		Total	
FLAGS Risk Level	N	Percent	N	Percent	N	Percent
No Detectable Risk	6,557	82.1%	141	34.1%	6,698	79.7%
Early Risk	922	11.5%	88	21.3%	1010	12.0%
Intermediate Risk	283	3.5%	45	10.9%	328	3.9%
Advanced Risk	183	2.3%	91	22.0%	274	3.3%
Problem Gambler	46	0.6%	49	11.8%	95	1.1%
Total	7,991	100%	414	100%	8,405	100%

(B) Have you ever lost more than 40 DKK in one day?

	No		Yes		Total	
FLAGS Risk Level	N	Percent	N	Percent	N	Percent
No Detectable Risk	4,600	88.5%	2,098	65.4%	6,698	79.7%
Early Risk	404	7.8%	606	18.9%	1010	12.0%
Intermediate Risk	109	2.1%	219	6.8%	328	3.9%
Advanced Risk	61	1.2%	213	6.6%	274	3.3%
Problem Gambler	25	0.5%	70	2.2%	95	1.1%
Total	5,199	100%	3,206	100%	8,405	100%

Figure 6: Comparison of True *FLAGS* Responses and Inferred Responses if Using Gambling History Triggers

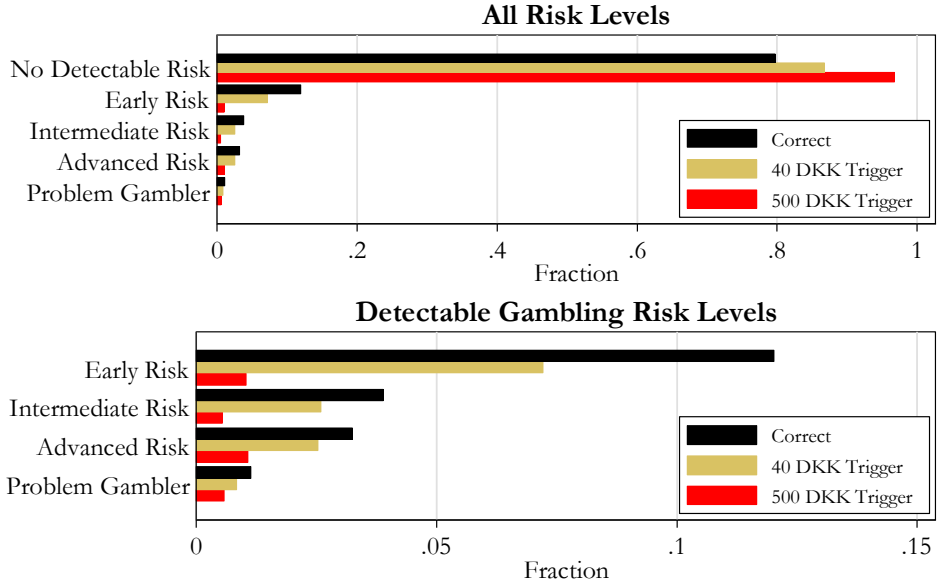


Figure 7: Comparison of True *DSM-IV* Responses and Inferred Responses if Using Gambling History Triggers

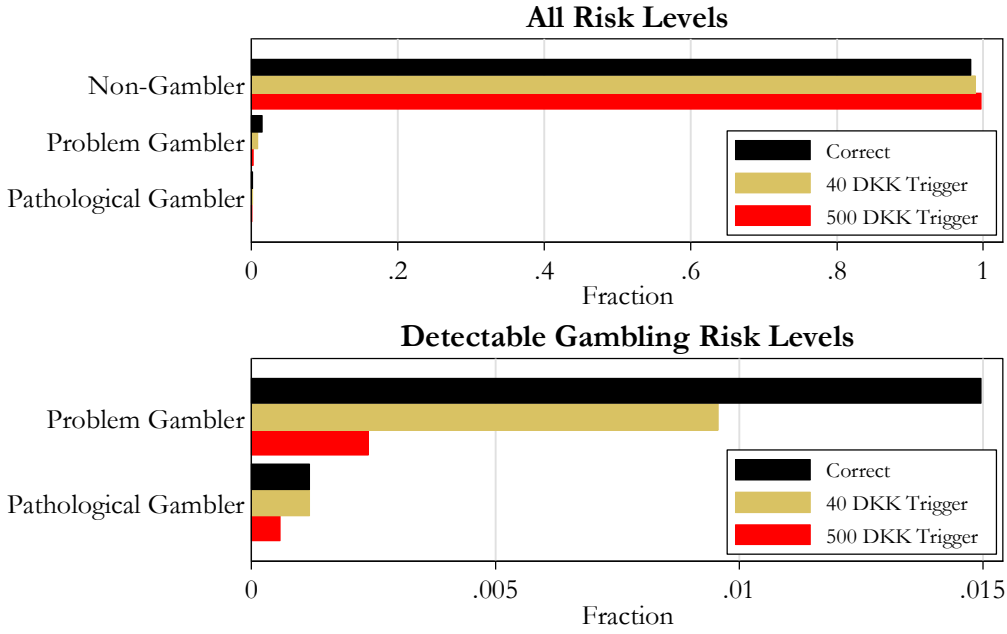


Figure 8: Comparison of True *PGSI* Responses and Inferred Responses if Using Gambling History Triggers

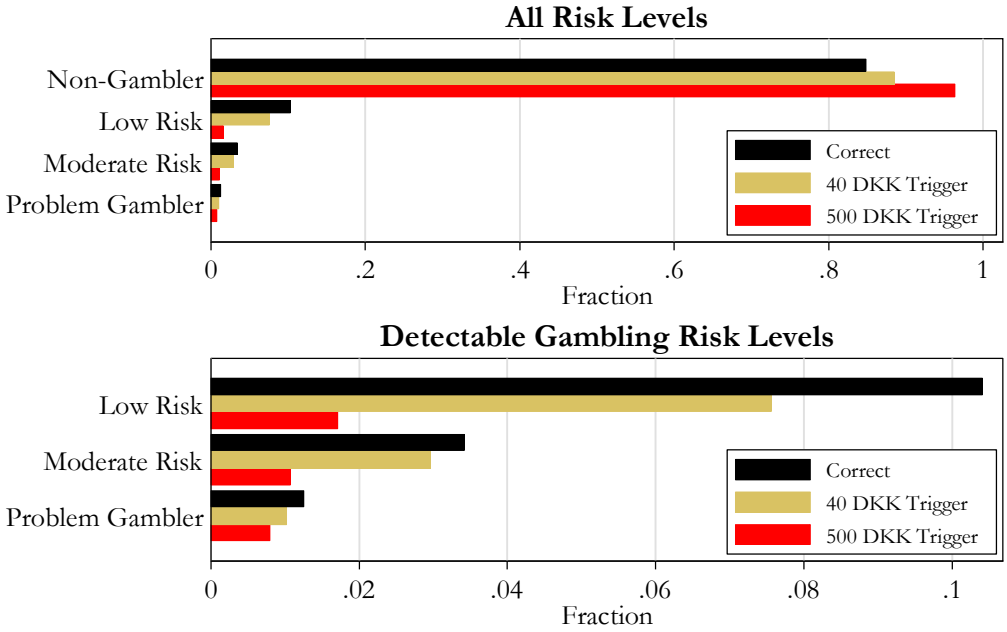
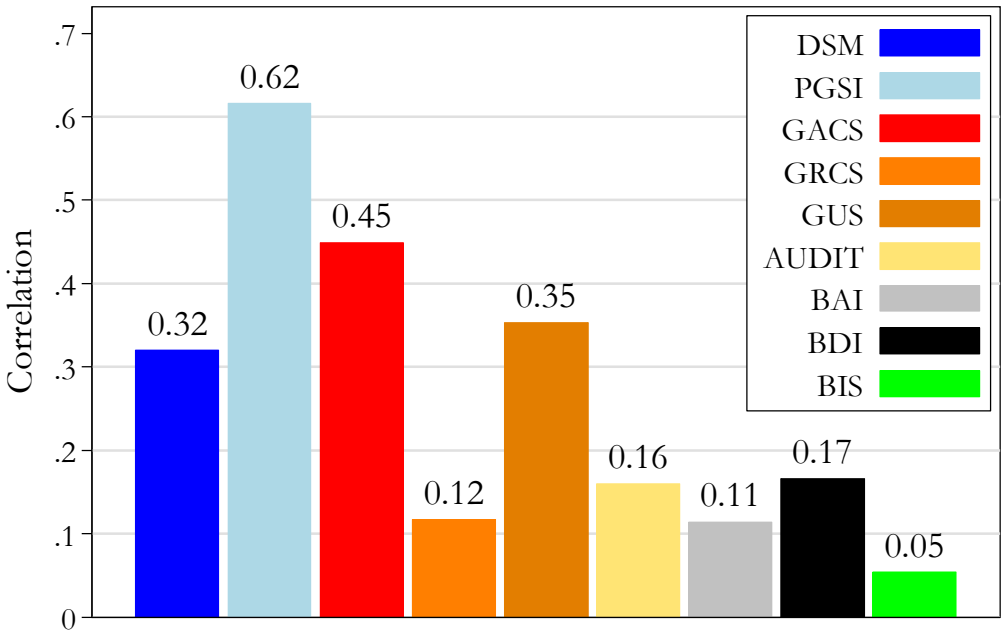


Figure 9: Correlation of *FLAGS* Scores with Other Instruments



References

American Psychiatric Association, *Diagnostic and Statistical Manual of Mental Disorders III.* (Washington, DC: American Psychiatric Association, 1980).

American Psychiatric Association, *Diagnostic and Statistical Manual of Mental Disorders IV*. (Washington, DC: American Psychiatric Association, 1994).

American Psychiatric Association, *Diagnostic and Statistical Manual of Mental Disorders 5*. (Washington, DC: American Psychiatric Association, 2013).

Babor, Thomas F.; Higgins-Biddle, John C.; Saunders, John B., and Monteiro, Maristela G., *The Use Disorders Identification Test. Guidelines for Use in Primary Care* (Geneva, CH: World Health Organization, 2001).

Beck, Aaron T.; Epstein, Norman; Brown, Gary, and Steer, Robert A., "An Inventory for Measuring Clinical Anxiety: Psychometric Properties," *Journal of Consulting and Clinical Psychology*, 56(6), 1988, 893-897.

Beck, Aaron T., and Steer, Robert A., *Manual for the Beck Anxiety Inventory* (San Antonio, TX: Psychological Corporation, 1990).

Beck, A. T..; Ward, C. H.; Mendelson, M.; Mock, J., and Erbaugh, J., "An Inventory for Measuring Depression," *Archives of General Psychiatry*, 4, 1961, 561-571.

Blanco, Carlos; Hasin, Deborah. S.; Petry, Nancy; Stinson, Frederick S., and Grant, Bridget F., "Sex Differences in Subclinical and DSM-IV Pathological Gambling: Results from the National Epidemiologic Survey on Alcohol and Related Conditions," *Psychological Medicine*, 36, 2006, 943-953.

Bonke, Jens and Borregaard, Karen, *Ludomani i Danmark. Udbredelsen af pengespil og problemspillere.* (København: Socialforskningsinstituttet, 2006.)

Bonke, Jens, and Borregaard, Karen, "The Prevalence of Problematic Gambling Behaviour: A Scandinavian Comparison," *Scandinavian Journal of Public Health*, 37(6), 2009, 654–660.

Breen, Robert B., and Zuckerman, Marvin, "'Chasing' in Gambling Behavior: Personality and Cognitive Determinants," *Personality and Individual Differences*, 27, 1999, 1097-1111.

Committee on the Social and Economic Impact of Pathological Gambling, *Pathological Gambling: A Critical Review* (Washington: National Academy Press, 1999).

Diggle, P. and Kenward, M. G., "Informative Drop-out in Longitudinal Data Analysis," *Applied Statistics*, 43, 1994, 49-93.

Ekholm, Ola; Eiberg, Stig; Davidsen, Michael; Holst, Maria; Larsen, Christina VL, and Juel, Knud, "The Prevalence of Problem Gambling in Denmark in 2005 and 2010: A Sociodemographic and Socioeconomic Characterization," *Journal of Gambling Studies*, 30(1), 2014, 1-10.

Ferris, Jackie, and Wynne, Harold, *The Canadian Problem Gambling Index: Final Report* (Ottawa: Canadian Centre on Substance Abuse, February 2001).

Gerstein, Dean; Hoffman, John; Larison, Cindy; Engelman, Laszlo; Murphy, Sally; Palmer, Amanda; Chucro, Lucian; Tace, Marianna; Johnson, Robert; Buie, Tracy; Hill, Mary Ann; Volberg, Rachel; Harwood, Henrick; Tucker, Adam; Christiansen, Eugene; Cummings, Will, and Sinclair, Sebastian, *Gambling Impact and Behavior Study: Report to the National Gambling Impact Study Commission* (Chicago: National Opinion Research Center at the University of Chicago, 1999).

Harrison, Glenn W.; Lau, Morten I., and Ross, Don, "Psychiatric Measures of Gambling Problems in the General Population: A Reconsideration," *Draft Manuscript*, Center for the Economic Analysis of Risk, Robinson College of Business, Georgia State University, 2016.

Hausman, Jerry A., and Wise, David A., "Attrition Bias in Experimental and Panel Data: The Gary Income Maintenance Experiment," *Econometrica*, 47(2), 1979, 455–473.

Heckman, J.J., "The Common Structure of Statistical Models of Truncation, Sample Selection, and Limited Dependent Variables and a Simple Estimator for such Models," *Annals of Economic and Social Measurement*, 5, 1976, 475–492.

Kapur, S.; Phillips, A.G., and Insel, T.R., "Why Has It Taken So Long for Biological Psychiatry to Develop Clinical Tests and What To Do About It?" *Molecular Psychiatry*, 17, 2012, 1174-1179.

