

The development of empirically derived Australian responsible gambling limits

August 2018



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The development of empirically derived Australian responsible gambling limits

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Deakin University

August, 2018



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Key terms

Acronym or term	Description
ACT	Australian Capital Territory
ANOVA	Analysis of Variance
ANS	Autonomic Nervous System Questionnaire
ASRS	ADHD Self-Report Scale
AUC	Area Under the Curve
AUDIT-3	Alcohol Use Disorders Identification Test-3
CATI	Computer Assisted Telephone Interviewing
DIGS	Diagnostic Interview for Gambling Severity
EGMs	Electronic Gaming Machines
GAD-2	Generalised Anxiety Disorder-2
K6	Kessler 6 Psychological Distress Scale
LGA	Local Government Area
Mini SPIN	Social Phobia Inventory
NHMRC	National Health and Medical Research Council
NPV	Negative Predictive Value
OR	Odds ratio
PC-PTSD	Primary Care Posttraumatic Stress Disorder
PGSI	Problem Gambling Severity Index
PHQ-2	Patient Health Questionnaire-2
PPV	Positive Predictive Value
ROC	Receiver Operating Characteristic
SCID	Structured Clinical Interview for DSM-IV
SEIS	Social and Economic Impact Study
SOGS	South Oaks Gambling Screen
WHOQOL-BREF	World Health Organisation Quality of Life-Bref

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Executive summary

Project overview

The Victorian Responsible Gambling Foundation engaged researchers from Deakin University, the Australian National University, and the Centre for Alcohol Policy Research (CAPR) at LaTrobe University to identify a set of empirically based responsible gambling limits that can be used to inform the development of responsible gambling guidelines for promotion to the Australian public. The identification and validation of responsible gambling limits for the Australian population was achieved through the secondary data analysis of several existing state or territory datasets (Tasmania and ACT). Given jurisdictional differences in socio-demographic and gambling behaviour, a similar pattern of results found across these independently conducted surveys would enhance the generalisability of the identified responsible gambling limits to other states of Australia, such as Victoria. Two primary data collection studies were also conducted to canvas Australian expert opinion and Victorian public opinion about the promotion of responsible gambling limits. The results from both the secondary analysis of population data and the public and expert opinion surveys have been integrated in this executive summary.

Background

In contrast to the alcohol field, which has identified low-risk drinking limits that distinguish low- and high-risk drinking behaviour, there has been very little empirical research attempting to define levels of responsible gambling. Research conducted across various North American population, clinical, and university student samples has employed almost identical statistical methodologies: risk (dose-response) curves to explore the degree to which gambling behaviours are associated with gambling-related harm; receiver operating characteristic (ROC) analyses to identify optimal responsible gambling limits; and predominantly logistic regression modelling to examine the associations between the limits and gambling-related harm. The population-representative studies have identified similar limits: gambling no more than 2 to 8 times per month; spending no more than \$132 and \$1020CAD per year on gambling; spending no more than 1 to 3% of gross household income on gambling activities; gambling for no longer than 60 minutes per session; and gambling on no more than 4 types of gambling activities per year. There is also longitudinal population-based evidence that gambling at levels beyond the limits is indicative of future harm. Gambling experts also believe that empirically derived responsible gambling limits are important in preventing gambling-related harm. The Canadian population-based responsible gambling limits, however, may not be generalisable to other jurisdictions given differences in gambling availability, regulation, and treatment provision.

Project aims

This program of research replicates and extends this previous research. The primary aim was to identify a set of empirically based responsible gambling limits that can be used to inform the development of Australian responsible gambling guidelines. Specifically, this aim involved: (a) examining the risk (dose-response) curves across multiple gambling indices and multiple definitions of harm using the Problem Gambling Severity Index (PGSI) across multiple population-representative studies; (b) identifying multiple sets of responsible gambling limits by exploring the optimal cut-offs in ROC analyses across these gambling indices and definitions of harm; and identify a set of proposed responsible gambling limits based on a selected definition of gambling-related harm; (c) identifying the proportion of the population exceeding the proposed responsible gambling limits; (d) exploring whether gambling at levels beyond the proposed responsible gambling limits is cross-sectionally and

longitudinally associated with gambling-related harm; (e) profiling the target population (gamblers exceeding the selected definition of gambling-related harm) and the target audience (gamblers exceeding each of the proposed responsible gambling limits) for the promotion of the proposed limits; (f) conducting sensitivity analyses excluding gamblers who only play lottery from the ROC analyses; (g) identifying the relative and absolute risk associated with exceeding the proposed responsible gambling limits; (h) considering the base prevalence rate of gambling-related harm by identifying the proportion of gamblers exceeding the proposed limits who actually experience gambling-related harm (positive predictive values) and the proportion of gamblers remaining within the limits who do not actually experience gambling-related harm (negative predictive values); and (i) maximising specificity (the ability of a responsible gambling limit to accurately identify individuals not experiencing gambling-related harm) then the sensitivity (the ability of a responsible gambling limit to accurately identify individuals not experiencing gambling-related harm) in the ROC analyses.

Secondary aims of this program of research were to: (1) Identify and evaluate responsible gambling limits for specific sub-groups of the population (gender and age); (2) Identify and evaluate responsible gambling limits for specific gambling activities; (3) Identify responsible gambling limits for the population using alternative measures of gambling-related harm, such as alternative gambling-related harm items, quality of life, mental health, and substance use; and (4) Canvas expert and public opinion about the promotion of responsible gambling limits.

Method

This project identified responsible gambling limits through secondary analysis of population data from the combined datasets from the second and third Social and Economic Impact Study of Gambling in Tasmania (n=9,303) and the dataset from the 2014 Survey on Gambling, Health and Wellbeing in the ACT (n=2,294). The longitudinal validity of the limits was explored through secondary analysis of the three waves (across nearly 4 years) of the Tasmanian Longitudinal Gambling Survey (wave 1: n=2,027; wave 2: n=1,039; wave 3: n=820). These computer assisted telephone interviewing (CATI) surveys were selected for analysis as they are among the few available population-representative studies in Australia to collect continuous expenditure data across multiple gambling activities. In this project, the optimal cut-off limit for the gambling behaviour being examined was considered acceptable for ROC models displaying moderate to high classification accuracy (i.e., an Area Under the Curve [AUC] value ≥ 0.70).

Because there is no standard unit of gambling, multiple dimensions of gambling behaviour were employed across the analyses (gambling frequency, gambling expenditure, gambling expenditure as a proportion of gross personal income, number of gambling activities, session expenditure, and session duration). As in previous research, multiple definitions of harm using subsets of items from the PGSI were employed. The definition of gambling-related harm was also extended to other harms, including alternative gambling-related harm items, and measures of quality of life (physical health, psychological health, social relationships, and environment), mental health (depression, generalised anxiety symptoms, panic symptoms, post-traumatic stress disorder symptoms, generalised social anxiety symptoms, attention-deficit hyperactivity disorder symptoms, and psychological distress), and substance use (hazardous drinking, smoking, illicit drug use, and prescription drug misuse). Several measures were also employed to profile the target population and target audience for the promotion of the proposed responsible gambling limits (socio-demographic characteristics, gambling participation, problem gambling severity, hazardous drinking, smoking, psychological distress, and general health).

Two primary data collected studies were conducted to canvas the opinions of Australian gambling experts (researchers, clinicians, policy makers, and industry representatives) (n=100) and the Victorian public (non-gamblers, non-problem gamblers, and any-risk gamblers) (n=200) about the promotion of responsible gambling limits. Experts completed an online survey, while a CATI study

employing random digit dialling of landline telephone numbers was conducted with Victorian adults in the general population.

Results

Identification of responsible gambling limits for the population

Although 79% of experts agreed that safe levels of gambling are possible, only 45% agreed that low-risk gambling can have benefits for some people. The risk (dose-response) relationships examined across the multiple gambling indices and multiple PGSI definitions of harm were generally J-shaped when employing the methodology employed in previous responsible gambling limit research. These curves indicate that the chances of experiencing gambling-related harm remained constant at low levels of each of the gambling indices then increased sharply when a certain threshold of gambling behaviour was reached. These curves were, however, generally r-shaped when employing an alternative methodology. Given the statistical robustness of the alternative approach, the data suggest that even low levels of gambling behaviour is associated with harm; and that this harm increases rapidly with even small increases in gambling consumption. While risk curves provide an interesting representation of the dose-response relationship between gambling behaviour and gambling-related harm, they themselves are not employed to identify optimal cut-offs of gambling behaviour involving increased risk of harm. They may, however, imply that responsible gambling limits may be made on the basis of the level of absolute risk that can be tolerated.

Responsible gambling limits for the Tasmania and ACT data identified by exploring the optimal cut-offs in ROC analyses were generally robust to variations in definitions of harm and were generally consistent across both datasets. The definition of harm based on two or more of the seven negative consequence PGSI items was selected as the definition of harm to be employed in this study as it produced superior ROC parameters and captured a relatively high proportion of gamblers in the population (3.5-3.7%). The proposed responsible gambling limits using this definition (Table 1) are generally at the lower end of the range identified in the previous studies. Experts and the public thought these proposed limits were just right (i.e., neither too high nor too low). The proposed responsible gambling limits were generally good cross-sectional predictors of gambling-related harm, even after controlling for the other limits. With the exception of the number of gambling activities limit, all limits were significant longitudinal predictors of gambling-related harm.

Two-thirds of stakeholders (67-68%) agreed that lottery play should be included in the development of responsible gambling guidelines. ROC analyses excluding people who *only* played lottery derived less consistently acceptable responsible gambling limits but similar limits (1.0 to 1.5 times higher). These findings imply that lottery play should be included in the development of responsible gambling limits; and that the development of limits for each type of gambling activity may be more helpful.

Gamblers who exceeded the proposed responsible gambling limits were 3 to 20 times more likely than gamblers who stayed within the limits to experience gambling-related harm. This information can be used in the promotion of the limits so that gamblers can estimate their individual level of risk of experiencing gambling-related harm based on their gambling frequency, expenditure, expenditure as a proportion of income, and number of gambling activities. Interestingly, however, gambling behaviour lower than the proposed responsible gambling limits identified in this study also conferred a considerable degree of risk, which again raises the question about whether there is any level of gambling behaviour that is not associated with harm. Absolute risk calculations in this study revealed that gamblers who exceeded the responsible gambling limits had a 5 to 17% risk of experiencing gambling-related harm. However, the degree of absolute risk incrementally increased as the responsible gambling limit increased. These estimates allow for the selection of responsible gambling limits depending on the tolerable levels of absolute risk.