Kessler, Ronald C; Abelson, Jamie; Demler, Olga; Escobar, Javier I.; Gibbon, Miriam; Guyer, Margaret E.; Howes, Mary J.; Jin, Robert; Vega, William A.; Walters, Ellen E.; Wang, Phillip; Zaslavsky, Alan, and Zheng, Hui, "Clinical Calibration of DSM-IV Diagnoses in the World Mental Health (WMH) Version of the World Health Organization (WHO) Composite International Diagnostic Interview (WMH-CIDI)," *International Journal of Methods in Psychiatric Research*, 13(2), 2004, 122-139.

Kessler, R.C.; Hwang, I.; LaBrie, R.; Petukhova, M.; Sampson, N.A.; Winters, K.C., and Shaffer, H.J., "DSM-IV Pathological Gambling in the National Comorbidity Survey Replication," *Psychological Medicine*, 38, 2008, 1351-1360.

Patton, J. H.; Stanford, M. S., and Barratt, E. S., "Factor Structure of the Barratt Impulsiveness Scale," *Journal of Clinical Psychology*, 51(6), 1995, 768-774.

Petry, Nancy; Stinson, Frederick S., and Grant, Bridget F., "Comorbidity of DSM-IV Pathological Gambling and Other Psychiatric Disorders: Results From the National Epidemiologic Survey on Alcohol and Related Conditions," *Journal of Clinical Psychiatry*, 66, 2005, 564-574.

Petry, Nancy M.; Blanco, Carlos; Auriacombe, Marc; Borges, Guilherme; Bucholz, Kathleen; Crowley, Thomas J.; Grant, Bridget F.; Hasin, Deborah S., and O'Brien, Charles, "An Overview of and

Rationale for Changes Proposed for Pathological Gambling in DSM-5," *Journal of Gambling Studies*, 30, 2014, 493-502.

Raylu, Namrata, and Oei, Tian P., "The Gambling Urge Scale: Development, Confirmatory Factor Validation, and Psychometric Properties," *Psychology of Addictive Behaviors*, 18(2), 2004a, 100-105.

Raylu, Namrata, and Oei, Tian P., "The Gambling Related Cognitions Scale (GRCS): Development, Confirmatory Factor Validation and Psychometric Properties," *Addiction*, 99(6), 2004b, 757-769.\

Redish, A. David, "Implications of the Multiple-Vulnerabilities Theory of Addiction for Craving and Relapse," *Addiction* 104: 1940-1941.

Redish, A. David; Jensen, Steve, and Johnson, Adam, "A Unified Framework for Addiction: Vulnerabilities in the Decision Process," *Behavioral and Brain Sciences* 31: 415-487.

Regier, Darrel; Kaelber, Charles T.; Rae, Donald S.; Farmer, Mary E.; Knauper, Barbel; Kessler, Ronald C., and Norquist, Grayson S., "Limitations of Diagnostic Criteria and Assessment Instruments for Mental Disorders," *Archives of General Psychiatry*, 55, February 1998, 109-115.

Ross, Don; Sharp, Carla; Vuchinich, Rudolph; Spurrett, David, *Midbrain Mutiny: The Picoeconomics and Neuroeconomics of Disordered Gambling* (Cambridge MA: MIT Press, 2008).

Schellinck, Tony; Schrans, Tracy; Bliemel, Michael, and Schellinck, Heather, *FLAGS: Development of an Instrument for Identifying Risk for Problem Gambling among Slot Machine Gamblers in Ontario* (Guelph, ON: Ontario Problem Gambling Research Centre, 2010).

Schellinck, Tony; Schrans, Tracy; Schellinck, Heather, and Bliemel, Michael, *Raising the FLAGS: A Pilot Study Adapting FLAGS, a Next-Generation Gambling Risk Assessment Instrument, for Use in Identifying Risk Among General Gambling Populations* (Guelph, ON: Ontario Problem Gambling Research Centre, 2011).

Schellinck, Tony; Schrans, Tracy; Bliemel, Michael, and Schellinck, Heather, "Construct Development for the FocaL Adult Gambling Screen (FLAGS): A Risk Measurement for Gambling Harm and Problem Gambling Associated with Electronic Gambling Machines," *Journal of Gambling Issues*, 2015a, 140-173.

Schellinck, Tony; Schrans, Tracy; Bliemel, Michael, and Schellinck, Heather, "Instrument Development for the FocaL Adult Gambling Screen (FLAGS-EGM): A Measurement of Risk and Problem Gambling Associated with Electronic Gambling Machines," *Journal of Gambling Issues*, 2015b, 174-200.

Sharp, Carla; Steinberg, Lynne; Yaroslavsky, Ilya; Hofmeyr, Andre; Dellis, Andrew; Ross, Don, and Kincaid, Harold, "An Item Response Theory Analysis of the Problem Gambling Severity Index," *Assessment*, 19(2), 2012, 167-175.

Strong, David R.; Breen, Robert B.; Lesieur, Henry R., and Lejuez, C.W., "Using the Rasch Model to Evaluate the South Oaks Gambling Screen for Use with Nonpathological Gamblers," *Addictive Behaviors*, 28, 2003, 1465-1472.

Strong, David R.; Breen, Robert B., and Lejuez, C.W., "Using Item Response Theory to Examine Gambling Attitudes and Beliefs," *Personality and Individual Differences*, 36, 2004a, 1515-1529.

Strong, David R., and Kahler, C. W., "Evaluation of the Continuum of Gambling Problems using the DSM-IV," *Addiction* 102, 5, 2007, 713-721.

Strong, David R.; Lesieur, Henry R.; Breen, Robert B.; Stinchfield, Randy, and Lejuez, C.W., "Using a Rasch Model to Examine the Utility of the South Oaks Gambling Screen Across Clinical and Community Samples," *Addictive Behaviors*, 29, 2004b, 465-481.

Wardle, H., Moody, A., Spence, S., Orford, J., Volberg, R., Jotangia, D., and Dobbie, F., *British Gambling Prevalence Survey 2010* (London: Stationery Office, 2011).

Wardle, H., Sproston, K., Orford, J., Erens, B., Griffiths, M., Constantine, R., and Pigott, S., *British Gambling Prevalence Survey 2007* (London: National Centre for Social Research, 2007).

Young, Matthew M., and Wohl, Michael J., "The Gambling Craving Scale: Psychometric Validation and Behavioral Outcomes," *Psychology of Addictive Behaviors*, 23(3), 2009, 512-522.

Appendix A: Survey Instruments

The instruments listed below were employed for use in our surveys. The format displayed below is the easiest to document the blocks and response formats, but is not literally the text given to respondents. For instance, the block headings with the FLAGS instrument were not given to respondents, but make it easier to see which questions go together.

A. Focal Adult Gambling Screen (FLAGS)

Please read the following list of statements about gambling, and for each please indicate whether or not this statement is true for you. A simple YES or NO response is all you need to provide. If some statement does not apply to you, just respond NO. The statements are in no particular order. Think about your lifetime gambling experiences [OR: your gambling experiences in the last year].

Risky Cognition: Belief (RCB)

RCB01	People who are good at gambling get more respect from others.
RCB02	Gambling is an easy way to get extra money when you need it.
RCB03	Using a system or a strategy when you play games like lottery draws, roulette, slots or other gambling machines improves your chances of winning.
RCB04	After you have been gambling and losing for a while your chances of winning improve.
RCB05	If you are on a winning streak it makes sense to keep gambling to take advantage of your luck.
RCB06	Once someone has been gambling and losing for a while they should keep playing so they don't miss out on the chance to win back their money.
RCB07	Some people are luckier than others and so they have a better chance of winning when they gamble.
RCB08	I had a big win when I first started to gamble.
RCB09	I used to win a lot when I gambled but it seems like the odds aren't as good anymore.

Risky Cognition: Motives (RCM)

RCM01	I find things a lot more interesting when I have a bet or wager riding on the outcome.
RCM02	I sometimes gamble when I am feeling down or depressed.
RCM03	I gamble when I want money.
RCM04	Even if I don't have much money I gamble to try to get a big win.
RCM05	Gambling helps me to fit in better with others.
RCM06	I want people to think I am good at gambling.
RCM07	I gamble because it feels good to beat others at the game.

Preoccupation: Desire (POD)

POD01	I would like to gamble almost every day.
POD02	Compared to many other things I can do I would rather gamble.
POD03	I wish I could gamble more often.

Impaired Control: Continue (ICC)

ICC01	Even when I only wanted to spend a few dollars gambling, I often ended up spending much more.
ICC02	Once I start gambling I sometimes find it difficult to stop.
ICC03	When I gambled I usually exceeded the amount of money I intended to spend.
ICC04	I often had trouble stopping/quitting play when I was ahead.

Risky Practices: Earlier (RBE)

RBE01	When I won big I usually kept playing rather than stop.
RBE02	I usually played at maximum bet or bet the most I could afford when I was on a winning streak.
RBE03	I often spend more time gambling than I intended.
RBE04	I am making bigger bets than I used to.
RBE05	I gamble or make bets when I get a good luck sign or I am feeling lucky.
RBE06	When I am gambling I am interested in the game, not socializing with others.

Risky Practices: Later (RBL)

RBL01	I sometimes borrowed money from others so I could go and gamble.
RBL02	I often used my credit card to get more money so I could keep gambling.
RBL03	I sometimes exceeded the amount of money I intended to spend in order to win back money I had lost.
RBL04	I gambled at work or when I was supposed to be doing something else.
RBL05	I have a strategy to improve my luck when I gamble.
RBL06	I have gambled using money that I was supposed to spend on other things.
RBL07	When gambling I usually played fast or made as many bets as quickly as I could.
RBL08	I sometimes bet when I believe I can predict the outcome of an event.

Impaired Control: Begin (ICB)

ICB01	If I have the opportunity to gamble I can't stop myself from taking it.
ICB02	There have been times I started to gamble despite my desire not to.
ICB03	I tried unsuccessfully to stop or reduce my gambling.
ICB04	I gamble more often than I want to.

Preoccupation: Obsession (POO)

POO01	I plan my life around my gambling.
POO02	I am obsessed with gambling thinking about when I will next gamble all the time.
POO03	I spend a lot of my time thinking about gambling or how to get money to gamble.
POO04	Thoughts of gambling or playing the games fill my mind day and night.

Negative Consequences (NGC)

NGC01	When I finished gambling, I sometimes did not have enough money for parking, food, a ride home or other things I was supposed to buy for myself.
NGC02	Sometimes I had to juggle money and bills to cover the cost of my gambling.
NGC03	My performance at work was negatively affected by my gambling.
NGC04	My goals in life were jeopardized by my gambling.
NGC05	I sometimes had trouble sleeping thinking about gambling.
NGC06	I missed social events with my friends and family because I was gambling.

NGC07 I sometimes neglected family or friends in order to gamble.
NGC08 My gambling caused problems for my relationship with my spouse or partner.
NGC09 I have become somewhat of a loner because of my gambling.
NGC10 My gambling caused me to have a falling out with people I used to hang out with.
NGC11 Sometimes I felt depressed over my gambling.
NGC12 I regret that I gambled as much as I did.
NGC13 I have lied to others about my gambling.

Persistence (PST)

PST01 Regardless of negative consequences, I kept gambling whenever I had the opportunity.
PST02 I have continued to gamble for some time despite the negative way gambling has affected my life.
PST03 I kept gambling last year even though I knew it was causing major problems for me.

B. The Problem Gambling Severity Index (PGSI)

[It is easy to confuse the acronyms of the PGSI and the CPGI. The PGSI is a scored 9-item component of the CPGI, which contains 12 items]

Some of the next 9 questions may not apply to you, but please try to be as accurate as possible. Think about your lifetime gambling experiences [OR: your gambling experiences in the last year].

Answer possibilities:
0 = Never
-1 = Sometimes
-2 = Most of the time
-3 = Almost always
-9 = Don't know

1. Have you bet more than you could really afford to lose?
2. Have you needed to gamble with larger amounts of money to get the same feeling of excitement?
3. When you gambled, did you go back on another day to try to win back the money you lost?
4. Have you borrowed money or sold anything to get money to gamble?
5. Have you felt that you might have a problem with gambling?
6. Has gambling caused you any health problems, including stress or anxiety?
7. Have people criticized your betting or told you that you had a gambling problem, regardless of whether or not you thought it was true?
8. Has your gambling caused any financial problems for you or your household?
9. Have you felt guilty about the way you gamble or what happens when you gamble?

C. The Diagnostic & Statistical Manual of Mental Disorders – Edition IV (DSM-IV)

Some of the next 10 questions may not apply to you, but please try to be as accurate as possible. Think about your lifetime gambling experiences [OR: your gambling experiences in the last year].

Answer possibilities:
0 = No
-1 = Once or twice
-2 = Sometimes
-3 = Often
-4 = Don't know

1. Have you found yourself thinking about gambling (e.g. reliving past gambling experiences, planning the next time you will play or thinking of ways to get money for gambling)?
2. Have you needed to gamble with more and more money to get the amount of excitement you are looking for?
3. Have you become restless or irritable when trying to cut down or stop gambling?
4. Have you gambled to escape from problems or when you are feeling depressed, anxious or bad about yourself?
5. After losing money gambling, have you returned another day in order to get even?
6. Have you lied to your family, or others, to hide the extent of your gambling?
7. Have you made repeated unsuccessful attempts to control, cut back or stop gambling?
8. Have you been forced to go beyond what is strictly legal, in order to finance gambling or to pay gambling debts?
9. Have you risked or lost a significant relationship, job, educational or career opportunity because of gambling?
10. Have you sought help from others to provide money to relieve a desperate financial situation caused by gambling?

D. The Gambling Craving Scale (GACS)

Please indicate how much you agree or disagree with the statements.

Answer possibilities:
1 = strongly disagree
2 = moderately disagree
3 = mildly disagree
4 = neither agree or disagree
5 = mildly agree
6 = moderately agree
7 = strongly agree

1 Gambling would be fun right now.
2 If I had an opportunity to gamble right now, I probably would take it.
3 If I were offered an opportunity to gamble right now, I would gamble.
4 If it were possible, I probably would gamble now.
5 I would not enjoy gambling right now.
6 Gambling would be very satisfying now.
7 Gambling now would make things seem just perfect.

8 All I want right now is to gamble.
9 I crave gambling right now.
10 My desire to gamble seems overpowering.
11 I need to gamble now.
12 I have an urge to gamble.
13 I would do almost anything to gamble now.
14 Nothing would be better than gambling now.
15 If I were gambling now, I could think more clearly.
16 I could control things better right now if I could gamble.
17 Gambling would make me less depressed.
18 I would be less irritable right now if I could gamble.

E. The Gambling Related Cognition Scale (GRCS)

Please indicate how much you agree or disagree with the statements.

Answer possibilities:
1 = strongly disagree
2 = moderately disagree
3 = mildly disagree
4 = neither agree or disagree
5 = mildly agree
6 = moderately agree
7 = strongly agree

1 Gambling makes me happier.
2 I can't function without gambling.
3 Praying helps me win.
4 Losses when gambling, are bound to be followed by a series of wins.
5 Relating my winnings to my skill and ability makes me continue gambling.
6 Gambling makes things seem better.
7 It is difficult to stop gambling as I am so out of control.
8 Specific numbers and colours can help increase my chances of winning.
9 A series of losses will provide me with a learning experience that will help me win later.
10 Relating my losses to bad luck and bad circumstances makes me continue gambling.
11 Gambling makes the future brighter.
12 My desire to gamble is so overpowering.
13 I collect specific objects that help increase my chances of winning.
14 When I have a win once, I will definitely win again.
15 Relating my losses to probability makes me continue gambling.
16 Having a gamble helps reduce tension and stress.
17 I'm not strong enough to stop gambling.
18 I have specific rituals and behaviours that increase my chances of winning.
19 There are times that I feel lucky and thus, gamble those times only.
20 Remembering how much money I won last time makes me continue gambling.

21 I will never be able to stop gambling.
22 I have some control over predicting my gambling wins.
23 If I keep changing my numbers, I have less chances of winning than if I keep the same numbers every time.

F. The Gambling Urge Screen (GUS)

The next 8 questions have to do with your feelings and thoughts right now. Please indicate how much you agree or disagree with the statements.

Answer possibilities:
1 = strongly disagree
2 = moderately disagree
3 = mildly disagree
4 = neither agree or disagree
5 = mildly agree
6 = moderately agree
7 = strongly agree

1 All I want to do now is to gamble.
2 It would be difficult to turn down a gamble this minute.
3 Having a gamble now would make things seem just perfect.
4 I want to gamble so bad that I can almost feel it.
5 Nothing would be better than having a gamble right now.
6 I crave a gamble right now.
7 I don't need to have a gamble now.
8 If I had the chance to have a gamble, I don't think I would gamble.

G. The Alcohol Use Disorders Identification Test (AUDIT)

Now I am going to ask you some questions about your use of alcoholic beverages during the past year. Because alcohol use can affect many areas of health, and may interfere with certain medications, it is important for us to know how much you usually drink and whether you have experienced any problems with your drinking. Please try to be as honest and as accurate as you can be.

1 How often do you have a drink containing alcohol?
0 - Never
1 - Monthly or less
2 - 2-4 times a month
3 - 2-3 times a week
4 - 4 or more times a week

2 How many drinks containing alcohol do you have on a typical day when you are drinking?
0 - 1 or 2

1 - 3 or 4
2 - 5 or 6
3 - 7 to 9
4 - 10 or more

3 How often do you have six or more drinks on one occasion?
0 - Never
1 - Less than monthly
2 - Monthly
3 - Weekly
4 - Daily or almost daily

4 How often during the last year have you found that you were not able to stop drinking once you had started?
0 - Never
1 - Less than monthly
2 - Monthly
3 - Weekly
4 - Daily or almost daily

5 How often during the last year have you failed to do what was normally expected of you because of drinking?
0 - Never
1 - Less than monthly
2 - Monthly
3 - Weekly
4 - Daily or almost daily

6 How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?
0 - Never
1 - Less than monthly
2 - Monthly
3 - Weekly
4 - Daily or almost daily

7 How often during the last year have you had a feeling of guilt or remorse after drinking?
0 - Never
1 - Less than monthly
2 - Monthly
3 - Weekly
4 - Daily or almost daily

8 How often during the last year have you been unable to remember what happened the night before because of your drinking?
0 - Never

1 - Less than monthly
2 - Monthly
3 - Weekly
4 - Daily or almost daily

9 Have you or someone else been injured because of your drinking?
0 - No
2 - Yes, but not in the last year
4 - Yes, during the last year

10 Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down?
0 - No
2 - Yes, but not in the last year
4 - Yes, during the last year

H. Beck Anxiety Index (BAI)

Over their entire life, some people have had a time in their life when they were a "worrier," in the sense that they worried a lot more about things than other with the same problems. Some people have also had a time when they were much more nervous or anxious than most other people with the same problems. And some people have had a time lasting 6 months or longer when they were anxious and worried most days. The next block of statements are common symptoms of people having these experiences. Please indicate how much you have been bothered by that symptom during the worst of these experiences in your life.

Answer possibilities:
1 = Not at all
2 = Mildly but it didn't bother me much.
3 = Moderately - it wasn't pleasant at times.
4 = Severely - it bothered me a lot.

1 Numbness or tingling
2 Feeling hot
3 Wobbliness in legs
4 Unable to relax
5 Fear of worst happening
6 Dizzy or lightheaded
7 Heart pounding/racing
8 Unsteady
9 Terrified or afraid
10 Nervous
11 Feeling of choking
12 Hands trembling
13 Shaky / unsteady

14 Fear of losing control
15 Difficulty in breathing
16 Fear of dying
17 Scared
18 Indigestion
19 Faint / lightheaded
20 Face flushed
21 Hot/cold sweats

I. Beck Depression Inventory (BDI)

Over their entire life, some people have had a time when they felt sad, blue, depressed or down most of the time for at least 2 weeks. Some people have also had a time over their entire life, lasting 2 weeks or more, when they didn't care about the things they usually cared about, or when they didn't enjoy the things they usually enjoyed. The next block of statements are about experiences that you might have had during one of those times, when your mood was the lowest, or you enjoyed or cared the least about things. Please pick out the one statement that best describes the way you have been feeling during that period. If none of the statements apply, just select the first one.

1 Sadness
0 - I do not feel sad.
1 - I feel sad much of the time.
2 - I am sad all the time.
3 - I am so sad or unhappy that I can't stand it.

2 Pessimism
0 - I am not discouraged about my future.
1 - I feel more discouraged about my future than I used to be.
2 - I do not expect things to work out for me.
3 - I feel my future is hopeless and will only get worse.

3 Past Failure
0 - I do not feel like a failure.
1 - I have failed more than I should have.
2 - As I look back, I see a lot of failures.
3 - I feel I am a total failure as a person.

4 Loss of Pleasure
0 - I get as much pleasure as I ever did from the things I enjoy.
1 - I don't enjoy things as much as I used to.
2 - I get very little pleasure from the things I used to enjoy.
3 - I can't get any pleasure from the things I used to enjoy.

5 Guilty Feelings
0 - I don't feel particularly guilty.

1 - I feel guilty over many things I have done or should have done.
2 - I feel quite guilty most of the time.
3 - I feel guilty all of the time.

6 Punishment Feelings
0 - I don't feel I am being punished.
1 - I feel I may be punished.
2 - I expect to be punished.
3 - I feel I am being punished.

7 Self-Dislike
0 - I feel the same about myself as ever.
1 - I have lost confidence in myself.
2 - I am disappointed in myself.
3 - I dislike myself.

8 Self-Criticalness
0 - I don't criticize or blame myself more than usual.
1 - I am more critical of myself than I used to be.
2 - I criticize myself for all of my faults.
3 - I blame myself for everything bad that happens.

9 Suicidal Thoughts or Wishes
0 - I don't have any thoughts of killing myself.
1 - I have thoughts of killing myself, but I would not carry them out.
2 - I would like to kill myself.
3 - I would kill myself if I had the chance.

10 Crying
0 - I don't cry any more than I used to.
1 - I cry more than I used to.
2 - I cry over every little thing.
3 - I feel like crying, but I can't.

11 Agitation
0 - I am no more restless or wound up than usual.
1 - I feel more restless or wound up than ususal.
2 - I am so restless or agitated that it's hard to stay still.
3 - I am so restless or agitated that have to keep moving or doing something.

12 Loss of Interest
0 - I have not lost interest in other people or activities.
1 - I am less interested in other people or things than before.
2 - I have lost most of my interest in other people.
3 - It's hard to get interested in anything.

13 Indecisiveness
0 - I make decisions about as well as ever.
1 - I find it more difficult to make decisions than usual.
2 - I have much greater difficulty in making decisions than I used to.
3 - I have trouble making any decisions.

14 Worthlessness
0 - I do not feel I am worthless.
1 - I don't consider myself as worthwhile and useful as I used to.
2 - I feel more worthless as compared to other people.
3 - I feel utterly worthless.

15 Loss of Energy
0 - I have as much energy as ever.
1 - I have less energy than I used to have.
2 - I don't have enough energy to do very much.
3 - I don't have enough energy to do anything.

16 Changes in Sleeping Pattern
0 - I have not experienced any change in my sleeping pattern.
1a - I sleep somewhat more than usual.
1b - I sleep somewhat less than usual.
2a - I sleep a lot more than usual.
2b - I sleep a lot less than usual.
3a - I sleep most of the day.
3b - I wake up 1-2 hours early and can't get back to sleep.

17 Irritability
0 - I am no more irritable than usual.
1 - I am more irritable than usual.
2 - I am much more irritable than usual.
3 - I am irritable all the time.

18 Changes in Appetite
0 - I have not experienced any change in my appetite.
1a - My appetite is somewhat less than usual.
1b - My appetite is somewhat greater than usual.
2a - My appetite is much less than before.
2b - My appetite is much greater than before.
3a - I have no appetite at all.
3b - I crave food all the time.

19 Concentration Difficulty
0 - I can concentrate as well as ever.
1 - I can't concentrate as well as usual.
2 - It's hard to keep my mind on anything for very long.

3 - I find I can't concentrate on anything.

20 Tiredness or Fatigue
0 - I am no more tired or fatigued than usual.
1 - I get more tired or fatigued more easily than usual.
2 - I am too tired or fatigued to do a lot of the things I used to do.
3 - I am too tired or fatigued to do most of the things I used to do.

21 Loss of Interest in Sex
0 - I have not noticed any recent change in my interest in sex.
1 - I am less interested in sex than I used to be.
2 - I am much less interested in sex now.
3 - I have lost interest in sex completely.

J. Barratt Impulsivity Scale (BIS)

People differ in the ways they act and think in different situations. The next block of questions are designed to measure some of the ways in which you act and think. Read each statement and select the best answer.

Answer possibilities:
1 = Rarely / Never
2 = Occasionally.
3 = Often
4 = Almost Always / Always

1 I plan tasks carefully.
2 I do things without thinking.
3 I make-up my mind quickly.
4 I am happy-go-lucky.
5 I don't "pay attention."
6 I have "racing" thoughts.
7 I plan trips well ahead of time.
8 I am self controlled.
9 I concentrate easily.
10 I save regularly.
11 I "squirm" at plays or lectures.
12 I am a careful thinker.
13 I plan for job security.
14 I say things without thinking.
15 I like to think about complex problems.
16 I change jobs.
17 I act "on impulse."
18 I get easily bored when solving thought problems.
19 I act on the spur of the moment.

20 I am a steady thinker.
21 I change residences.
22 I buy things on impulse.
23 I can only think about one thing at a time.
24 I change hobbies.
25 I spend or charge more than I earn.
26 I often have extraneous thoughts when thinking.
27 I am more interested in the present than the future.
28 I am restless at the theater or lectures.
29 I like puzzles.
30 I am future oriented.

K. Additional Questions

1. Have you experienced the death of an immediate family member (partner, child, parent or sibling) in the past 12 months? (Yes/No)

2. Have you been hospitalized for a major medical problem during the past 12 months? (Yes/No)

3a. In the past 12 months have you lost more than 40 kroner on gambling in a single day? (Yes/No)
3b. Have you ever lost more than 40 kroner on gambling in a single day? (Yes/No)

4a. In the past 12 months have you lost more than 500 kroner on gambling in a single day? (Yes/No)
4b. Have you ever lost more than 500 kroner on gambling in a single day? (Yes/No)

5. Do you currently smoke cigarettes?
6. If yes, how much do you smoke in one day?

Thank you very much for your participation in the survey. Your answers are valuable to us.

Appendix B: Scoring the Survey Instruments

In this appendix we document how we have scored each instrument.