Based on the prevalence of gambling-related harm in the population, between 7% and 12% of gamblers in the population will actually experience gambling-related harm; and approximately 99% of gamblers who remain within the limits will not experience harm. An appropriate strategy for promoting the proposed limits may therefore be to pose the question: “Approximately 1 in 10 gamblers who spend more than \$615 in a year will experience harm related to their gambling. Is this you?”. These limits identify a higher proportion of gamblers exceeding the limits who experience harm in higher prevalence populations, such as Victorian EGM venue employees (23-34%), Victorian mental health services (53-66%), and Australian online self-directed and support services (98-100%).

In the absence of a conceptual rationale for maximising sensitivity or specificity, previous research has attempted to balance them. This approach produced a very high proportion of false positives in the current study, which may diminish the credibility of responsible gambling limits in the eyes of the public. Limits with specificity maximised resulted in a higher proportion of gamblers exceeding the limits who actually experienced gambling-related harm (7-21%); and resulted in limits that were generally two to four times higher: a gambling frequency of 49 to 65 times per year; a gambling expenditure of \$1,380 to \$2,306 per year; a gambling expenditure comprising 3.03% to 6.19% of an individual's gross personal income; and 2 to 3 gambling activities. These findings suggest that increasing the limits to these consumption levels would identify a larger proportion of gamblers exceeding the limits who actually experience gambling-related harm; without considerably impacting on the identification of gamblers who remain within the limits and do not experience harm.

Responsible gambling limits for population subgroups

The findings suggest that each of the responsible gambling limits predicts gambling-related harm equally for men and women and across age categories. Moreover, few experts (23%) and members of the public (33%) agreed that separate responsible gambling guidelines should be available for men and women. The calculation of gender- and age-specific limits therefore appears unwarranted.

Gambling activity-specific responsible gambling limits

Using the selected definition of harm, only some of the responsible gambling limits were acceptable across gambling activities (Table 1). Stakeholders generally rated the gambling activity-specific limits as just right and three-quarters (73-77%) agreed that responsible gambling guidelines should be available for each type of gambling. Exceeding each of the proposed limits predicted gambling-related harm for all gambling activities, with the exception of horse/dog racing and bingo. There was little consistency in exceeding the proposed gambling activity-specific responsible gambling limits as independent predictors of gambling-related harm after controlling for the other limits. The proposed EGM-specific limits were generally the strongest and most consistent predictors of gambling-related harm.

Responsible gambling limits for the population using alternative measures of gambling-related harm

The use of alternative measures of gambling-related harm items produced relatively consistent and less conservative responsible gambling limits across the four gambling indices. It is likely, however, premature to base responsible gambling guidelines on these measures as they did not produce consistently acceptable limits, they captured fewer respondents in the population experiencing harm, they do not comprise validated instruments with interpretable scoring procedures, and experts and the public rated the validity of the resulting responsible gambling limits as too high. An attempt made to identify responsible gambling limits by exploring the optimal cut-offs in ROC analyses using definitions of harm based on measures of quality of life, mental health, and substance use failed to produce any acceptable responsible gambling limits. These findings highlight the need to derive responsible gambling limits by subjecting validated measures of harm attributable to gambling other than the PGSI

to ROC analyses.

The promotion of responsible gambling limits

Although most stakeholders (90-93%) indicated that responsible gambling guidelines are important in preventing gambling-related harm, behavioural responsible gambling guidelines were rated as more important than each of the proposed responsible gambling limits identified in this study. *Responsible gambling guidelines* and *responsible gambling limits* were the terms preferred by both experts and the public. Experts and members of the public agreed with the promotion of responsible gambling guidelines to the broader population (e.g., via media and education campaigns [88-91%] and social media [79-83%]), gambling populations (e.g., gambling-related websites [93-95%], gambling venues [94%], gambling counselling services [92-94%]), and other vulnerable populations in which there is a high rate of gambling problems (e.g., other community clinics, such as mental health or alcohol or other drug use services [85-90%]). Just under half of experts agreed that the promotion of responsible gambling guidelines should generally indicate that not everyone who exceeds the limit are experiencing gambling-related harm (43%). Their preference was to express this likelihood of risk via risk ratios (e.g., you are up to seven times more likely to experience gambling-related harm if you exceed the limits) (89%) rather than positive predictive values (e.g., approximately 1 in 10 people in the general population who exceed the limits are experiencing gambling-related harm) (46%). Stakeholders preferred weekly (44-50%) or monthly (39-45%) timeframes for the gambling frequency limit; however, while the experts preferred monthly (48%) for the gambling expenditure limit, the public preferred weekly (53%).

The target population for the promotion of the proposed responsible gambling limits (3.5-3.7% of gamblers experiencing gambling-related harm) were most likely to be moderate risk gamblers (53-57%), with smaller proportions of problem gamblers (21-28%) and low risk gamblers (19-22%). They were characterised by EGM and sports/other event betting gambling. In contrast, the target audience for the promotion of the proposed responsible gambling limits (26-60% of gamblers exceeding the proposed limits) to identify gamblers who are at risk for gambling-related harm were characterised by a broad range of characteristics, including older age, male gender, participation on most gambling activities, classification within any of the PGSI risk categories, and hazardous drinking; higher levels of education and higher gross personal incomes appear to be somewhat protective for exceeding the proposed limits.

Given it is likely impractical to promote multiple gambling guidelines, evaluation information about each of the responsible gambling limits was provided to inform limit selection (Table 2). In this study, the gambling expenditure and gambling expenditure as a proportion of gross personal income limits were consistently the best-performing. Because gambling expenditure is confounded by annual income, it has been suggested that gambling expenditure as a proportion of gross personal income may be most relevant in assessing the risk of harm as it provides a standardised index across the gambling population. However, because a considerable proportion of gamblers who exceeded a particular proposed responsible gambling limit also exceeded other proposed limits, the promotion of one of the proposed limits will also likely identify gamblers who exceed other proposed limits.

Experts identified several concerns with the promotion of responsible gambling limits, such as some labels may imply permission to gamble up to the suggested level; the term responsible gambling may perpetuate the notion of individual responsibility, without attributing responsibility to industry or government; the public may dismiss the limits because they are low or due to difficulties with problem recognition; promotion without caveats indicating the likelihood of risk would result in misinterpretations of the limits; gender-specific limits may create confusion; limits cannot be generalised across all forms of gambling; gambling expenditure as a proportion of gross personal income may be difficult to calculate for some people; and responsible gambling limits do not take individual differences into account. Although some experts indicated that the responsible gambling

limits were another avenue with the potential to reduce gambling-related harm, they recommended proper testing of the marketing strategy and messaging prior to and after promotion of the responsible gambling limits to the public, especially with individuals in high-risk demographic categories.

Strengths and limitations

This research allowed for a triangulation of findings from multiple datasets conducted by independent research teams. The similar pattern of results provides strong evidence of robust and generalizable responsible gambling limits to other Australian states and territories. The use of the Tasmanian and ACT surveys as the basis for the data analyses offer several advantages, such as large sample sizes, detailed and precise estimates of gambling frequency and expenditure for each gambling activity, dual-frame methodologies, multiple measures of gambling-related harm, rigorous weighting procedures, and good response rates. Scientific limitations include the use of self-reported measures of gambling involvement and gambling-related harm. Although a strong argument can be made for basing responsible gambling limits on self-reported data because it best reflects the perceptions of gamblers when they consider the relevance of the limits to their behaviour, further research is required to explore the validity of self-reported measures of gambling-related harm. Other limitations include smaller sample sizes and inferior classification accuracy estimates for subgroup analyses; and high amounts of missing data and broad bandwidth intervals for categorical measures of personal income.

Implications

Consistent with a public health perspective, efforts targeted at the prevention of gambling-related harm, rather than problem gambling, may be more effective as they potentially impact a much larger segment of the population. The proposed responsible gambling limits can be used to inform the development of formally-derived quantitative responsible gambling guidelines that can usefully augment the currently available behavioural responsible gambling guidelines. They can serve as an easy and cost-effective screening method for people at high risk for gambling-related harm that may reduce the subjective bias inherent when gamblers respond to problem-focused screening questions. Such normative data allows gamblers to compare their current behaviour with the guideline and can assist them in reducing their gambling consumption by increasing awareness of what defines risk behaviour, highlighting potential negative consequences of exceeding the limits, and enhancing motivation to employ self-directed change strategies or seek help. Responsible gambling limits can also be employed in population-level surveillance research to monitor the prevalence of gambling-related harm, be used to investigate the efficacy of secondary intervention efforts, and be applied in tertiary intervention settings for gamblers selecting a moderation goal.

Conclusions

This is the first study to attempt to identify and evaluate responsible gambling limits using population-representative samples recruited in Australia. Using the less conservative limits from the larger Tasmanian dataset, the proposed responsible gambling limits identified in this program of research are: a gambling frequency of 30 times per year (2.5 times per month); a gambling expenditure of \$615 per year (\$51 per month); a gambling expenditure comprising 1.7% of gross personal income; and 2 gambling activities. While the proposed responsible gambling limits may still appear somewhat conservative, they are consistent with previous research and are supported by expert and public opinion, cross-sectional and longitudinal predictive ability, and similar relative risk ratios at higher levels of gambling consumption. The limits related to gambling expenditure (gambling expenditure and gambling expenditure as a proportion of income limits) were consistently the best-performing limits.

However, the approach employed to derive these limits produced a very high proportion of false positives, which may reduce the creditability of the limits in the eyes of the public. An argument can therefore be made to set higher consumption thresholds and reduce the proportion of false positives by giving more weight to specificity than sensitivity. Maximising specificity resulted in limits that were generally two to four times higher the proposed responsible gambling limits. In Tasmania, these limits were: a gambling frequency of 65 times per year (5.4 times per month); a gambling expenditure of \$2,306 per year (\$192 per month); a gambling expenditure comprising 6.2% of an individual's gross personal income; and 3 gambling activities. These estimates provide an indication of the *most extreme* upper estimates for each of the responsible gambling limits. However, stakeholders believed limits of this magnitude were too liberal, there is little utility in increasing the limits from a relative risk perspective, and some findings, such as r-shaped risk curves and similar relative risk ratios at lower levels of gambling consumption, suggest that gambling at any level appears to carry some level of risk. Moreover, it is important to note that these limits are also predominantly based on less than acceptable sensitivity estimates.

The cut-offs selected may be dependent on the target population, setting, purpose, and amount of tolerable risk. We hope these two sets of limits serve as working guidelines for the consideration of researchers, clinicians, and policy makers and are subject to further rigorous empirical investigation. The eventual offering guidelines based on empirically evaluated limits may generate public discussion about gambling norms and provide the opportunity for consumers to make informed choices about personal risk. Comprehensive evaluation of marketing strategies and messaging is required before these guidelines are promoted to the Australian public.

Table 1. Summary of proposed responsible gambling limits

RESPONSIBLE GAMBLING LIMITS FOR THE POPULATION	
<ul style="list-style-type: none"> • a gambling frequency of 20 to 30 times per year • a gambling expenditure of \$380 to \$615 per year • a gambling expenditure comprising 0.83% to 1.68% of gross personal income • 2 gambling activities 	
RESPONSIBLE GAMBLING LIMITS FOR EGM GAMBLING	RESPONSIBLE GAMBLING LIMITS FOR HORSE/DOG RACE GAMBLING
<ul style="list-style-type: none"> • an EGM gambling frequency of 10 times per year • an EGM gambling expenditure of \$300 per year • an EGM gambling expenditure comprising 0.63% to 1.04% of gross personal income • an EGM session gambling expenditure of \$35 • an EGM session duration of 40 minutes 	<ul style="list-style-type: none"> • a horse/dog race gambling expenditure comprising 0.55% of gross personal income
RESPONSIBLE GAMBLING LIMITS FOR INSTANT SCRATCH TICKET GAMBLING	RESPONSIBLE GAMBLING LIMITS FOR LOTTERY GAMBLING
<ul style="list-style-type: none"> • an instant scratch ticket gambling expenditure of \$45 per year 	<ul style="list-style-type: none"> • a lottery gambling expenditure comprising 0.45% of an individual's gross personal income
RESPONSIBLE GAMBLING LIMITS FOR KENO GAMBLING	RESPONSIBLE GAMBLING LIMITS FOR CASINO TABLE GAMBLING
<ul style="list-style-type: none"> • a keno gambling frequency of 4 to 13 times per year • a keno gambling expenditure of \$45 to \$160 per year 	<ul style="list-style-type: none"> • a casino table game gambling expenditure of \$345 per year • a casino table game gambling expenditure comprising 0.36% to 0.76% of an individual's gross personal income
RESPONSIBLE GAMBLING LIMITS FOR BINGO GAMBLING	RESPONSIBLE GAMBLING LIMITS FOR SPORT/OTHER EVENT GAMBLING
<ul style="list-style-type: none"> • a bingo gambling expenditure of \$150 per year • bingo gambling expenditure comprising 0.49% of an individual's gross personal income • a bingo session duration of 90 minutes • bingo session expenditure of \$17 	<ul style="list-style-type: none"> • a sports/other event betting gambling frequency of 14 times per year • a sports/other event betting gambling expenditure of \$400 per year • a sports/other event gambling expenditure comprising 0.55% to 0.86% of gross personal income

Table 2. Summary comparison of the proposed responsible gambling limits

	Gambling frequency	Gambling expenditure	Gambling expenditure as proportion of gross personal income	Number of gambling activities
General population exceeding this limit (%)	19-24	15-16	14-16	27-37
Gamblers exceeding this limit (%)	35-39	26-28	27-28	50-60
Gamblers exceeding this limit who only exceeded this limit (%)	9-12	1	2-4	25-40
Gamblers exceeding this limit who exceeded all four limits (%)	25-35	57-60	56-71	27-43
Cross-sectional association with gambling-related harm ^a	Yes	Yes	Yes	Yes
Independent cross-sectional association with gambling-related harm ^b	No	Yes	N/A	Yes (Tas only)
Longitudinal association with gambling-related harm ^a	Yes	Yes (wave 2 only)	Yes	No
Independent longitudinal association with gambling-related harm ^b	Yes (wave 3 only)	Yes (wave 2 only)	N/A	No
Relative risk	3-6	7-11	8-20	4-5
Absolute risk (%)	5-12	7-15	7-17	5-11
Gamblers exceeding this limit who actually experience gambling-related harm (%)	8	10-12	10-11	7
Gamblers staying within this limit who actually do not experience gambling-related harm (%)	98-99	99	99	98-99
Ranking by experts	3	1	2	4
First preference for promotion by experts (%)	27	35	32	6
First preference for promotion by the public (%)	26	26	41	8

^a after controlling for socio-demographic characteristics^b after controlling for other proposed responsible gambling limits and socio-demographic characteristics

Background

Introduction

Australian states and territories have adopted a public health perspective towards gambling. This perspective, which frames gambling within a whole of population approach that can inform policy for prevention and intervention practices, attempts to identify the determinants of health behaviours (such as gambling) and subsequent health outcomes (such as harm) (Korn & Shaffer, 1999). In their recent study systematically investigating gambling-related harm in Victoria, Browne et al. (2016) proposed a functional definition of gambling-related harm generated from their data analysis: *Any initial or exacerbated adverse consequence due to an engagement with gambling that leads to a decrement to the health or wellbeing of an individual, family unit, community or population*. They developed a conceptual framework that organised harms within seven broad domains (financial harm; relationship disruption, conflict or breakdown; emotional or psychological distress; decrements to health; cultural harm; reduced performance at work or study; and criminal activity) separated into three temporal categories (general harms, crisis harms [harms that occur at a temporal point of significance], and legacy harms [those harms that continue to occur, or emerge, even if engagement with gambling ceases]). The application of the public health framework to gambling, however, has resulted in growing concern that gambling research, and subsequent gambling policy, has conflated problem gambling symptomatology and characteristics with the potential negative consequences of gambling (Browne et al., 2016; Productivity Commission, 2010). Problem gambling severity and harm are closely coupled but conceptually distinct constructs, and harm that occurs below the problem gambling threshold is still relevant to policy (Browne et al., 2016; Productivity Commission, 2010).

Browne et al. (2016) assessed the aggregate ‘burden of harm’ caused by gambling in Victoria with reference to different levels of problem gambling. Using the prevalence data from the most recent Victorian prevalence survey, Browne et al. (2016) estimated that 50%, 34%, and 15% of the total harm resulting from gambling in Victoria can be divided among low risk, moderate risk and problem gamblers, respectively. Although the quality of life of problem gamblers is affected 3 to 4 times more than low risk gamblers, this is outweighed by the larger prevalence of individuals in the low risk category. The finding that small individual-level harms can aggregate to a significant population level harm suggests a need to capture the degree of harm across the spectrum of gambling problems, including capturing harms amongst people with few symptoms of disordered gambling (Browne et al., 2016; Productivity Commission, 2010). Efforts moving towards the prevention of gambling-related harm allows for a broader prevention goal that impacts on a much broader segment of the population than just problem gamblers (Currie et al., 2006; Currie, Miller, Hodgins, & Wang, 2009).

To date, however, there is little research on gambling-related harm or “normal” or “responsible” gambling behaviour. The term “responsible gambling” is widely used but has been criticised on the grounds that it lacks a universally accepted definition (Blaszczynski, Ladouceur, & Shaffer, 2004), although it usually refers generically to gambling at recreational or safe levels (Currie et al., 2006). The Victorian Responsible Gambling Foundation defines responsible gambling in terms of responsibilities for both individuals and the wider community. In this definition, responsible gambling for individuals means: “they may gamble for pleasure and entertainment but are aware of their likelihood of losing and understand the associated risks; they exercise control over their gambling activity; and responsible gambling occurs in balance with other activities in their lives and is not causing problems or harm for themselves or others”. In contrast, responsible gambling for the broader community, including gambling providers, governments, and sporting associations, requires: “shared responsibility for generating awareness of the risks associated with gambling; creating and promoting environments that prevent or minimise problem gambling, and being responsive to community concerns around

gambling". To date, however, there is very little empirical evidence defining levels of responsible, safe or recreational gambling.

The development of low-risk drinking guidelines

In contrast, in the alcohol field, research and health prevention efforts have focused on preventing the range of alcohol-related harm in addition to alcohol use disorders (Currie et al., 2009). A rapidly increasing literature of epidemiological studies have explored the dose-response relationship between amounts and patterns of drinking and alcohol-related health harms (Babor et al., 2003; Bondy et al., 1999; Room, 1996; Room & Rehm, 2012). Regardless of the measurement of harm (e.g., chronic disease from volume of drinking over time, injury from specific drinking occasions, or total mortality), these curves are usually a smooth upwards curve of relative risks as amount of consumption increases (Rehm et al., 2010; Rehm & Patra, 2012; Room & Rehm, 2012; Taylor et al., 2010). There is an accumulation of evidence on the short and long term health effects (risk and benefits) of alcohol consumption, including the identification of the level of alcohol intake at which low-risk behaviour is distinguished from high-risk behaviour. These cut-offs, which are known as *low-risk drinking limits*, *behavioural indicators* for low-risk drinking, *responsible drinking limits*, *low-risk cut-offs*, or *low-risk thresholds*, serve as the basis for formally-derived quantitative behavioural guidelines (Room & Rehm, 2012; Wechsler, Dowdall, Davenport, & Castillo, 1995). The guidelines, which are generally developed by committees that evaluate and interpret the latest and best available scientific evidence on the health effects of alcohol consumption, can be promoted to the general public to help individuals make informed decisions about their drinking habits.

International and Australian guidelines incorporate the concept of a "standard drink". While the exact alcohol content of a standard drink varies from country to country, a standard drink in Australia is defined as containing 10 grams of alcohol (National Health and Medical Research Council, 2007). The current NHMRC Australian Guidelines to Reduce Health Risks from Drinking Alcohol were developed on the basis of modelling studies on: (1) mortality associated with alcohol-related chronic disease (e.g., alcohol use disorders, liver cancer, ischaemic heart disease) to yield the limit pertaining to the number of standard drinks consumed on any given day (Rehm, Room, & Taylor, 2008; Room & Rehm, 2012); and (2) mortality associated with lifetime risk of alcohol-related injuries (e.g., road traffic accidents, poisoning, violence) to ascertain the limit relating to the number of standard drinks per-occasion (Rehm et al., 2008; Room & Rehm, 2012). Due to the nature of the available literature, the Australian low-risk drinking guidelines do not take into account the adverse consequences of drinking on other people, and are framed entirely in terms of risk to the drinker (National Health and Medical Research Council, 2009; Room & Rehm, 2012).

The guidelines based on modelling studies of lifetime alcohol-attributable mortality used a standard of 1 in 100 as an "acceptable risk from drinking in the context of present-day Australian society" (Rehm et al., 2008; Room & Rehm, 2012). While relatively high compared to exposure to other risk factors, this choice was justified under the assumption that individuals understand the dangers associated with drinking, and are therefore making an informed decision when choosing to drink (Room & Rehm, 2012). However, it has since been argued that this is very high compared to the accepted risk levels for other voluntary daily activities, whereby an acceptable level of risk has been defined as 1 in 1000 (Rehm, Lachenmeier, & Room, 2014). The current NHMRC guidelines are: drinking no more than (i) 2 standard drinks on any day for healthy men and women (oriented to cumulative volume of drinking and set with reference to a risk of dying of alcohol-related chronic disease), and (ii) 4 standard drinks on any single occasion for healthy men and women (oriented to reducing the risk of injury on a single occasion of drinking and set with reference to a risk less than 1 in 100 of dying of an alcohol-related injury for those who drink this amount fairly regularly [e.g., two or three times a week] (National Health and Medical Research Council, 2009).