A. FLAGS

We have 8,422 valid survey respondents that completed the survey, and of course everyone did FLAGS. The FLAGS documentation [Schellinck et al., 2011] explains the scoring:

Construct	Abrev.	Chosen Cut-Off
Persistence	(PST)	2
Negative Consequences	(NGC)	3
Preoccupation: Obsession	(POO)	2
Impaired Control: Begin	(ICB)	2
Risky Practices: Later	(RBL)	3
Risky Practices: Earlier	(RBE)	3
Impaired Control: Continue	(ICC)	2
Preoccupation: Desire	(POD)	2
Risky Cognitions: Motives	(RCM)	2
Risky Cognitions: Beliefs	(RCB)	3

Constructs Scoring

- $\sum_i RCBi \geq 3 \rightarrow RCB$
- $\sum_i RCMi \geq 2 \rightarrow RCM$
- $\sum_i PODi \geq 2 \rightarrow POD$
- $\sum_i ICCi \geq 2 \rightarrow ICC$
- $\sum_i RBEi \geq 3 \rightarrow RBE$
- $\sum_i RBLi \geq 3 \rightarrow RBL$
- $\sum_i ICBi \geq 2 \rightarrow ICB$
- $\sum_i POOi \geq 2 \rightarrow POO$
- $\sum_i NGCi \geq 3 \rightarrow NGC$
- $\sum_i PSTi \geq 2 \rightarrow PST$

Here is the raw tabulation:

FLAGS Risk Level	Freq.	Percent	Cum.
No Detectable Risk	6,698	79.69	79.69
Early Risk	1,010	12.02	91.71
Intermediate Risk	328	3.90	95.61
Advanced Risk	274	3.26	98.87
Problem Gambler	95	1.13	100.00
Total	8,405	100.00	

B. PGSI

We have 1,757 valid survey respondents that completed the PGSI survey questions, and of course everyone in that 1,757 also did FLAGS.

The PGSI is directly scored from the responses, once we conservatively assign a Don't Know response as a No. The classification is then to assign anyone with a score of 1 or 2 to Low Risk, a score between 3 and 7 to Moderate Risk, and a score of 8 or more to Problem Gambler.

Here is the raw tabulation:

PGSI Risk Level	Freq.	Percent	Cum.
Non-Gambler	1,492	84.92	84.92
Low Risk	183	10.42	95.33
Moderate Risk	60	3.41	98.75
Problem Gambler	22	1.25	100.00
Total	1,757	100.00	

	Lifetime prevalence		
PGSI Risk Level	0	1	Total
Non-Gambler	650	842	1,492
Low Risk	79	104	183
Moderate Risk	29	31	60
Problem Gambler	11	11	22
Total	769	988	1,757

Pearson chi2(3) =	0.9067	Pr = 0.824
likelihood-ratio chi2(3) =	0.9009	Pr = 0.825
gamma =	-0.0303	ASE = 0.065
Kendall's tau-b =	-0.0110	ASE = 0.024

C. DSM

We have 1,671 valid survey respondents that completed the DSM-IV survey questions, and of course everyone in that 1,671 also did FLAGS.

One initial question is how we score these responses. Many of the applications of DSM just ask YES or NO questions (apart from a DON'T KNOW). But we asked the extended list:

Have you found yourself thinking about gambling (e.g. reliving past gambling exp	Freq.	Percent	Cum.
Don't know	13	0.78	0.78
Often	20	1.20	1.97
Sometimes	98	5.86	7.84
Once or twice	101	6.04	13.88
No	1,439	86.12	100.00
Total	1,671	100.00	

Have you found yourself thinking about gambling (e.g. reliving past gambling exp	Freq.	Percent	Cum.
-4	13	0.78	0.78
-3	20	1.20	1.97
-2	98	5.86	7.84
-1	101	6.04	13.88
0	1,439	86.12	100.00
Total	1,671	100.00	

This comes from the MR (Multiple Response) version of the DSM screen developed by Susan Fisher, "Measuring the Prevalence of Sector-Specific Problem Gambling: A Study of Casino Patrons," *Journal of Gambling Studies*, 16(1), 2000, 25-51. She argues these are easier for respondents to follow in a non-clinical setting where one is not face-to-face with the subject. She has also used a closely-related MR version in Sue Fisher, "Developing the DSM-IV-DSM-IV Criteria to Identify Adolescent Problem Gambling in Non-Clinical Populations," *Journal of Gambling Studies*, 16(2/3), 2000, 253-273. A MR version was also used in the British Gambling Prevalence Study of 2007 (p. 135) and 2010 (p. 154), who also proposed a "continuous" scoring for each question rather than the mapping from MR categories to a "binary" YES or NO.

We follow the first Fisher paper and code the first 7 DSM question as YES if the respondent responded "Often" and code the last 3 DSM questions as YES if the respondent responded "Once or Twice," "Sometimes" or "Often." Using these binary classifications, she proposed that one define a subclinical Problem Gambler as someone that had between 1 and 4 positive DSM criteria responses, providing at least one of these was for the last 3 DSM questions. Following the DSM-IV, someone is declared to be a Pathological Gambler if they have 5 or more positive DSM responses.

Using these criteria we have the following:

dsm_score	Freq.	Percent	Cum.
0	1,612	96.47	96.47
1	44	2.63	99.10
2	6	0.36	99.46
3	5	0.30	99.76
4	2	0.12	99.88
5	2	0.12	100.00
Total	1,671	100.00	

DSM Risk Level	Freq.	Percent	Cum.
Non-Gambler	1,644	98.38	98.38
Problem Gambler	25	1.50	99.88
Pathological Gambler	2	0.12	100.00
Total	1,671	100.00	

DSM Risk Level	Lifetime prevalence 0	1	Total
Non-Gambler	733	911	1,644
Problem Gambler	13	12	25
Pathological Gambler	0	2	2
Total	746	925	1,671

Pearson chi2(2) =	2.1626	Pr =	0.339
likelihood-ratio chi2(2) =	2.9114	Pr =	0.233
gamma =	-0.0703	ASE =	0.193
Kendall's tau-b =	-0.0089	ASE =	0.025

D. GACS

We have 1,626 valid survey respondents that completed the GACS survey questions, and of course everyone in that 1,626 also did FLAGS.

Here is the Likert scale used for each question, with one (GACS_5) reverse-coded:

If it were possible, I probably would gamble now.	Freq.	Percent	Cum.
strongly disagree	1,152	70.85	70.85
moderately disagree	145	8.92	79.77
mildly disagree	70	4.31	84.07
neither agree or disagree	127	7.81	91.88
mildly agree	75	4.61	96.49
moderately agree	31	1.91	98.40
strongly agree	26	1.60	100.00
Total	1,626	100.00	

If it were possible, I probably would gamble now.	Freq.	Percent	Cum.
1	1,152	70.85	70.85
2	145	8.92	79.77
3	70	4.31	84.07
4	127	7.81	91.88
5	75	4.61	96.49
6	31	1.91	98.40
7	26	1.60	100.00
Total	1,626	100.00	

So the usual way one generates a score from such things is just to average. They do discuss 3 subscales from the 18 questions, but we do not want to presume factor loadings from their statistical analysis would apply to our analysis or population.

Here is the raw tabulation of the scale, rounded to the nearest 0.1 and 1 for ease of viewing:

gacs_scoreR	Freq.	Percent	Cum.
1	526	32.35	32.35
1.1	107	6.58	38.93
1.2	133	8.18	47.11
1.3	232	14.27	61.38
1.4	65	4.00	65.38
1.5	60	3.69	69.07
1.6	53	3.26	72.32
1.7	53	3.26	75.58
1.8	49	3.01	78.60
1.9	29	1.78	80.38
2	19	1.17	81.55
2.1	31	1.91	83.46
2.2	35	2.15	85.61
2.3	25	1.54	87.15
2.4	28	1.72	88.87
2.5	11	0.68	89.54
2.6	15	0.92	90.47
2.7	12	0.74	91.21
2.8	15	0.92	92.13
2.9	10	0.62	92.74
3	4	0.25	92.99
3.1	6	0.37	93.36
3.2	10	0.62	93.97
3.3	8	0.49	94.46
3.4	8	0.49	94.96
3.5	5	0.31	95.26
3.6	4	0.25	95.51
3.7	5	0.31	95.82
3.8	3	0.18	96.00
3.9	6	0.37	96.37
4	27	1.66	98.03
4.1	6	0.37	98.40
4.2	2	0.12	98.52
4.3	2	0.12	98.65
4.4	5	0.31	98.95
4.5	2	0.12	99.08

```
        4.8 |          1        0.06       99.14
        5.1 |          1        0.06       99.20
        5.3 |          1        0.06       99.26
        5.4 |          1        0.06       99.32
        5.5 |          2        0.12       99.45
        5.6 |          1        0.06       99.51
        5.8 |          1        0.06       99.57
        6.1 |          1        0.06       99.63
        6.2 |          1        0.06       99.69
        6.3 |          1        0.06       99.75
        6.7 |          4        0.25      100.00
------------+-----------------------------------
      Total |      1,626      100.00
```

```
        RR |         0          1 |     Total
-----------+----------------------+----------
         1 |       476        587 |     1,063
         2 |       179        203 |       382
         3 |        40         59 |        99
         4 |        30         35 |        65
         5 |         4          2 |         6
         6 |         5          2 |         7
         7 |         2          2 |         4
-----------+----------------------+----------
     Total |       736        890 |     1,626

          Pearson chi2(6) =   4.5373   Pr = 0.604
 likelihood-ratio chi2(6) =   4.5755   Pr = 0.599
                    gamma =  -0.0236  ASE = 0.047
          Kendall's tau-b =  -0.0119  ASE = 0.024
```

E. GRCS

We have 1,656 valid survey respondents that completed the GRCS survey questions, and of course everyone in that 1,656 also did FLAGS.

Here is the Likert scale used for each question:

```
Gambling makes me happier. |      Freq.     Percent        Cum.
---------------------------+-----------------------------------
          strongly disagree |        797       48.13       48.13
       moderately disagree |        162        9.78       57.91
           mildly disagree |         65        3.93       61.84
 neither agree or disagree |        364       21.98       83.82
               mildly agree |        190       11.47       95.29
          moderately agree |         55        3.32       98.61
            strongly agree |         23        1.39      100.00
---------------------------+-----------------------------------
                     Total |      1,656      100.00
```

```
   Gambling |
   makes me |
   happier. |      Freq.     Percent        Cum.
------------+-----------------------------------
          1 |        797       48.13       48.13
          2 |        162        9.78       57.91
          3 |         65        3.93       61.84
          4 |        364       21.98       83.82
          5 |        190       11.47       95.29
          6 |         55        3.32       98.61
          7 |         23        1.39      100.00
------------+-----------------------------------
      Total |      1,656      100.00
```

Raylu & Oei [2004b] document clearly how to score this instrument. We generate the simple average subscale score and then the simple average of those for an overall score.

Here is the raw tabulation of the scale, rounded to the nearest 0.1 and 1 for ease of viewing:

grcs_scoreR	Freq.	Percent	Cum.
1	482	29.11	29.11
1.1	195	11.78	40.88
1.2	98	5.92	46.80
1.3	132	7.97	54.77
1.4	86	5.19	59.96
1.5	86	5.19	65.16
1.6	80	4.83	69.99
1.7	44	2.66	72.64
1.8	51	3.08	75.72
1.9	30	1.81	77.54
2	30	1.81	79.35
2.1	32	1.93	81.28
2.2	36	2.17	83.45
2.3	32	1.93	85.39
2.4	20	1.21	86.59
2.5	28	1.69	88.29
2.6	14	0.85	89.13
2.7	16	0.97	90.10
2.8	16	0.97	91.06
2.9	9	0.54	91.61
3	9	0.54	92.15
3.1	8	0.48	92.63
3.2	16	0.97	93.60
3.3	5	0.30	93.90
3.4	15	0.91	94.81
3.5	7	0.42	95.23
3.6	3	0.18	95.41
3.7	10	0.60	96.01
3.8	5	0.30	96.32
3.9	4	0.24	96.56
4	35	2.11	98.67
4.1	5	0.30	98.97
4.2	2	0.12	99.09
4.3	2	0.12	99.21
4.6	1	0.06	99.28
4.7	3	0.18	99.46
4.8	1	0.06	99.52
4.9	1	0.06	99.58
5.2	1	0.06	99.64
5.5	1	0.06	99.70
6	1	0.06	99.76
6.3	1	0.06	99.82
6.7	1	0.06	99.88
6.9	2	0.12	100.00
Total	1,656	100.00	

grcs_score RR	Lifetime prevalence 0	1	Total
1	472	562	1,034
2	179	239	418
3	56	64	120
4	34	37	71
5	6	1	7
6	3	0	3

```
         7 |         1          2 |         3
-----------+---------------------+----------
     Total |       751        905 |     1,656

          Pearson chi2(6) =   9.7742   Pr = 0.134
 likelihood-ratio chi2(6) =  11.2655   Pr = 0.081
                    gamma =  -0.0028  ASE = 0.046
          Kendall's tau-b =  -0.0014  ASE = 0.024
```

F. GUS

We have 1,695 valid survey respondents that completed the GUS survey questions, and of course everyone in that 1,695 also did FLAGS.

Here is the Likert scale used for each question:

```
  All I want to do now is |
               to gamble. |      Freq.     Percent        Cum.
--------------------------+-----------------------------------
        strongly disagree |      1,432       84.48       84.48
     moderately disagree |         89        5.25       89.73
        mildly disagree |         31        1.83       91.56
neither agree or disagree |         86        5.07       96.64
            mildly agree |         27        1.59       98.23
         moderately agree |         16        0.94       99.17
           strongly agree |         14        0.83      100.00
--------------------------+-----------------------------------
                    Total |      1,695      100.00

 All I want |
  to do now |
      is to |
    gamble. |      Freq.     Percent        Cum.
------------+-----------------------------------
          1 |      1,432       84.48       84.48
          2 |         89        5.25       89.73
          3 |         31        1.83       91.56
          4 |         86        5.07       96.64
          5 |         27        1.59       98.23
          6 |         16        0.94       99.17
          7 |         14        0.83      100.00
------------+-----------------------------------
      Total |      1,695      100.00
```

Raylu & Oei [2004a] document clearly how to score this: they suggest the total score, since this is viewed as one factor, but the average score would do the same. They drop 2 of the 8 questions (the reverse-coded ones, GUS_7 and GUS_8).

Here is the raw tabulation of the scale, rounded to the nearest 0.1 and 1 for ease of viewing:

```
 gus_scoreR |      Freq.     Percent        Cum.
------------+-----------------------------------
          1 |        996       58.76       58.76
        1.1 |         70        4.13       62.89
        1.3 |         50        2.95       65.84
        1.4 |         66        3.89       69.73
        1.5 |         42        2.48       72.21
        1.6 |         40        2.36       74.57
        1.8 |        126        7.43       82.01
        1.9 |         30        1.77       83.78
          2 |         23        1.36       85.13
```

```
        2.1 |         16        0.94       86.08
        2.3 |         18        1.06       87.14
        2.4 |         12        0.71       87.85
        2.5 |         63        3.72       91.56
        2.6 |         15        0.88       92.45
        2.8 |          6        0.35       92.80
        2.9 |          7        0.41       93.22
          3 |          6        0.35       93.57
        3.1 |         10        0.59       94.16
        3.3 |         10        0.59       94.75
        3.4 |          5        0.29       95.04
        3.5 |          3        0.18       95.22
        3.6 |          8        0.47       95.69
        3.8 |          9        0.53       96.22
        3.9 |          6        0.35       96.58
          4 |         23        1.36       97.94
        4.1 |          3        0.18       98.11
        4.3 |          3        0.18       98.29
        4.5 |          1        0.06       98.35
        4.6 |          4        0.24       98.58
        4.8 |          3        0.18       98.76
        4.9 |          3        0.18       98.94
          5 |          2        0.12       99.06
        5.1 |          1        0.06       99.12
        5.3 |          2        0.12       99.23
        5.4 |          1        0.06       99.29
        5.5 |          2        0.12       99.41
        5.6 |          1        0.06       99.47
        5.9 |          1        0.06       99.53
          6 |          1        0.06       99.59
        6.3 |          2        0.12       99.71
        6.5 |          1        0.06       99.76
        6.8 |          1        0.06       99.82
          7 |          3        0.18      100.00
------------+-----------------------------------
      Total |      1,695      100.00


gus_scoreRR |      Freq.     Percent        Cum.
------------+-----------------------------------
          1 |      1,182       69.73       69.73
          2 |        307       18.11       87.85
          3 |        122        7.20       95.04
          4 |         55        3.24       98.29
          5 |         17        1.00       99.29
          6 |          7        0.41       99.71
          7 |          5        0.29      100.00
------------+-----------------------------------
      Total |      1,695      100.00


gus_scoreR |  Lifetime prevalence
         R |         0          1 |     Total
-----------+----------------------+----------
         1 |       505        677 |     1,182
         2 |       136        171 |       307
         3 |        59         63 |       122
         4 |        30         25 |        55
         5 |         9          8 |        17
         6 |         5          2 |         7
         7 |         5          0 |         5
-----------+----------------------+----------
     Total |       749        946 |     1,695

          Pearson chi2(6) =  13.2318   Pr = 0.039
 likelihood-ratio chi2(6) =  15.0737   Pr = 0.020
                   gamma =  -0.1055  ASE = 0.047
          Kendall's tau-b =  -0.0514  ASE = 0.023
```

G. AUDIT

We have 6,661 valid survey respondents that completed the AUDIT survey questions, and of course everyone in that 6,661 also did FLAGS.

Here is the Likert scale used for each of the first 8 questions:

How often during the last year have you found that you were not able to stop dri	Freq.	Percent	Cum.
Never	5,707	85.85	85.85
Less than monthly	695	10.45	96.30
Monthly	154	2.32	98.62
Weekly	65	0.98	99.59
Daily or almost daily	27	0.41	100.00
Total	6,648	100.00	

How often during the last year have you found that you were not able to stop dri	Freq.	Percent	Cum.
0	5,707	85.85	85.85
1	695	10.45	96.30
2	154	2.32	98.62
3	65	0.98	99.59
4	27	0.41	100.00
Total	6,648	100.00	

But the last 2 questions have different coding, with the numerical values shown:

Have you or someone else been injured because of your drinking?	Freq.	Percent	Cum.
No	6,071	91.32	91.32
Yes, but not in the last year	467	7.02	98.35
Yes, during the last year	110	1.65	100.00
Total	6,648	100.00	

Have you or someone else been injured because of your drinking?	Freq.	Percent	Cum.
0	6,071	91.32	91.32

```
          2 |        467        7.02       98.35
          4 |        110        1.65      100.00
------------+-----------------------------------
      Total |      6,648      100.00
```

Bablor et al. [2001] document clearly how to score this: they suggest the total score, since this is viewed as one factor. While the average score would do the same, we want comparability to cutoff thresholds stated in terms of the score. For instance, here is the default categories based on the total score:

Box 6

Risk Level	Intervention	AUDIT score*
Zone I	Alcohol Education	0-7
Zone II	Simple Advice	8-15
Zone III	Simple Advice plus Brief Counseling and Continued Monitoring	16-19
Zone IV	Referral to Specialist for Diagnostic Evaluation and Treatment	20-40

*The AUDIT cut-off score may vary slightly depending on the country's drinking patterns, the alcohol content of standard drinks, and the nature of the screening program. Clinical judgment should be exercised in cases where the patient's score is not consistent with other evidence, or if the patient has a prior history of alcohol dependence. It may also be instructive to review the patient's responses to individual questions dealing with dependence symptoms (Questions 4, 5 and 6) and alcohol-related problems (Questions 9 and 10). Provide the next highest level of intervention to patients who score 2 or more on Questions 4, 5 and 6, or 4 on Questions 9 or 10.

Here is the raw tabulation of the scale, with extra lines between the above "zones":

```
audit_score |      Freq.     Percent        Cum.
------------+-----------------------------------
          0 |        406        6.11        6.11
          1 |        575        8.65       14.76
          2 |        712       10.71       25.47
          3 |        928       13.96       39.43
          4 |        998       15.01       54.44
          5 |        711       10.69       65.13
          6 |        556        8.36       73.50
          7 |        386        5.81       79.30
------------+-----------------------------------
          8 |        313        4.71       84.01
          9 |        212        3.19       87.20
         10 |        169        2.54       89.74
         11 |        148        2.23       91.97
         12 |         87        1.31       93.28
         13 |        103        1.55       94.83
         14 |         66        0.99       95.82
         15 |         45        0.68       96.50
------------+-----------------------------------
         16 |         50        0.75       97.25
         17 |         36        0.54       97.79
         18 |         26        0.39       98.18
         19 |         19        0.29       98.47
```

20	21	0.32	98.78
21	14	0.21	98.99
22	19	0.29	99.28
23	8	0.12	99.40
24	7	0.11	99.50
25	9	0.14	99.64
26	3	0.05	99.68
27	4	0.06	99.74
28	2	0.03	99.77
29	3	0.05	99.82
30	1	0.02	99.83
31	1	0.02	99.85
32	3	0.05	99.89
33	2	0.03	99.92
34	3	0.05	99.97
35	1	0.02	99.98
40	1	0.02	100.00
Total	6,648	100.00	

Here are the evaluations of treatments:

audit_score	Lifetime prevalence 0	1	Total
0	188	218	406
1	263	312	575
2	306	406	712
3	393	535	928
4	431	567	998
5	326	385	711
6	241	315	556
7	177	209	386
8	142	171	313
9	101	111	212
10	77	92	169
11	62	86	148
12	49	38	87
13	50	53	103
14	27	39	66
15	26	19	45
16	24	26	50
17	21	15	36
18	13	13	26
19	9	10	19
20	13	8	21
21	11	3	14
22	13	6	19
23	5	3	8
24	3	4	7
25	4	5	9
26	1	2	3
27	1	3	4
28	0	2	2
29	1	2	3
30	0	1	1
31	0	1	1
32	2	1	3
33	0	2	2
34	2	1	3
35	0	1	1
40	0	1	1
Total	2,982	3,666	6,648

Pearson chi2(36) = 41.8557 Pr = 0.232

```
likelihood-ratio chi2(36) =  45.1015   Pr = 0.142
                    gamma =  -0.0288  ASE = 0.016
          Kendall's tau-b =  -0.0193  ASE = 0.010
```

H. BAI

We have 1,671 valid survey respondents that completed the BAI survey questions, and of course everyone in that 1,671 also did FLAGS.

Here is the Likert scale used for each question:

Fear of dying	Freq.	Percent	Cum.
Not at all	1,253	74.99	74.99
Mildly but it didn't bother me much.	267	15.98	90.96
Moderately - it wasn't pleasant at time	112	6.70	97.67
Severely - it bothered me a lot.	39	2.33	100.00
Total	1,671	100.00	

Fear of dying	Freq.	Percent	Cum.
1	1,253	74.99	74.99
2	267	15.98	90.96
3	112	6.70	97.67
4	39	2.33	100.00
Total	1,671	100.00	

Beck and Steer [1990] document clearly how to score this: they suggest the total score, since this is viewed as one factor, but the average score would do the same. We have 21 BAI questions. Here is the raw tabulation of the scale, rounded to the nearest 0.1 for ease of viewing:

bai_scoreR	Freq.	Percent	Cum.
1	537	32.14	32.14
1.1	159	9.52	41.65
1.2	139	8.32	49.97
1.3	130	7.78	57.75
1.4	105	6.28	64.03
1.5	90	5.39	69.42
1.6	88	5.27	74.69
1.7	58	3.47	78.16
1.8	50	2.99	81.15
1.9	47	2.81	83.96
2	51	3.05	87.01
2.1	41	2.45	89.47
2.2	40	2.39	91.86
2.3	16	0.96	92.82
2.4	22	1.32	94.14
2.5	12	0.72	94.85
2.6	14	0.84	95.69
2.7	9	0.54	96.23
2.8	10	0.60	96.83
2.9	10	0.60	97.43
3	14	0.84	98.26
3.1	8	0.48	98.74
3.2	2	0.12	98.86
3.3	1	0.06	98.92
3.4	7	0.42	99.34
3.5	4	0.24	99.58

3.6	2	0.12	99.70
3.7	1	0.06	99.76
3.8	1	0.06	99.82
4	3	0.18	100.00
Total	1,671	100.00	

Here are the evaluations of treatments:

bai_scoreR	Lifetime prevalence 0	1	Total
1	245	292	537
1.1	72	87	159
1.2	60	79	139
1.3	53	77	130
1.4	58	47	105
1.5	33	57	90
1.6	45	43	88
1.7	28	30	58
1.8	18	32	50
1.9	22	25	47
2	22	29	51
2.1	17	24	41
2.2	16	24	40
2.3	6	10	16
2.4	11	11	22
2.5	5	7	12
2.6	5	9	14
2.7	4	5	9
2.8	3	7	10
2.9	5	5	10
3	7	7	14
3.1	5	3	8
3.2	1	1	2
3.3	0	1	1
3.4	2	5	7
3.5	2	2	4
3.6	0	2	2
3.7	0	1	1
3.8	0	1	1
4	1	2	3
Total	746	925	1,671

```
         Pearson chi2(29) =  20.4571   Pr = 0.878
likelihood-ratio chi2(29) =  22.4397   Pr = 0.802
                    gamma =   0.0250  ASE = 0.032
          Kendall's tau-b =   0.0163  ASE = 0.021
```

I. BDI

We have 1,695 valid survey respondents that completed the BDI survey questions, and of course everyone in that 1,695 also did FLAGS.

Here is the Likert scale used for each question:

Loss of Interest in Sex	Freq.	Percent	Cum.
I have not noticed any recent ch	1,159	68.38	68.38

```
       I am less interested in sex than |        316       18.64       87.02
       I am much less interested in sex |        117        6.90       93.92
       I have lost interest in sex comp |        103        6.08      100.00
----------------------------------------+-----------------------------------
                                  Total |      1,695      100.00
```

```
    Loss of |
Interest in |
        Sex |      Freq.     Percent        Cum.
------------+-----------------------------------
          0 |      1,159       68.38       68.38
          1 |        316       18.64       87.02
          2 |        117        6.90       93.92
          3 |        103        6.08      100.00
------------+-----------------------------------
      Total |      1,695      100.00
```

Beck et al. [1961] document clearly how to score this: they suggest the total score, since this is viewed as one factor, but the average score would do the same.

Here is the raw tabulation of the scale, rounded to the nearest 0.1 for ease of viewing:

```
 bdi_scoreR |      Freq.     Percent        Cum.
------------+-----------------------------------
          0 |        631       37.23       37.23
         .1 |        167        9.85       47.08
         .2 |        110        6.49       53.57
         .3 |         67        3.95       57.52
         .4 |         52        3.07       60.59
         .5 |         35        2.06       62.65
         .6 |         44        2.60       65.25
         .7 |         63        3.72       68.97
         .8 |         51        3.01       71.98
         .9 |         50        2.95       74.93
          1 |         50        2.95       77.88
        1.1 |         34        2.01       79.88
        1.2 |         27        1.59       81.47
        1.3 |         33        1.95       83.42
        1.4 |         26        1.53       84.96
        1.5 |         18        1.06       86.02
        1.6 |         19        1.12       87.14
        1.7 |         23        1.36       88.50
        1.8 |         25        1.47       89.97
        1.9 |         15        0.88       90.86
          2 |         16        0.94       91.80
        2.1 |         13        0.77       92.57
        2.2 |         16        0.94       93.51
        2.3 |         10        0.59       94.10
        2.4 |         13        0.77       94.87
        2.5 |          8        0.47       95.34
        2.6 |          7        0.41       95.75
        2.7 |         10        0.59       96.34
        2.8 |          7        0.41       96.76
        2.9 |          7        0.41       97.17
          3 |          9        0.53       97.70
        3.1 |          6        0.35       98.05
        3.2 |          6        0.35       98.41
        3.3 |          4        0.24       98.64
        3.4 |          5        0.29       98.94
        3.5 |          3        0.18       99.12
        3.6 |          3        0.18       99.29
        3.7 |          1        0.06       99.35
        3.8 |          4        0.24       99.59
        3.9 |          2        0.12       99.71
          4 |          4        0.24       99.94
```

```
        4.2 |          1        0.06      100.00
------------+-----------------------------------
      Total |      1,695      100.00
```

J. BIS

We have 1,761 valid survey respondents that completed the BIS survey questions, and of course everyone in that 1,761 also did FLAGS.