Conventional wisdom suggests that the smaller average body size and lower lean tissue in women results in greater intoxicating effects from the same number of per-occasion drinks and a higher overall risk for chronic disease at high volumes of consumptions (Room & Rehm, 2012). However, the lifetime risk analyses for the NHMRC guidelines found that although the lifetime risk of death from alcohol-related disease at any substantial level of drinking was higher for women than for men, risk for women only began to gradually exceed that of men at three drinks per day (National Health and Medical Research Council, 2009; Room & Rehm, 2012). Moreover, the absolute risk in terms of risk of injury at a given level of consumption was actually less for women than for men (National Health and Medical Research Council, 2009; Room & Rehm, 2012). It was therefore argued that there was no justification for specifying different limits for women from those for men at or below the level of two drinks per day; although the guidelines do emphasise that women drinking above the guideline are at greater risk than men consuming the same amount (National Health and Medical Research Council, 2009). Room and Rehm (2012) argue that these findings can be explained by the fact that men engage in more risky behaviour while sober, which results in them being granted a “bonus level of alcohol-related risk” beyond that for women in a relative risk-based guideline. Other countries have also adopted guidelines with equal levels of consumption for men and women (National Health and Medical Research Council, 2009).

Room and Rehm (2012) argue that there is actually a much stronger argument for differentiating low- from high-risk drinking based on age than gender. To derive low-risk drinking limits for young people (i.e., under 15 years of age and 16-17 years of age), alcohol-related harm was examined using self-report data on past year problems that arose from drinking (Livingston & Room, 2009). These included two subscales examining hazardous behaviours (e.g., went to work under the influence of alcohol, drove a motor vehicle under the influence of alcohol) and delinquent behaviours (e.g., created a public nuisance or disturbance under the influence of alcohol or stole money, goods or property under the influence of alcohol). Analyses based on these potential harms per litre or per heavy drinking occasions revealed a steep decrease in harms in teenage years and early 20s, then a continuing decline with increasing age (National Health and Medical Research Council, 2009; Room & Rehm, 2012). Based on these findings, the NHMRC guidelines suggest that the initiation of drinking be delayed as long as possible for those under 18 years of age and that not drinking alcohol is especially important for those under 15 years of age (National Health and Medical Research Council, 2009).

Low-risk drinking limits are now employed in public health initiatives in several countries worldwide (e.g., USA and Canada; (Kalinowski & Humphreys, 2016). Room and Rehm (2012) argue that the idea of offering guidelines fits modern ideals of the consumer society, whereby well-informed consumers adapt their behaviour to consumer advice from professional organisations. To that end, the NHMRC guidelines de-emphasised particular thresholds and attempted to provide considerable amounts of information on risks to consumers to enhance informed choices about personal risk. Low-risk drinking guidelines may also serve to reduce gambling harms by generating public discussion about drinking norms (National Health and Medical Research Council, 2009; Room & Rehm, 2012). Despite these advantages, the Australian low-risk drinking guidelines have not been widely promoted (Room & Rehm, 2012). It is important to note that there have been some concerns about the promotion of low-risk drinking limits, including that consumers may ‘drink up’ to the limit specified in the guidelines or that the guidelines may be perceived as a ‘safe’ baseline from which to range upwards in setting personal limits (Casswell, 2012; Hawks, 1994; Latino-Martel et al., 2011; Room & Rehm, 2012). To date, however, there is currently limited evidence concerning the impact of guidelines on consumer drinking behaviour.

The development of responsible gambling limits

Comparable low-risk or responsible gambling limits have only very recently been investigated. Until recently, responsible gambling guidelines have included a list of behaviours that can reduce the likelihood of gambling-related harm, such as leaving ATM cards at home and setting money limits in advance (see Table 3 for the behavioural responsible gambling guidelines offered by the Victorian Responsible Gambling Foundation). These guidelines, however, lack specific quantitative limits to guide gambling behaviour. It has been argued that such quantitative limits are critical given that many gamblers attempt to reduce their gambling by setting time and money limits (Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008).

There is now some evidence that the development of empirically-derived quantitative responsible gambling limits may be possible. The literature related to the development of responsible gambling limits has been dominated by three research groups in North America. In Canada, Currie and colleagues conducted a program of research exploring the identification of responsible gambling limits in population-representative samples (Currie et al., 2017; Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008; Currie et al., 2009). Independently, Weinstock and colleagues identified responsible gambling limits in samples of problem gamblers (Weinstock, Ledgerwood, & Petry, 2007) and university students (Weinstock, Whelan, & Meyers, 2008) from the United States. Most recently, Quilty, Avila Murati, and Bagby (2014) identified responsible gambling limits in a combined community and psychiatric outpatient sample in Canada. A replication of these Canadian thresholds has been conducted in a representative dual-frame German dataset (Brosowski et al., 2015).

Table 3. Responsible gambling guidelines offered by the Victorian Responsible Gambling Foundation

Behavioural responsible gambling guidelines
Don't think of gambling as a way to make money
Only gamble with money you can afford to lose
Set a money limit in advance
Set a time limit in advance
Never chase your losses
Don't gamble when you're depressed or upset
Balance gambling with other activities
Don't take your ATM card with you
Take frequent breaks
Don't drink or use drugs when gambling

Source: <https://www.responsiblegambling.vic.gov.au/awareness-and-prevention/gamble-aware/staying-in-control>

Because there is no standard unit of gambling, it remains necessary to examine the dose-response relationship across multiple dimensions of gambling behaviour (Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008; Weinstock et al., 2007). The available studies have explored quantitative responsible gambling limits mostly related to gambling frequency (Brosowski et al., 2015; Currie et al., 2017; Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008; Quilty et al., 2014; Weinstock et al., 2007; Weinstock et al., 2008), gambling expenditure (Brosowski et al., 2015; Currie et al., 2017; Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008; Currie et al., 2009; Quilty et al., 2014), gambling expenditure as a proportion of income (Currie et al., 2017; Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008; Currie et al., 2009; Weinstock et al., 2007; Weinstock et al., 2008), average session duration (Currie, Hodgins, Wang, El-Guebaly,

Wynne, et al., 2008; Quilty et al., 2014; Weinstock et al., 2008), gambling duration (Weinstock et al., 2007; Weinstock et al., 2008), and number of gambling activities undertaken (Brosowski et al., 2015; Currie et al., 2009). A smaller proportion of studies have explored responsible gambling limits related to proportion of income respondents intended to risk gambling (Weinstock et al., 2008), gambling plan adherence (Weinstock et al., 2008), and episodes where gambling expenditure exceeded intent (Weinstock et al., 2008).

In these studies, gambling-related harm has been defined using subsets of items from the Problem Gambling Severity Index (PGSI), the South Oaks Gambling Screen (SOGS), or diagnostic criteria. No study, to date, has explored any other type of harm. This contrasts to the alcohol literature that employs a range of harms to the drinker, including chronic disease from volume of drinking over time, injury from specific drinking occasions, and total mortality, hazardous behaviours, and delinquent behaviours (National Health and Medical Research Council, 2009; Rehm et al., 2008; Room & Rehm, 2012).

The studies of responsible gambling limits conducted to date have employed almost identical statistical methodologies, which involve:

- risk (dose-response) curves to explore the degree to which these gambling behaviours are associated with gambling-related harm;
- receiver operating characteristic (ROC) analyses to identify optimal responsible gambling limits using a cut-off that maximised the discrimination of low- and high-risk gambling, giving equal weighting to sensitivity (the ability of a responsible gambling limit to accurately identify individuals experiencing gambling-related harm) and specificity (the ability of a responsible gambling limit to accurately identify individuals not experiencing gambling-related harm); and
- logistic regression modelling to examine the associations between the responsible gambling limits and gambling-related harm.

Development of responsible gambling limits in population-representative samples

Currie et al. (2006) were the first to examine the relationship between indices of gambling behaviour and risk of gambling-related harm. Using data from 19,012 individuals participating in the Canadian Community Health Survey, this study investigated the shape (e.g. dose-response curves) of the associations of these gambling behaviours with gambling-related harm. Currie et al. (2006) described the curves for all gambling behaviours as J-shaped, rather than linear, indicating that the chances of experiencing gambling-related harm remained constant at low levels of gambling participation but then increased sharply when a certain threshold of gambling behaviour was reached. These risk curves were similar for men and women. The risk of harm from electronic gaming machines (EGMs) and casino table games increased with greater frequency of play. A similar but less pronounced trend was observed with bingo and instant scratch tickets but lotteries were low-risk at all playing frequencies.

ROC analyses revealed optimal responsible gambling limits that were robust to variations in definitions of harm (endorsement of one or more gambling-related problems on any of the seven negative consequence items of the PGSI; endorsement of two or more gambling-related problems on any of the nine items of the PGSI; and endorsement of two or more gambling-related problems on any of the seven negative consequence items of the PGSI). Although acceptable limits were identified for all indices of gambling behaviour across all definitions of harm, defining gambling-related harm as two or more negative consequences on the PGSI produced superior ROC parameters. On average, 4.2% of the population reported two or more negative consequences. These individuals were more likely to be

male, aged under 40 years, non-Caucasian, have high school education or less, and be in the low income category for household income. Using this definition of gambling-related harm, the optimal responsible gambling limits were: gambling no more than 2 to 3 times per month; spending no more than \$501 to \$1000CAD per year on gambling; and spending no more than 1% of gross monthly household income on gambling activities. Approximately one-third (32.4%) of gamblers exceeded the gambling frequency limit, 11.1% exceeded the gambling expenditure limit, and 11.4% exceeded the gambling expenditure as a proportion of gross household income.

Currie et al. (2006) argued that the inclusion of lottery gambling in the analyses may skew the responsible gambling limits because it is generally viewed as a safe activity due to small gambling expenditures and delay between bet placement and outcome. However, while they found that excluding respondents whose *only* form of gambling was playing lottery resulted in a slightly lower (i.e., more conservative) optimal threshold of gambling expenditure, the limits for frequency and expenditure as a proportion of income did not change. After controlling for socio-demographic characteristics, logistic regression modelling revealed that all of the responsible gambling limits were significantly related to gambling-related harm. Exceeding the frequency limit increased the risk of experiencing gambling-related harm by a factor of 13.3, exceeding the expenditure limit increased the risk of harm by a factor of 13.8, and exceeding the gambling as a proportion of income limit increased the risk of harm by a factor of 10.5.