Here is the Likert scale used for each question:

```
          I plan tasks |
    carefully.         |      Freq.     Percent        Cum.
-----------------------+-----------------------------------
                 Never |         74        4.21        4.21
          Occasionally |        494       28.12       32.33
                 Often |        786       44.74       77.06
Almost always / Always |        403       22.94      100.00
-----------------------+-----------------------------------
                 Total |      1,757      100.00

     I plan |
      tasks |
 carefully. |      Freq.     Percent        Cum.
------------+-----------------------------------
          1 |         74        4.21        4.21
          2 |        494       28.12       32.33
          3 |        786       44.74       77.06
          4 |        403       22.94      100.00
------------+-----------------------------------
      Total |      1,757      100.00
```

Patton, Stanford and Barratt [1995] document clearly how to score this: they suggest the total score, since this is viewed as one factor, but the average score would do the same. We have 30 BIS questions.

Here is the raw tabulation of the scale, rounded to the nearest 0.1 for ease of viewing:

```
bis_scoreR |      Freq.     Percent        Cum.
------------+-----------------------------------
          1 |          3        0.17        0.17
        1.1 |          2        0.11        0.28
        1.2 |          3        0.17        0.46
        1.3 |          1        0.06        0.51
        1.4 |          3        0.17        0.68
        1.5 |          3        0.17        0.85
        1.6 |          6        0.34        1.20
        1.7 |         52        2.96        4.15
        1.8 |        116        6.60       10.76
        1.9 |        214       12.18       22.94
          2 |        291       16.56       39.50
        2.1 |        366       20.83       60.33
        2.2 |        309       17.59       77.92
        2.3 |        209       11.90       89.81
        2.4 |        102        5.81       95.62
        2.5 |         53        3.02       98.63
        2.6 |         17        0.97       99.60
        2.7 |          3        0.17       99.77
        2.8 |          3        0.17       99.94
        2.9 |          1        0.06      100.00
------------+-----------------------------------
      Total |      1,757      100.00
```

Appendix C: Summary Statistics

Of the 65,592 Danes that were invited to participate in the survey, only 8,405 completed the entire survey, while 3,331 started but did not complete the survey. We here present the background information that is available for participants and non-participants.

We have background information for all participants and non-participants on sex, age, and region, but we have missing values for the other variables for several non-participants. We received background information on non-participants from the companies that administered the survey, and they could not provide complete information for all invited people.

	Completed					**Partially Completed**					**Non-Participants**				
	N	*Mean*	*Std. Dev.*	*Min*	*Max*	*N*	*Mean*	*Std. Dev.*	*Min*	*Max*	*N*	*Mean*	*Std. Dev.*	*Min*	*Max*
Female	8405	0.54	0.50	0	1	3331	0.58	0.49	0	1	53856	0.62	0.49	0	1
Age	8405	49.19	14.82	18	75	3331	48.15	15.23	18	75	53856	41.32	14.07	18	75
Young (18-29)	8405	0.13	0.33	0	1	3331	0.16	0.36	0	1	53856	0.24	0.42	0	1
Middle (30-39)	8405	0.15	0.36	0	1	3331	0.15	0.35	0	1	53856	0.23	0.42	0	1
Ripe Aged (40-49)	8405	0.20	0.40	0	1	3331	0.20	0.40	0	1	53856	0.25	0.43	0	1
Older (50+)	8405	0.52	0.50	0	1	3331	0.49	0.50	0	1	53856	0.29	0.45	0	1
Capital Region	8405	0.49	0.50	0	1	3331	0.55	0.50	0	1	53856	0.44	0.50	0	1
Central Denmark	8405	0.17	0.37	0	1	3331	0.15	0.36	0	1	53856	0.18	0.39	0	1
North Denmark	8405	0.06	0.25	0	1	3331	0.06	0.23	0	1	53856	0.07	0.26	0	1
Zealand	8405	0.12	0.33	0	1	3331	0.11	0.31	0	1	53856	0.13	0.34	0	1
Southern Denmark	8405	0.16	0.37	0	1	3331	0.13	0.33	0	1	53856	0.17	0.38	0	1
Lives in a House	8405	0.56	0.50	0	1	3000	0.55	0.50	0	1	42699	0.55	0.50	0	1
Owns a House	8405	0.55	0.50	0	1	3030	0.56	0.50	0	1	43046	0.53	0.50	0	1
Lives with a Partner	8405	0.64	0.48	0	1	2991	0.64	0.48	0	1	38373	0.63	0.48	0	1
Children in Household	8405	0.26	0.44	0	1	944	0.25	0.43	0	1	9177	0.43	0.50	0	1
Civil Servant	8405	0.39	0.49	0	1	3094	0.44	0.50	0	1	44428	0.43	0.49	0	1
Retired	8405	0.23	0.42	0	1	3094	0.17	0.38	0	1	44428	0.08	0.27	0	1
Unskilled	8405	0.05	0.22	0	1	3094	0.04	0.20	0	1	44428	0.06	0.24	0	1
Skilled	8405	0.10	0.30	0	1	3094	0.08	0.28	0	1	44428	0.12	0.33	0	1
Self Employed	8405	0.05	0.21	0	1	3094	0.04	0.20	0	1	44428	0.04	0.20	0	1
Vocational Training	8405	0.23	0.42	0	1	2993	0.19	0.39	0	1	37716	0.19	0.39	0	1
Low Formal Education	8405	0.21	0.41	0	1	2993	0.21	0.41	0	1	37716	0.26	0.44	0	1
Short Education (<3 Y. College)	8405	0.10	0.31	0	1	2993	0.09	0.29	0	1	37716	0.09	0.28	0	1
Med. Education (3-4 Y. College)	8405	0.29	0.45	0	1	2993	0.31	0.46	0	1	37716	0.30	0.46	0	1
High Education (5+ Y. College)	8405	0.17	0.38	0	1	2993	0.18	0.38	0	1	37716	0.15	0.36	0	1
Low Income (<300,000)	8405	0.37	0.48	0	1	3033	0.36	0.48	0	1	43021	0.42	0.49	0	1
Med. Income (300,000-500,000)	8405	0.34	0.47	0	1	3033	0.33	0.47	0	1	43021	0.32	0.47	0	1
High Income (500,000-800,000)	8405	0.12	0.33	0	1	3033	0.12	0.32	0	1	43021	0.10	0.30	0	1
Very High Income (>800,000)	8405	0.02	0.15	0	1	3033	0.03	0.16	0	1	43021	0.02	0.15	0	1
Silent about Income	8405	0.14	0.35	0	1	3033	0.16	0.37	0	1	43021	0.14	0.34	0	1
Q: Experienced Death	8405	0.12	0.33	0	1	33	0.12	0.33	0	1	0				
Q: Has been Hospitalized	8405	0.10	0.30	0	1	33	0.06	0.24	0	1	0				
Q: Trigger 40 DKK	8405	0.38	0.49	0	1	33	0.24	0.44	0	1	0				
Q: Trigger 500 DKK	8405	0.05	0.22	0	1	33	0.03	0.17	0	1	0				
Q: Currently Smoker	8405	0.20	0.40	0	1	32	0.34	0.48	0	1	0				

Note: The last 5 variables are based on additional questions asked in the surveys (see Appendix A).

Appendix D: The Ordered Probit Statistical Model

We document here the statistical model developed for the primary analyses. The outcome of interest is the FLAGS risk level, which can take on any of the ordinal values h={1, 2, 3, 4, 5} corresponding to the five FLAGS risk categories, (1) no detectable risk; (2) early risk; (3) intermediate risk; (4) advanced risk; and (5) problem gambler. The statistical tool to analyze the ordinal outcome is the Ordered Probit model. The probability that outcome y_j=h for a given individual j is defined by

$$\Pr(\mathrm{yj} = \mathrm{h}) = \Pr\left(\kappa_{h-1} < x_j\beta + u_j \leq \kappa_h\right) = \Phi\left(\kappa_h - x_j\beta\right) - \Phi\left(\kappa_{h-1} - x_j\beta\right)$$

where x_j is a vector of k independent variables and β are the k corresponding coefficients. κ_i are the cut points between the various outcome possibilities, where $\kappa_0 = -\infty$ and $\kappa_5 = +\infty$. The error term u_j is assumed to be normally distributed and $\Phi(\cdot)$ is the cumulative standard normal distribution function. The probability of observing outcome h for individual j is then defined by the probability that $x_j\beta + u_j$ falls between the cut points κ_{h-1} and κ_h.

We estimate the cut points κ_1 to κ_4 and the vector of coefficients β using maximum likelihood. The log likelihood function is

$$\ln L(\beta, \kappa_h) = \sum_{j=1}^{n}\sum_{h=1}^{H} I_h(y_j = h) \ln\left(\Phi\left(\kappa_h - x_j\beta\right) - \Phi\left(\kappa_{h-1} - x_j\beta\right)\right)$$

where $I_h(y_j = h) = 1$ if $y_j = h$, and 0 otherwise. H is the highest outcome: in the case of a FLAGS risk level H=5. *n* is the number of respondents for whom we can calculate a valid FLAGS risk level.

As independent variables, we include treatments (FLAGS first, randomized questions, lifetime frame), demographic characteristics (sex, age, and income), as well as an indicator for smoking and an indicator for subcontractor. To analyze the effects of scores in other gambling screens on FLAGS levels, we expand the model by adding the score in the other instrument as an independent variable. When other gambling screens are analyzed we simply replace the ordered outcome variable y_j with the risk category from the other gambling screen.

We make two extensions to the Ordered Probit model. First, we control for sample weights, and second, we correct for sample selection. Sample weights are constructed from administrative data at Statistics Denmark on the population size of men and women in various age groups and regions in Denmark, and we specify in the estimation that each observation in the data is weighted by the corresponding sample weight.

To correct for sample selection, we model the decision to participate in the survey as

$$s_j = 1(z_j\gamma + v_j > 0)$$

where $s_j = 1$ if an invited participant completes the survey, z_j is a vector of independent variables that affect participation in the survey, γ is vector of coefficients, and v_j is a random error. We assume that v_j from the selection equation and u_j from the ordered probit equation have a bivariate normal distribution with mean zero and covariance matrix

$$\begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix}$$

We jointly estimate the cut points κ_1 to κ_4, the vector of coefficients β from the ordered probit equation, the vector of coefficients γ from the selection equation, and the correlation coefficient ρ using maximum likelihood. The log likelihood is

$$\ln L(\beta, \kappa_h, \gamma, \rho) = \sum_{\substack{j=1 \\ i \notin S}}^{N} \ln\left(\Phi(-z_j\gamma)\right) + \sum_{\substack{j=1 \\ i \in S}}^{N} \sum_{h=1}^{H} I_h(y_j = h) \ln\left(\Phi_2(z_j\gamma, \kappa_h - x_j\,\beta\,, -\rho) - \Phi_2(z_j\gamma, \kappa_{h-1} - x_j\,\beta\,, -\rho)\right)$$

where S is the set of participants for whom the outcome y_j is observed. $\Phi_2(\cdot)$ is the cumulative bivariate normal distribution function, and $\Phi(\cdot)$ is the standard normal distribution.

When the correlation coefficient ρ of the bivariate normal distribution is equal to 0, the log likelihood becomes

$$\ln L(\beta, \kappa_h, \gamma) = \sum_{j=1}^{N} \omega_j \ln\left(\Phi(-z_j\gamma)\right) + \sum_{\substack{j=1 \\ i \in S}}^{N} \sum_{h=1}^{H} \omega_j I_h(y_j = h) \ln\left(\Phi(\kappa_h - x_j\beta) - \Phi(\kappa_{h-1} - x_j\beta)\right)$$

which is simply the sum of two likelihood functions: the probit model on selection and the ordered probit model on FLAGS levels.

Appendix E: Predicted FLAGS Levels

We present predicted FLAGS levels for the sample and the population. Prevalence of *No Risk* is the average of $\Phi(\text{Cut } 1 - x_i\beta)$ of all 8,405 participants in the survey, where Φ is a cumulative normal distribution, Cut 1 is the estimated first cut point, and $x_i\beta$ is the prediction for each participant based on the covariate values x_i and estimated coefficients β reported in Table 2. Prevalence of *Early Risk* is the average of $[\Phi(\text{Cut } 2 - x_i\beta) - \Phi(\text{Cut } 1 - x_i\beta)]$, prevalence of *Intermediate Risk* is the average of $[\Phi(\text{Cut } 3 - x_i\beta) - \Phi(\text{Cut } 2 - x_i\beta)]$, prevalence of *Advanced Risk* is the average of $[\Phi(\text{Cut } 4 - x_i\beta) - \Phi(\text{Cut } 3 - x_i\beta)]$, and prevalence of *Problem Gambling* is the average of $[1 - \Phi(\text{Cut } 4 - x_i\beta)]$.

We start with the Ordered Probit model without sample weights and report the predicted prevalence rates for the sample below. The prevalence rates are predicted for the 8,405 participants.

	Delta-method				
	Margin	Std. Err.	z	P>|z|	[95% Conf. Interval]
no_risk	.7970511	.0040352	197.52	0.000	.7891421 .80496
early_risk	.1198309	.0034657	34.58	0.000	.1130382 .1266236
int_risk	.0392533	.0020744	18.92	0.000	.0351875 .0433191
adv_risk	.0325441	.0018598	17.50	0.000	.0288991 .0361891
pg	.0113206	.001096	10.33	0.000	.0091725 .0134688

We now add sample weights in the Ordered Probit model and generate predicted prevalence rates for the adult Danish population. The prevalence rates are predicted for the 8,405 participants and weighted with the sample weights for the participants.