Currie et al. (2006) stressed that the responsible gambling limits identified in their study were tentative and should be subject to cross-validation using data derived from other prevalence studies. Currie, Hodgins, Wang, El-Guebaly, Wynne, et al. (2008) subsequently conducted a replicate study using data collected in three independently conducted Canadian provincial prevalence surveys (Alberta, British Columbia, and Ontario) with a combined sample of 7,275 respondents. Two definitions of harm (endorsement of two or more gambling-related problems on any of the nine items of the PGSI; and endorsement of two or more gambling-related problems on any of the seven negative consequence items of the PGSI) produced similar results. Currie, Hodgins, Wang, El-Guebaly, Wynne, et al. (2008) suggested that the risk of gambling-related harm noticeably increased in men and women in a J-shaped fashion with greater gambling consumption. Because there were no gender differences in the risk curves, males and females were combined in subsequent analyses. Despite differences in gambling availability between provinces, similar responsible gambling limits were identified across provinces using the definition of harm based on two or more of the seven negative consequence items. Across the three provinces, acceptable limits were identified for almost all indices of gambling behaviour: gambling no more than 2 to 5 times per month; spending no more than \$132 to \$1,020CAD per year on gambling; spending no more than 1% to 3% of gross household income on gambling activities; and gambling for no longer than 60 minutes per session. Less than 6% of the population reported two or more negative consequences. Excluding people who only played lottery from the analysis did not affect the responsible gambling limits, but did strengthen the accuracy of prediction for frequency of gambling. Logistic regression adjusted for socio-demographic characteristics indicated that all of the identified responsible gambling limits significantly predicted gambling-related harm; and that all except frequency in one dataset significantly predicted gambling-related harm after controlling for the other limits and socio-demographic characteristics.

Currie et al. (2009) conducted a third study using combined data from six provincial surveys conducted in Canada with a combined sample of 12,285 respondents. The focus of this study, however, was on how indices of gambling behaviour are associated with three different definitions of gambling-related harm on the PGSI (reporting one or more PGSI symptoms; reporting two or more PGSI symptoms; and having a PGSI score ≥ 3). Overall, 5.4% of gamblers met the definition of harm based on a PGSI score ≥ 3 , 7.1% reported two or more PGSI symptoms, and 16.1% reported one or more PGSI symptoms. The ROC estimates were generally in the moderate accuracy range, although they were uniformly lower for gambling frequency. The best overall psychometric results were

obtained for percentage of income. Although the responsible gambling limits were comparable across the three definitions, two definitions of harm (reporting two or more PGSI symptoms; and having a PGSI score ≥ 3) demonstrated slighter superior results. Across the definitions of harm, the responsible gambling limits derived from this study were: gambling no more than 2 to 3 times per month; spending no more than \$154 to 357CAD per year on gambling; spending no more than 1% of gross household income on gambling activities; and gambling on no more than 4 types of gambling activities per year. EGM and casino table game gamblers were on average three to five times more likely to report gambling-related harm than gamblers who played other games (instant scratch tickets, bingo, private games, horse betting, sports betting, games of skill, internet, raffle tickets and arcade games), regardless of the definition of harm employed. Moreover, the relationship between the responsible gambling limits and harm was stronger in the EGM/casino table game group.

A replication of these Canadian thresholds was conducted in a representative dual-frame German dataset: Pathological Gambling and Epidemiology [PAGE] (Brosowski et al., 2015). Only limits with accurate prediction accuracy were reported (Area Under the Curve [AUC] ≥ 0.70). Using multiple definitions of harm based on past year diagnostic criteria to individuals who gambled more than 10 days during their lifetime (≥ 1 criterion, ≥ 2 criteria, ≥ 3 criteria, ≥ 4 criteria), this study found the following limits: gambling no more than 7-15 days in the last year; and gambling on no more than 2 gambling activities. Using the same definitions of harm based on lifetime diagnostic criteria, this study found the following limits: gambling no more than 11-50 times; spending no more than €29-100 on gambling; and gambling on no more than 3 gambling activities. Brosowski et al. (2015) also identified past-year limits with accurate prediction accuracy for EGMs (gambling no more than 3 days in the last year); as well as lifetime limits for EGMs and poker (no more than 1-10 days). The concurrent validity of exceeding these limits was illustrated via increased risk of actual problem gambling symptoms after controlling for a range of sociodemographic covariates. Interestingly, the predictive accuracies for the population were slightly better in the entire sample than from respondents who gambled in the previous year; and the low-risk thresholds approximately doubled. The cut-offs, however, remained unchanged for the gambling activity-specific limits identified for EGMs and poker.

Currie et al. (2011) assessed the impact of gambling above the responsible gambling limits identified in Currie et al. (2006) on future harm with data from 809 adult gamblers participating in the Leisure, Lifestyle and Life-Cycle Project (LLLP) longitudinal study. The findings revealed that chances of harm increased threefold for each additional responsible gambling limit exceeded. Moreover, gamblers who moved from staying within the responsible gambling limits in wave 1 to exceeding them in wave 2 were two to three times more likely to experience gambling-related harm compared to gamblers who remained below the limits at both time periods. This study also identified the factors that predicted the shift from staying within the responsible gambling limits in wave 1 to exceeding them in wave 2. These included being male, tobacco use, older age, having less education, having friends who gamble and playing EGMs. Currie et al. (2011) concluded that these longitudinal data support the validity of the previously identified responsible gambling limits.

Finally, Currie et al. (2017) has derived low-risk gambling limits applied to longitudinal data across a total of 3863 past-year gamblers from two independently conducted Canadian cohort studies (the Quinte Longitudinal Study [QLS] and the LLLP). There were no discernible gender or age differences in the risk curves developed for this study. Interestingly, because the set of analyses that gave equal weighting to sensitivity and specificity resulted in some very low specificity values, this study employed an alternative method in which more weight was given to specificity (specificity was held at 0.70 or higher) to reduce the unacceptably high number of false positives. Using the same definition of gambling-related harm, the low-risk limits were substantially higher in the cross-sectional (time 1 only) data from these samples than in their previous cross-sectional samples. Moreover, the mid-point between the QLS and LLLP optimal responsible gambling limits determined from the longitudinal data were also higher than previously derived limits from cross-sectional data: gambling no more than 8

times per month; spending no more than \$75CAD per month on gambling; and spending no more than 1.7% of gross monthly household income on gambling activities. Gambling above each of the low-risk gambling limits predicted harm independently at time 2 in both the QLS and LLP for all gambling indices, except percentage of income in the QLS dataset (which was borderline significant). Across both datasets, approximately 40% of gamblers exceeded at least one of the limits at time 1 and 7 to 11% exceeded all three limits. Exceeding any low-risk limit at time 1 increased the risk of harm at time 2 by a factor of 3.7 to 4.4. The authors suggest that these higher limits can be explained by several factors: the level of gambling expenditure has to be significantly higher to have an enduring harmful impact; the deliberate inclusion of a high proportion of at-risk gamblers with a higher level of gambling expenditure; the modification of the statistical criteria for establishing the optimal cut-off; improvements in the assessment of gambling expenditure; and the administration of the PGSI to low-intensity gamblers.

Across these studies, Currie and colleagues (2017; 2006; 2008) described the curves for all gambling behaviours as J-shaped, similar to those identified in the alcohol literature. Cunningham (2006) highlighted several concerns with Currie et al.'s (2006) data on which the first risk curves were based. These include the use of the most frequent type of gambling behaviour as a proxy for the frequency of all the person's gambling behaviour and the amount of missing data through the exclusion of low-frequency gambling respondents and respondents who stated that they were not gamblers in a screening item (including respondents who were frequent gamblers). In response, Currie (2006) acknowledges that these limitations may limit the generalisability of the results and speak to the challenge of using population data for reasons other than the intended purpose. Further, Markham, Young, and Doran (2016) have questioned the shape of the risk curves based on secondary analysis of data from four nationally representative cross-sectional surveys of adults in Australia (n=10632), Canada (n=3120), Finland (n=4484), and Norway (n=5235). They argued that Currie et al.'s (2006; 2008) interpretation of the risk curves is an artefact of the treatment of gambling expenditure data using ordinal brackets of increasing magnitude as though they were of equal magnitude in the published plots. Recoding of Currie and colleagues (2006; 2008) expenditure data using category mid-points and dropping the final open-ended bracket was suggestive of a linear relationship. In this study, they estimated the shape of risk curves for gambling expenditure and risk of gambling-related harm as measured by continuous SOGS, PGSI or NODS scores. Using bootstrapped local polynomial regression, multiple linear regression and mixed effects linear models, they estimated that the risk curves for total gambling losses were r-shaped in Australia, Canada, and Finland, and linear in Norway. Risk curves for gambling expenditure disaggregated by gambling activity were linear, r-shaped, or non-significant. EGM curves, in particular, were r-shaped and displayed the strongest correlation between gambling expenditure and risk of harm.

Markham et al. (2016) argued that r-shaped curves suggest that risk of harm increases as gambling expenditure increases and that there is no low-risk region of the curve in which increasing expenditure does not increase harm; while linear relationships imply that all consumption increases risk of harm. They argued that these curves are more similar to tobacco than alcohol consumption, in that there is no threshold below which consumption does not increase risk. They concluded that linear or r-shaped, rather than J-shaped, curves make the identification of responsible gambling thresholds problematic and that guidelines should be based on the amount of absolute risk that can be tolerated. To date, however, this treatment of the data has not been extended to other indices of gambling behaviour, such as gambling frequency, in which categorical data has also been employed. In their most recent article based on two independently conducted longitudinal datasets, Currie et al. (2017) continued to argue for J-shaped curves on the basis of more equal categories for gambling frequency, expenditure and percentage of income on the x-axis on each risk curve. They suggest that their risk curves indicate that low-level gamblers experience less harm than very low-level gamblers, although the degree of protection is likely relatively small. They acknowledge, however, that it is difficult to draw

conclusions about the degree to which low-level gambling provides protective benefits from harm without further replication using other datasets.

Development of responsible gambling limits in other samples

Other studies have extended this population-based work to specific groups, such as treatment-seeking problem gamblers (Weinstock et al., 2007), university students (Weinstock et al., 2008), and a combined sample of gamblers recruited from the community and psychiatric outpatient facilities (Quilty et al., 2014). Weinstock et al. (2007) employed an identical statistical methodology to identify responsible gambling limits in a sample of treatment-seeking problem gamblers who selected non-abstinence (i.e., controlled gambling) as a treatment goal. This study was conducted in the United States with 178 pathological gamblers one year after initiating treatment. Risk curves were plotted using SOGS gambling-related harm with three indices of gambling behaviour derived from the Gambling Timeline Followback. ROC analyses identified limits that reliably differentiated problem free (SOGS score of 0) from symptomatic gambling (SOGS score ≥ 1). The responsible gambling limits derived from this study were: gambling no more than once per month; gambling for no more than 1.5 hours per month, and spending no more than 1.9% of monthly income on gambling. These limits increased when four higher SOGS cut-points were used as the thresholds for defining gambling-related harm. However, the sensitivity and specificity values were optimised when a SOGS score ≥ 1 was employed as the threshold. These findings are important, because they suggest that quantitative responsible gambling limits may also apply to problem gamblers who select non-abstinence in recovery. Interestingly, these responsible gambling limits are very similar to those derived in the population studies described above.

The same research group extended this methodology by identifying responsible gambling limits in university students from the United States ($n=159$) (Weinstock et al., 2008). ROC analyses were used to determine optimal cut-offs on the Diagnostic Interview for Gambling Severity (DIGS) for differentiating pathological gambling (DIGS score ≥ 5) or non-pathological gambling (DIGS score ≤ 4). This study identified four responsible gambling limits with acceptable sensitivity and specificity. These limits were: gambling no more than 1.25 times per month; gambling for no more than 2.1 hours per month; intending to gamble 6.1% of monthly income; and spending no more than 10.5% of monthly income on gambling. Again, this study suggests that quantitative responsible gambling limits may also apply to specific population subgroups. Interestingly, although the responsible gambling limits for gambling frequency and gambling duration are very similar to those derived in the studies described above, the limit relating to expenditure as a proportion of income is much higher.

Most recently, Quilty et al. (2014) independently replicated the Currie studies, but emphasised the identification of responsible gambling limits for specific gambling activities. Using 503 gamblers recruited from Canadian psychiatric outpatient and community populations, this study identified similar responsible gambling limits for overall gambling, regardless of the definition of harm employed, although using ≥ 2 PGSI problems as the measure of harm produced superior classification accuracies. The responsible gambling limits according to this definition of harm were: gambling no more than once per month; gambling for no longer than 35 minutes per session; and spending no more than \$294CAD per year on gambling. Responsible gambling limits for specific gambling activities were only available for a subset of gambling activities because of low involvement on some gambling activities. The identified responsible gambling limits in Quilty et al. (2014) were: gambling no more than once per month on instant scratch tickets and never on casino table games; gambling for no longer than 2hrs, 15mins per session on bingo and 3hrs, 10mins per session on casino table games; spending no more than \$37.50CAD per month (\$450CAD per year) on bingo; \$27.50 to \$100CAD per month (\$330 to \$1,200CAD per year) on casino table games; \$42.50 to \$65CAD per month (\$510 to \$780CAD per year) on sports betting. Quilty et al. (2014) stressed the need for future research to further evaluate specific activities using large community representative samples.

Expert opinion on responsible gambling limits

Overall, the findings of the available research suggest that similar quantitative responsible gambling limits may be applicable for both the general population and specific groups of gamblers. In the first of their series of studies on the empirical identification of responsible gambling limits, Currie et al. (2006) suggested that one of the next steps in this area of research was to disseminate information about such limits to other professionals in the field for feedback. It is important that responsible gambling limits are accepted by professionals working in the field (Currie, Hodgins, Wang, El-Guebaly, & Wynne, 2008).

This approach was adopted by Currie, Hodgins, Wang, El-Guebaly, and Wynne (2008), who canvassed expert opinion from 171 researchers, clinicians and policy makers in Canada and the United States on the importance of responsible gambling limits, concerns regarding the dissemination of limits to the public in the form of responsible gambling guidelines, and the face validity of their empirically derived responsible gambling limits (Currie, Hodgins, Wang, El-Guebaly, & Wynne, 2008). The majority of experts believed that responsible gambling limits were important and rated the empirically derived limits as having sound face validity. They rated limits related to expenditure as a proportion of income as the most important, followed by limits pertaining to gambling frequency, gambling expenditure, and gambling duration. They favoured the expression 'responsible gambling limits' over 'safe gambling limits' or 'low-risk gambling limits'. Approximately one-quarter of the professionals thought that lottery games should be excluded from the development of responsible gambling limits but the sample were divided about whether there should be game-specific responsible gambling guidelines. There were also concerns about the promotion of responsible gambling guidelines to the general population in relation to the potential for creating a false sense of security among gamblers, encouraging people to gamble, and difficulties in applying the limits across different forms of gambling. These concerns raise the importance of monitoring the impact of responsible gambling guidelines on vulnerable groups. Currie, Hodgins, Wang, El-Guebaly, and Wynne (2008) argued that the next logical step in this program of research would be to seek the opinions of gamblers themselves on the utility of responsible gambling limits. They noted that additional consultation with experts in the field of gambling and consumers regarding the wording and presentation of quantitative responsible gambling limits is required.

Project aims

Consistent with a public health perspective, efforts targeted at the prevention of gambling-related harm, rather than problem gambling, may be more effective as they potentially impact a much larger segment of the population (Currie et al., 2006; Currie et al., 2009). Responsible gambling limits can be used to inform the development of formally-derived quantitative responsible gambling guidelines that can usefully augment the currently available behavioural responsible gambling guidelines (Currie, Hodgins, Wang, El-Guebaly, & Wynne, 2008; Currie et al., 2006). They can serve as an easy and cost-effective screening method for people at high risk for gambling-related harm that may reduce the subjective bias inherent when gamblers respond to problem-focused screening questions (Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008; Rockloff, 2012; Weinstock et al., 2007; Weinstock et al., 2008). Such normative data allows gamblers to compare their current behaviour with the guideline and can assist them in reducing their gambling consumption by increasing awareness of what defines risk behaviour, highlighting potential negative consequences of exceeding the limits, and enhancing motivation to employ self-directed change strategies or seek help (Currie et al., 2006; Weinstock et al., 2008). Responsible gambling limits can also be employed in population-level surveillance research to monitor the prevalence of gambling-related harm (Currie et al., 2011; Currie et al., 2009; Weinstock et al., 2008), investigate the efficacy of secondary intervention efforts (Weinstock et al., 2008), and be

applied in tertiary intervention settings for gamblers selecting a moderation goal (Currie et al., 2006; Quilty et al., 2014; Weinstock et al., 2007).

Research conducted across various samples (including general population, clinical, and university student samples), predominantly from North America, has identified similar, although not identical, responsible gambling limits. Overall, the responsible gambling limits across the population-representative samples are:

- Gambling no more than 0.6 to 8 times per month
- Spending no more than \$132 and \$1020CAD per year on gambling
- Spending no more than 1 to 3% of gross household income on gambling activities
- Gambling for no longer than 60 minutes per session
- Gambling on no more than 2 to 4 types of gambling activities per year

There is also evidence from longitudinal population-based research that gambling at levels beyond the responsible gambling limits is indicative of future harm (Currie et al., 2017; Currie et al., 2011). Taken together, the current findings suggest that these limits are helpful in the identification of people who may be unaware that they are currently experiencing gambling-related harm, as well as those who may experience gambling-related harm in the future. Furthermore, North American experts in the gambling field (clinicians, researchers, and policy-makers) believe that empirically derived responsible gambling limits are important in preventing gambling-related harm (Currie, Hodgins, Wang, El-Guebaly, & Wynne, 2008). However, the responsible gambling limits identified in population-representative samples from other countries are not likely to be generalisable to Australia given differences between jurisdictions in gambling availability, regulation, and treatment provision (Brosowski et al., 2015; Currie, Hodgins, Wang, El-Guebaly, & Wynne, 2008; Currie et al., 2006).

The primary aim of this program of research was therefore to identify a set of empirically based responsible gambling limits that can be used to inform the development of responsible gambling guidelines for promotion to the Australian public. Specifically, this aim involved:

- a. examining the risk (dose-response) curves across multiple gambling indices and multiple PGSI definitions of harm across multiple population-representative studies;
- b. identifying multiple sets of responsible gambling limits by exploring the optimal cut-offs in ROC analyses across these gambling indices and definitions of harm; and identify a set of proposed responsible gambling limits based on a selected definition of gambling-related harm;
- c. identifying the proportion of the population exceeding the proposed responsible gambling limits;
- d. exploring whether gambling at levels beyond the proposed responsible gambling limits is cross-sectionally and longitudinally associated with gambling-related harm;
- e. profiling the target population for promotion of the proposed responsible gambling limits (i.e., gamblers exceeding the selected definition of gambling-related harm) and the target audience for the promotion of the proposed responsible gambling limits (i.e., gamblers exceeding each of the proposed responsible gambling limits);

- f. conducting sensitivity analyses excluding gamblers who only play lottery from the ROC analyses;
- g. identifying the relative and absolute risk associated with exceeding the proposed responsible gambling limits;
- h. considering the base prevalence rate of gambling-related harm by identifying the proportion of gamblers exceeding the proposed responsible gambling limits who actually experience gambling-related harm (positive predictive values) and the proportion of gamblers remaining within the limits who do not actually experience gambling-related harm (negative predictive values); and
- i. maximising the specificity (the ability of a responsible gambling limit to accurately identify individuals not experiencing gambling-related harm) then the sensitivity (the ability of a responsible gambling limit to accurately identify individuals not experiencing gambling-related harm) in the ROC analyses.

Secondary aims of this research were to:

1. Identify and evaluate responsible gambling limits for specific sub-groups of the population (gender and age);
2. Identify and evaluate responsible gambling limits for specific gambling activities;
3. Identify responsible gambling limits for the population using alternative measures of gambling-related harm, such as alternative gambling-related harm items, quality of life, mental health, and substance use; and
4. Canvas expert and public opinion about the promotion of responsible gambling limits.

The identification and validation of responsible gambling limits for the Australian population was achieved through the secondary data analysis of several existing datasets. Two primary data collection studies were also conducted to canvas expert and public opinion about the promotion of responsible gambling limits. This program of research will replicate previous research in the area, but will also extend this work in several ways. This program of research was approved by the Deakin University Human Research Ethics Committee (2016-190) and the Deakin University Human Research Ethics Advisory Group - Health (HEAG-H 140_2016). Each existing dataset was also approved by Human Research Ethics Committees (University of Melbourne Human Research Ethics Committee [1135477.1/1125477.2, 1340411, 1135477.1]; Australian National University Human Research Ethics Committee [2014/580]).