	Delta-method				
	Margin	Std. Err.	z	P>|z|	[95% Conf. Interval]
no_risk	.7603547	.0068287	111.35	0.000	.7469688 .7737406
early_risk	.1324899	.0052416	25.28	0.000	.1222151 .1427646
int_risk	.0423597	.0031089	13.63	0.000	.0362655 .0484538
adv_risk	.0462341	.0037533	12.32	0.000	.0388766 .0535915
pg	.0185617	.002697	6.88	0.000	.013275 .0238485

Finally, we estimate the Ordered Probit model with controls for sample selection and sample weights calculated for the sample frame of all invited people. The prevalence rates are predicted for the 8,405 participants and weighted with the sample weights for the participants.

	Delta-method				
	Margin	Std. Err.	z	P>|z|	[95% Conf. Interval]
no_risk	.9539403	.0079902	119.39	0.000	.9382797 .9696008
early_risk	.0287174	.005468	5.25	0.000	.0180004 .0394344
int_risk	.0082087	.0014781	5.55	0.000	.0053117 .0111057
adv_risk	.0070422	.0010905	6.46	0.000	.0049048 .0091796
pg	.0020914	.000324	6.45	0.000	.0014563 .0027265

Appendix F: Additional Figures on Marginal Effects of Demographic Characteristics

We present additional figures that illustrate the marginal effects of demographic characteristics on FLAGS levels. The estimations are based on the Ordered Probit model with controls for sample selection and sample weights.

Figure F1: Marginal Effect of Being Young
on Probability of FLAGS Gambling Risk Level

Young defined as aged between 18 and 29

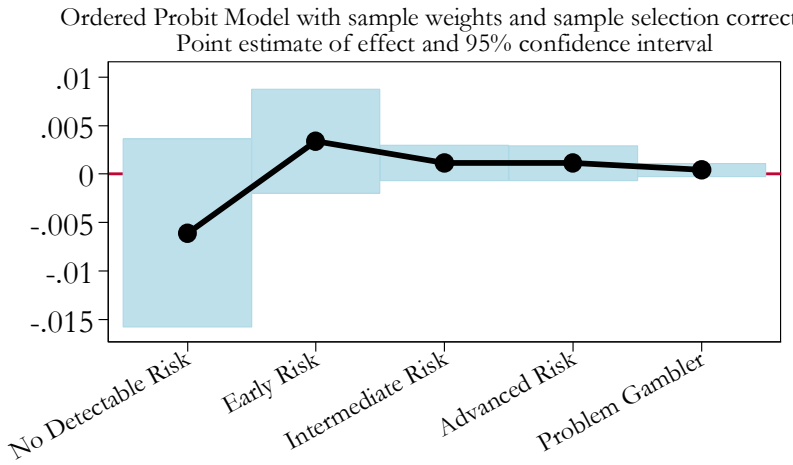


Figure F2: Marginal Effect of Being Ripe_Aged
on Probability of FLAGS Gambling Risk Level

Ripe-Aged defined as aged between 40 and 49

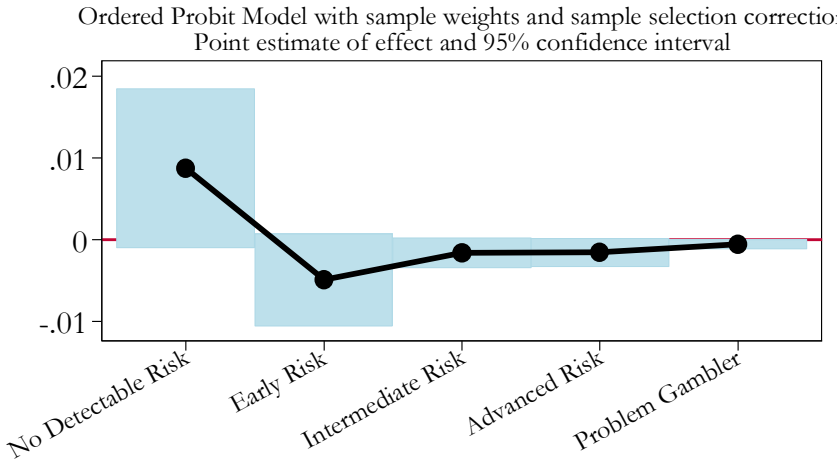


Figure F3: Marginal Effect of Being Older
on Probability of FLAGS Gambling Risk Level

Older defined as aged 50 and over

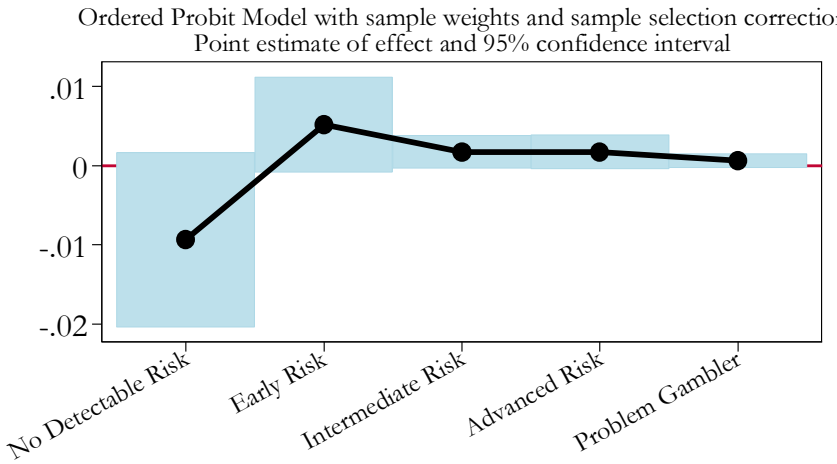


Figure F4: Marginal Effect of Having Medium Income
on Probability of FLAGS Gambling Risk Level

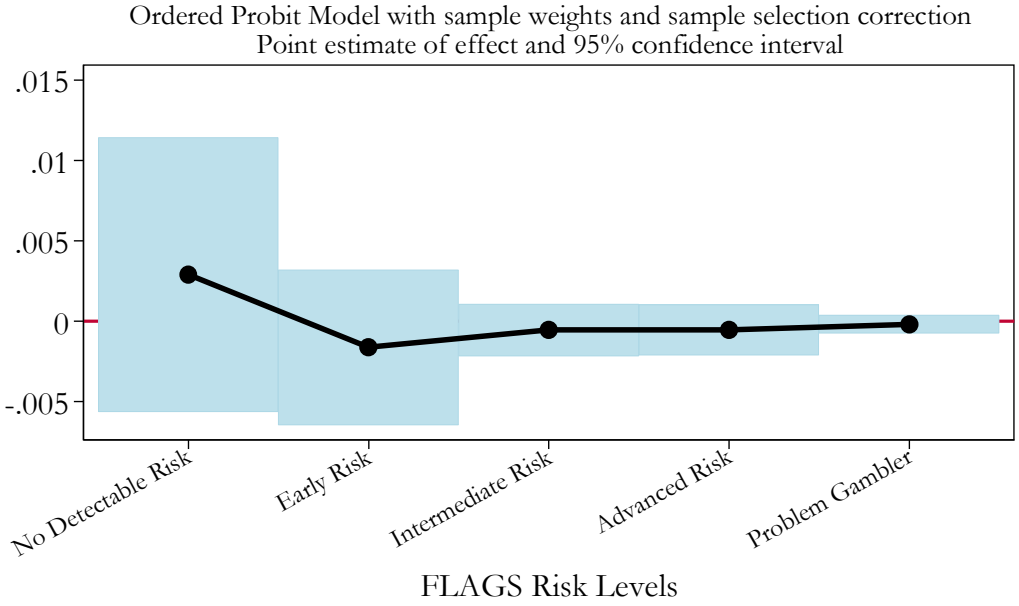


Figure F4: Marginal Effect of Having Medium Income
on Probability of FLAGS Gambling Risk Level

Ordered Probit Model with sample weights and sample selection correction
Point estimate of effect and 95% confidence interval

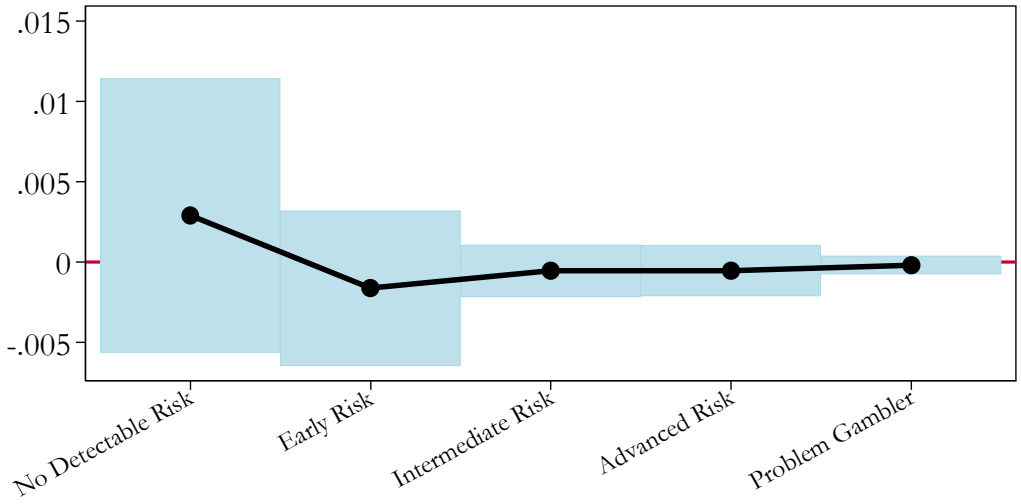


Figure F6: Marginal Effect of Having Very High Income
on Probability of FLAGS Gambling Risk Level

Ordered Probit Model with sample weights and sample selection correction
Point estimate of effect and 95% confidence interval

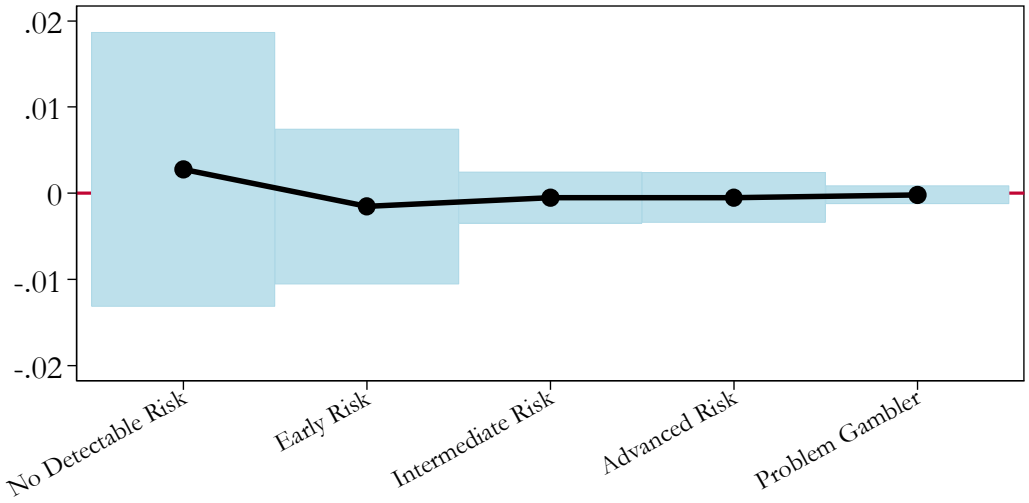
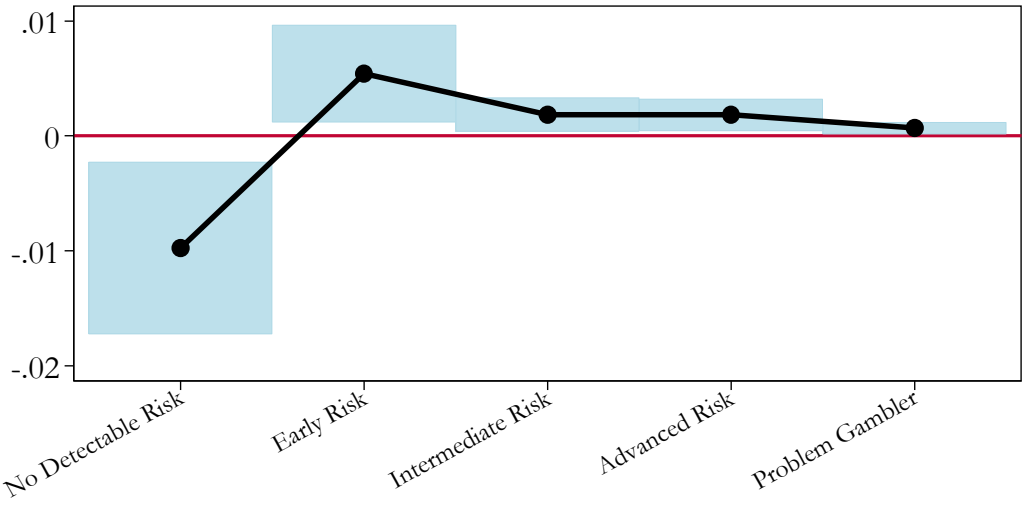


Figure F7: Marginal Effect of Being Smoker
on Probability of FLAGS Gambling Risk Level

Ordered Probit Model with sample weights and sample selection correction
Point estimate of effect and 95% confidence interval



u

Appendix G: Marginal Effects of other Survey Instruments on FLAGS Level

The figures below show the marginal effects of scores from other gambling screens on predicted FLAGS levels. The estimations are based on the Ordered Probit model with no controls for sample selection or survey weights.