Secondary analysis of existing datasets

Project methodology

Existing datasets employed in this study

This project identified responsible gambling limits through secondary analysis of population data from the second and third Social and Economic Impact Study (SEIS) of Gambling in Tasmania (ACIL Allen Consulting, Social Research Centre, & Problem Gambling Research and Treatment Centre, 2014a; Allen Consulting Group, Problem Gambling Research and Treatment Centre, & the Social Research Centre, 2011) and the 2014 Survey on Gambling, Health and Wellbeing in the ACT (Davidson, Rodgers, Taylor-Rodgers, Suomi, & Lucas, 2015). These Computer Assisted Telephone Interviewing (CATI) surveys were selected for analysis as they are among the few available population-representative studies in Australia to collect continuous expenditure data across multiple gambling activities. The longitudinal validity of the responsible gambling limits was explored through secondary analysis of the three waves of the Tasmanian Longitudinal Gambling Survey (ACIL Allen Consulting, Social Research Centre, & Problem Gambling Research and Treatment Centre, 2014b). The Tasmanian Longitudinal Gambling Study is the only longitudinal general population survey in Australia that has collected continuous expenditure data across multiple gambling activities.

Table 4 outlines the socio-demographic characteristics (Australian Bureau of Statistics, 2014), gambling participation, and problem gambling prevalence of Tasmania (ACIL Allen Consulting et al., 2014a; Davidson et al., 2015) compared to estimates from a national dual-frame omnibus survey (Dowling et al., 2016). The socio-demographic characteristics Australia-wide are generally located between the disparate socio-demographic profiles of Tasmania and the ACT. Compared with Tasmania, the ACT has a younger median age, a higher proportion of working age people, a lower proportion of people aged 65+, higher education levels, lower proportions of people with an Australian ancestry, lower proportions of people born in Australia, lower unemployment rates, a lower indigenous population, and higher median weekly household and personal incomes. Although gambling opportunities also differ across the two states/territories, they display generally similar rates of gambling participation and problem gambling to the national averages. The rates of problem gambling are relatively similar in Tasmania and the ACT, although the ACT has slightly lower rates of gambling participation. Specifically, the ACT has higher rates of participation on horse or greyhound racing and lower rates of participation on lotteries, instant scratch tickets, and keno. Given these differences in socio-demographic and gambling behaviour, a decision was made not to combine the datasets across Tasmania and the ACT. However, a similar pattern of results found across independently conducted state/territory surveys would provide strong evidence of the robust dose-response relationship between gambling involvement and risk of gambling-related harm and enhance the generalisability of the identified responsible gambling limits to other states and territories of Australia.

Table 4. Demographic and gambling involvement profiles in Tasmania and the ACT compared to national estimates

	Tasmania ^{a,b}	ACT ^{a,c}	Australia ^{a,d}
Proportion of Australian population (%)	2.3	1.7	
Median age	40	34	37
Gender (% males)	49.0	49.5	49.4
Number of children per family	1.8	1.8	1.9
Not married (%)	40.4	41.0	41.3

Average people per household	2.4	2.6	2.6
Single person household (%)	28.0	23.4	24.3
Working age (15-64 years) (%)	64.9	70.6	66.7
Elderly population (65+) (%)	16.7	10.7	14.0
Education (secondary school or higher) (%)	21.0	52.9	42.1
Unemployment (%)	6.4	3.6	5.6
Indigenous (%)	4.0	1.4	2.5
Country of birth (Australia) (%)	83.6	71.4	69.8
Australian ancestry (%)	33.9	26.6	25.4
No religion (%)	28.6	28.9	22.3
Median weekly personal income	499	918	577
Median weekly household income	948	1920	1234
Annual gambling participation (%)	61.2	55.1	63.9
EGMs	18.6	19.9	20.7
Horse or greyhound	10.5	17.6	15.9
Lotteries	43.0	33.4	49.2
Instant scratch tickets	20.6	15.1	22.0
Keno	26.0	2.9	7.2
Casino table games	6.3	5.8	5.9
Bingo	1.7	2.2	3.0
Sporting or other events	4.4	6.9	5.7
Informal private games	2.6	3.7	3.1
Any PGSI endorsement (%)	6.2	5.4	5.3
Low risk gambling	3.9	3.9	3.0
Moderate risk gambling	1.8	1.1	1.9
Problem gambling	0.5	0.4	0.4

^a Socio-demographic characteristics (Australian Bureau of Statistics, 2014)

^{b,c} Gambling characteristics (ACIL Allen Consulting et al., 2014a; Davidson et al., 2015)

^d Gambling characteristics (Dowling et al., 2016)

Tasmanian SEIS surveys

The second Tasmanian SEIS survey, which was conducted between February 7 and March 3, 2011, involved CATI interviews of a stratified random sample of 4,303 adult respondents in Tasmania using a random digit dialling and exchange-based telephone survey of registered landline telephone numbers. A disproportionate stratified sample design was employed in which selected Local Government Areas (LGAs) of high and low EGM density and high and low socio-economic status were over-sampled relative to their population. A sub-sample of 2,027 respondents (47% of the overall sample) was administered a supplementary survey in which they were asked questions relating to psychosocial issues. This sub-sample comprised all low risk, moderate risk, and problem gamblers (PGSI score > 0), all past-year EGM gamblers, a randomly selected one-third of non-gamblers (no past-year gambling participation), and a randomly selected one-third of non-problem gamblers (past-year gambling participation and PGSI score = 0). The overall survey participation rate (defined as the number of completed interviews divided by the sum of the completed interviews plus refusals) was 48.8% and the average interview length was 15.8 minutes. For further methodological details, see Allen Consulting Group et al. (2011).

The third Tasmanian SEIS survey, which was conducted over the period 16 September to 27 October, 2013, comprised 5,000 CATI interviews with adults across Tasmania. It involved a semi-random dual-frame survey design, whereby both landline and mobile telephone numbers were included. This

design resulted in 3,500 interviews being conducted with respondents who were part of the randomly generated landline sample and 1,500 interviews with respondents selected from a non-random list-based mobile telephone sample. Such an approach was adopted given evidence that only interviewing persons contactable via landline telephone numbers results in biased survey estimates due to the exclusion of an increasing proportion of the population residing in mobile - only households (Dowling et al., 2016; Jackson, Pennay, Dowling, Coles-Janess, & Christensen, 2014). Similar to the second SEIS, a disproportionate stratified sample design was employed in which selected LGAs of high and low EGM density and high and low socio-economic status were over-sampled relative to their population in this survey ($n=1,887$; 38% of the overall sample). The overall survey participation rate (defined as the number of completed interviews divided by the sum of the completed interviews plus refusals) was 54.6% and the overall average interview length was 15.0 minutes. For further methodological details, see ACIL Allen Consulting et al. (2014a).

The second and third Tasmanian SEIS surveys employed very similar measures of gambling behaviour indices. Moreover, time series analyses revealed that there were few differences in gambling participation and problem gambling severity over the 2.5 years between the surveys (ACIL Allen Consulting et al., 2014a). For these reasons, these surveys were merged to create a combined sample of 9,303 respondents completing the main surveys and a sub-sample of 3,914 respondents completing the supplementary surveys. A two-stage weighting approach involved the calculation of: (a) a post-stratification weight using a raking approach to adjust for the disproportionate nature of the sample and differential survey response rates across age, gender, educational attainment, country of birth, geographical location and telephone status using independent population benchmarks, and (b) a design weight for each frame that included typical adjustments relating to the number of in-scope people in each household and the number of landline telephone connections per household. An additional pre-weight was calculated to adjust for the overlapping chances of selection for persons with both landline and mobile telephones into both sample frames by adjusting for the telephone status of sample members to population parameters. Descriptive statistics for this sample are displayed in Appendix 1.

Survey on Gambling, Health and Wellbeing in the ACT

The 2014 Survey on Gambling, Health and Wellbeing in the ACT, which was conducted over the period 18 November 2014 and 11 February 2015, employed random digit dialling of landline telephone numbers, including listed and unlisted numbers, to contact 7,068 ACT residents. This main survey included questions about socio-demographic characteristics, gambling participation, gambling frequency, and overall net expenditure. A sub-sample of 2,294 respondents was administered measures of gambling expenditure, the PGSI, gambling-related harm, and physical and mental wellbeing. The criteria used to select this sub-sample was based on past-year gambling frequency and overall net expenditure. Analyses for the full sample were weighted so that the sample proportionately reflected the age, gender, and marital status of the adult ACT population; while analyses for the sub-sample also addressed the oversampling of non-gamblers, high frequency gamblers, and high expenditure gamblers so that levels of gambling were proportionately represented. The data employed in the current study were restricted to the sub-sample. Descriptive statistics for this sample are displayed in Appendix 1. For further methodological details, see Davidson et al. (2015).

This dataset was analysed separately from the Tasmanian dataset as it is a well-known statistical phenomenon that it is inappropriate to merge independent data sets as there may be unknown or paradoxical consequences (Simpson's paradox). This effect involves a trend appearing in different groups of data but disappearing or reversing when these groups are combined. Moreover, these two jurisdictions display very disparate socio-demographic profiles (Appendix 1); each dataset was weighted for the state/territory population; and each construct was operationalised slightly differently in

each state/territory. For these reasons, we argue that the merging of the Tasmanian and ACT datasets would be both theoretically and statistically unsound.

Tasmanian Longitudinal Gambling Study

The longitudinal validity of the responsible gambling limits was explored through secondary analysis of the three waves of the Tasmanian Longitudinal Gambling Survey. The first wave of this study comprised the sub-sample of 2,027 respondents who completed the main and supplementary surveys in the second Tasmanian SEIS. Wave 2 took place over the period 6 November to 22 December 2013 (2 years and 9 months after the Wave 1 survey). The in-scope sample for this survey was respondents who were administered the main and supplementary surveys in the second SEIS (Wave 1) and who agreed to be re-contacted (n=1,879). The total achieved sample size for the Wave 2 survey was 1,039. The consent rate was 82.1%, which represents the number of completed interviews as a percentage of the number of in-scope people actually contacted. The average interview length was 24.2 minutes. Wave 3 of the survey took place over the period 19 November to 21 December, 2014 (approximately one year after the Wave 2 survey). The in-scope sample for this survey was respondents to Wave 2 who agreed to be recontacted, and those who were unable to be interviewed in Wave 2 but remained a valid contact (n=1,269). The total achieved sample size for the Wave 3 survey was 820. The consent rate was 84.4%, which represents the number of completed interviews as a percentage of the number of in-scope people actually contacted. The average interview length was 26.2 minutes. Weights were generated for the Waves 2 and 3 survey data using raking procedures using benchmarks based on Wave 1. Descriptive statistics for each wave of this study are displayed in Appendix 1. For further methodological details, see ACIL Allen Consulting et al. (2014b).