Figure G1: Marginal Effect of DSM Level
on Probability of *FLAGS* Gambling Risk Level

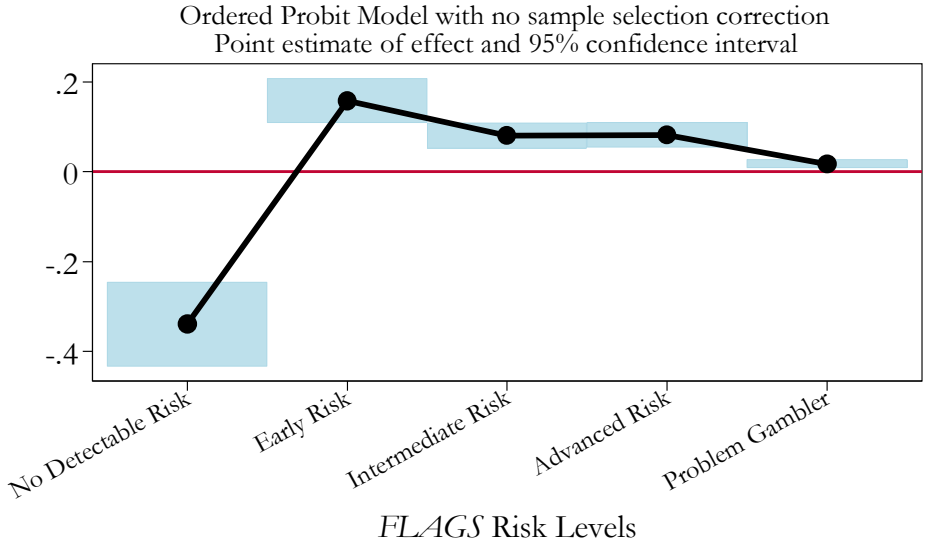


Figure G2: Marginal Effect of PGSI Level
on Probability of *FLAGS* Gambling Risk Level

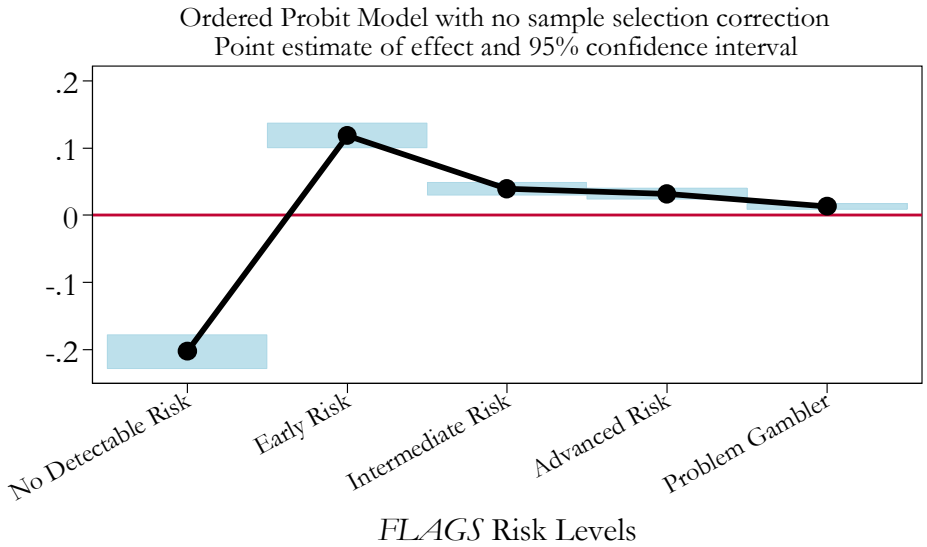


Figure G3: Marginal Effect of GACS Score
on Probability of *FLAGS* Gambling Risk Level

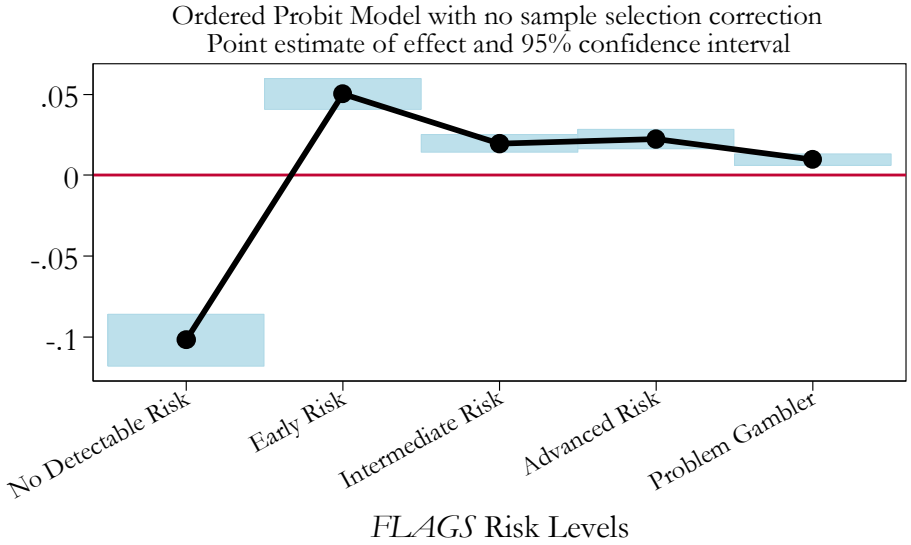


Figure G4: Marginal Effect of GRCS Score
on Probability of *FLAGS* Gambling Risk Level

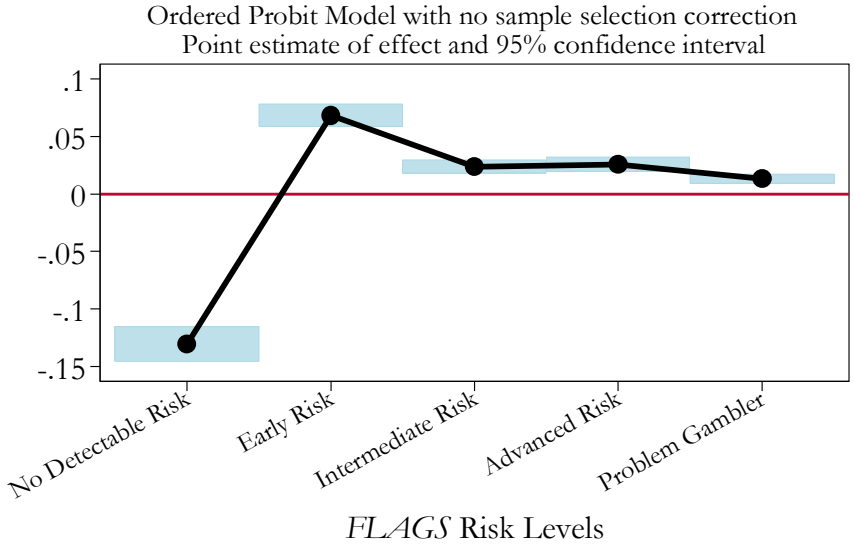


Figure G5: Marginal Effect of GUS Score
on Probability of *FLAGS* Gambling Risk Level

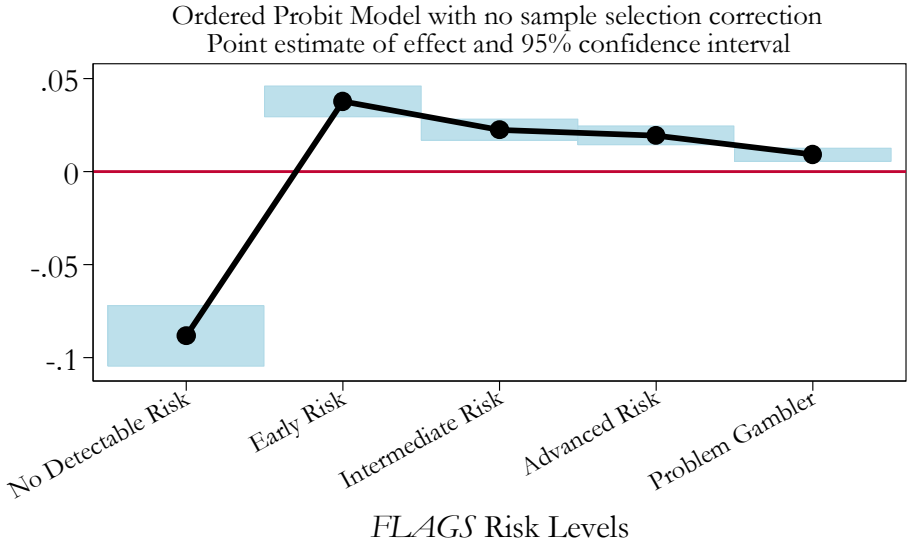


Figure G6: Marginal Effect of AUDIT Score
on Probability of *FLAGS* Gambling Risk Level

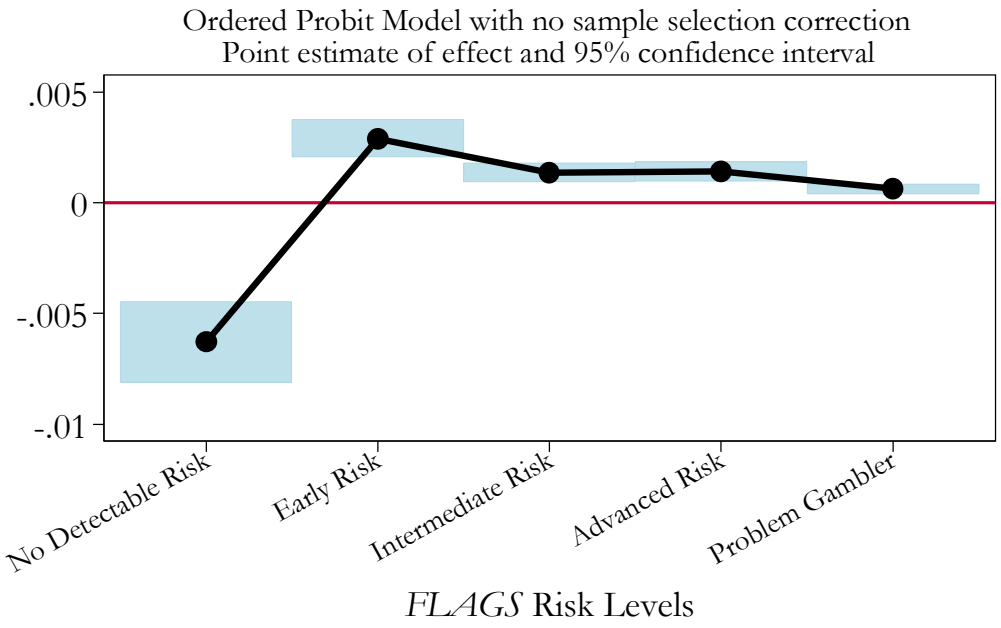


Figure G7: Marginal Effect of BAI Score
on Probability of *FLAGS* Gambling Risk Level

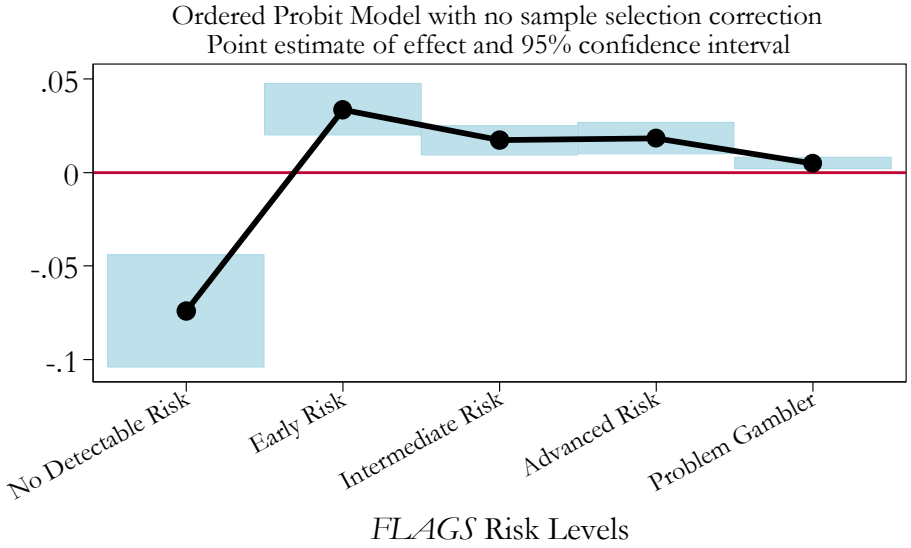


Figure G8: Marginal Effect of BDI Score
on Probability of *FLAGS* Gambling Risk Level

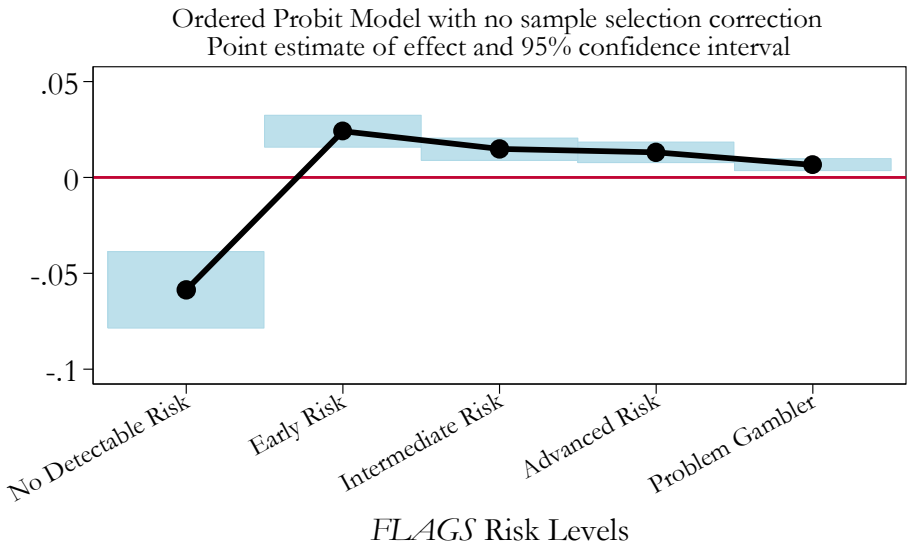


Figure G9: Marginal Effect of BIS Score
on Probability of *FLAGS* Gambling Risk Level