Measures

Respondents across surveys completed a range of measures, including gambling behaviour indices (on which the responsible gambling limits were derived) and measures of gambling-related harm. Several measures were also employed to understand the characteristics of the population subgroup that will be targeted by the promotion of the responsible gambling limits. A summary of the measures employed across each of the existing datasets is provided in Table 5.

Table 5. Summary of measures in the existing datasets that were employed in the secondary analyses

Measure	Second Tasmanian SEIS survey (2011)		Third Tasmanian SEIS survey (2013)		Survey on Gambling, Health and Wellbeing in the ACT (2014)	Tasmanian wave 2 longitudinal survey (2013)	Tasmanian wave 3 longitudinal survey (2014)
	Main survey	Supplementary survey (wave 1 longitudinal survey)	Main survey	Supplementary survey			
Gambling behaviour indices (responsible gambling limits)							
Gambling frequency	✓		✓		✓	✓	✓
Gambling expenditure	✓		✓		✓	✓	✓
Gambling expenditure as proportion of gross personal income	✓		✓		✓		
Number of gambling activities	✓		✓		✓	✓	✓
Session expenditure	✓		✓				
Session duration					✓		
Gambling-related harm							
Problem gambling severity	✓		✓		✓	✓	✓
Alternative gambling-related harm			✓		✓		
Quality of life		✓		✓			
Depression				✓			
Generalised anxiety symptoms				✓			
Panic symptoms				✓			
Post-traumatic stress disorder symptoms				✓			
Generalised social anxiety symptoms				✓			
Attention-deficit hyperactivity disorder				✓			
Psychological distress					✓		
Hazardous drinking		✓		✓	✓		
Smoking		✓		✓	✓		
Illicit drug use		✓		✓			
Prescription drug misuse		✓		✓			
Profiling measures							
Age	✓		✓		✓		
Gender	✓		✓		✓		
Marital status					✓		
Education	✓		✓		✓		

Country of birth	✓		✓		✓		
Main language spoken at home	✓		✓		✓		
Employment status	✓		✓		✓		
Gross personal income	✓		✓		✓		
Gambling participation	✓		✓		✓		
Problem gambling severity	✓		✓		✓		
Hazardous drinking		✓			✓		
Smoking		✓			✓		
Psychological distress					✓		
General health					✓		

Measurement of gambling behaviour indices

Indices of gambling behaviour on which the responsible gambling limits are derived include gambling frequency, gambling expenditure, gambling expenditure as a proportion of income, number of gambling activities, session expenditure, and session duration.

Gambling frequency. Gambling frequency was measured for multiple gambling activities, including EGMs, horse or greyhound racing, instant scratch tickets, lotteries, keno, casino table games, bingo, sports or other event betting, and informal private games. In Tasmania, the frequency items were typically worded in the following way: ‘In the last 12 months, how many times per week, per month or per year have you played/bet on [gambling activity]?’ In the ACT, the frequency items were typically worded in the following way: ‘In the last 12 months, how many times per week or per month or per year have you played [gambling activity]?’ In both jurisdictions, frequency was available separately for different modalities (e.g., venue, telephone, racetrack, off-course venue, internet) of each gambling activity. Annual gambling frequency was calculated by standardising each response to an estimated yearly frequency and summing these yearly frequencies across all gambling activities.

Gambling expenditure/session expenditure/gambling expenditure as a proportion of income. Gambling expenditure was measured for multiple gambling activities, including EGMs, horse or greyhound racing, instant scratch tickets, lotteries, keno, casino table games, bingo, sports or other event betting, and informal private games. In the Tasmanian surveys, the expenditure items were typically worded in the following way: ‘In the past 12 months, approximately how much money, on average, did you spend during each session of [gambling activity]?’ This allowed for the calculation of session expenditure for each specific gambling activity. Annual gambling expenditure was calculated by multiplying the number of sessions (gambling frequency) with the expenditure per session estimates for each gambling activity then summing these yearly gambling expenditures across all gambling activities. In the ACT survey, the expenditure items were typically worded in the following way: ‘Subtracting any winnings, how much money did you spend on [gambling activity] in an average week/an average month in the last 12 months?’ Expenditure was collected separately for different modalities (e.g., venue, telephone, racetrack, off-course venue, internet). Overall annual gambling expenditure was calculated by standardising each response to an estimated yearly expenditure and summing these yearly gambling expenditures across all gambling activities. Expenditure in the Tasmanian surveys was assessed only in terms of amount of money lost (i.e., respondents who had won money were allocated a zero gambling expenditure to indicate zero loss); in contrast, in the ACT survey, winnings were represented by negative values. In order to harmonise between the two datasets, all negative gambling expenditure values in the ACT dataset were recoded to zero to indicate zero gambling expenditure.

The cross-sectional surveys each employed an item of gross annual personal income. The item wordings were: ‘Could you please tell me your approximate annual personal income before tax?’ (Tasmania) and ‘Which of the following categories contains your total annual personal income from all sources before tax?’ (ACT). Response options for the Tasmanian surveys were: Less than \$25,000; \$25,000-\$39,999; \$40,000-\$64,999; \$65,000-\$79,999; \$80,000-\$129,999; \$130,000 or more. Response options for the ACT survey were: negative or zero income; \$1-\$9,999; \$10,000-\$19,999; \$20,000-\$29,999; \$30,000-\$39,999; \$40,000-\$49,999; \$50,000-\$59,999; \$60,000-\$79,999; \$80,000-\$99,999; \$100,000-\$124,999; \$125,000-\$149,999; \$150,000-\$199,999; \$200,000 or more. In order to derive expenditure as a proportion of income, we used the mid-point of each category’s range to represent the respective income category (e.g. \$25,000 to \$39,999 became \$32,500). For the final income category (e.g. \$130,000 or more), for which no mid-point exists, the same interval that was applied to the preceding category was applied. For example, if the interval preceding the final income category was “\$80,000 to \$129,999”, this would represent an interval of approximately \$50,000 and midpoint of \$105,000. Therefore, for final

income category of “\$130,000 or more”, the mid-point was denoted as \$155,000. A small number of derived expenditure as a proportion of income estimates exceeding 100% were then removed from the dataset (17 in Tasmania, 2 in the ACT).

Number of gambling activities. The number of gambling activities for both surveys were based on participation across eight gambling activities: EGMs, horse or greyhound racing, instant scratch tickets, lotteries, keno, casino table games, bingo, and sports or other event betting. Informal private games and “other” gambling activities were excluded due to low frequencies of participation. In the Tasmanian surveys, these items were worded in the following way: ‘I am going to start by reading a list of popular gambling activities and find out if you have played them for money in the previous 12 months. In the last 12 months, have you...?’ In the ACT survey, these items were worded in the following way: ‘I’m going to read out a list of popular gambling activities that people can do in a number of ways, such as gambling at a venue, by phone, and over the internet. Could you please tell me which of these you have participated in FOR MONEY, during the last 12 months?’ The number of gambling activities in which each respondent participated in the previous 12 months were calculated from these responses.

Session duration. The ACT survey employed items measuring gambling duration for several gambling activities (EGMs, keno, casino table games, and bingo). These items were typically worded in the following way: ‘For how long do you usually play [gambling activity] [when you visit a venue/over the internet on these occasions]?’ Duration was collected separately for different modalities (e.g., venue, internet) for each of these gambling activities. Responses were recorded in minutes or hours, but were converted to minutes for the current analyses. This allowed for the calculation of session duration for each specific gambling activity.

Measurement of gambling-related harm

As in previous research, gambling-related harm was primarily measured using the PGSI, but the definition of gambling-related harm was also extended to other harms, including alternative gambling-related harm items, and measures of quality of life, mental health, and substance use.

Problem gambling severity. The nine-item PGSI (Ferris & Wynne, 2001) was employed to evaluate problem gambling severity in all surveys. Respondents indicated how often each item applied to them in the last 12 months on a four-point scale: (0) never, (1) sometimes, (2) most of the time, and (3) almost always. Scores range from 0 to 27, and higher scores indicate higher problem severity. Scores on the PGSI can be used to classify individuals as non-problem gamblers (score of 0), low risk gamblers (scores of 1 or 2), moderate risk gamblers (scores between 3 and 7), or problem gamblers (scores of 8 or higher). Although the PGSI generally displays good psychometric properties (Currie, Hodgins, & Casey, 2013; Ferris & Wynne, 2001; Neal, Delfabbro, & O’Neil, 2005), a simple scoring modification in which moderate risk gambling is defined by scores between 5 and 7 has been recommended given evidence that the low and moderate risk categories display poor discriminant validity (Currie et al., 2013). The PGSI has been adopted as the preferred measurement tool for population-level research in Australia (Neal et al., 2005).

Although the PGSI is used to identify problem gambling severity, it has a focus on the negative consequences of gambling rather than behavioural symptoms (Currie et al., 2009). Due to the preliminary nature of the investigation into the presence of responsible gambling limits, this study emphasised multiple different thresholds of gambling-related harm using the PGSI. Many of these definitions are based on dichotomous, presence-absence scoring of individual items, whereby respondents who endorse a PGSI item as occurring ‘sometimes’, ‘most of the time’, or ‘all of the time’ are

coded as experiencing a gambling-related harm. Currie and colleagues (2008; 2009) argue that the PGSI comprises a subset of 7 items measuring negative consequences of gambling and a subset of 2 items measuring behavioural symptoms of gambling rather than clearly defined consequences (see Table 6). Although this classification is not entirely consistent with the development classification, which suggests there are only 4 PGSI adverse consequence items and 5 items measuring behavioural symptoms of gambling (Ferris & Wynne, 2001), it was retained to allow comparisons to findings reported by Currie and colleagues (Currie et al., 2017; 2006; 2008; 2009). Results relating to results from the endorsement of one or two of these 4 adverse consequence items were, however, very consistent with the results from the classification employed by Currie and colleagues (2008; 2009). These results are available from the first author on request.

Based on the previous responsible gambling limits literature, eight definitions of gambling-related harm using subsets of items from the PGSI were employed:

1. Endorsement of one or more gambling-related problems on any of the nine items of the PGSI (Brosowski et al., 2015; Currie et al., 2009)
2. Endorsement of one or more gambling-related problems on any of the seven negative consequence items of the PGSI (Currie et al., 2006; Quilty et al., 2014)
3. Endorsement of two or more gambling-related problems on any of the nine items of the PGSI (Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008; Currie et al., 2009; Quilty et al., 2014)
4. Endorsement of two or more gambling-related problems on any of the seven negative consequence items of the PGSI (Brosowski et al., 2015; Currie et al., 2017; Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008; Quilty et al., 2014)
5. Reporting low-risk gambling on the PGSI (scoring ≥ 1 on the PGSI) (Weinstock et al., 2007)
6. Reporting moderate-risk gambling using the original scoring of the PGSI (scoring ≥ 3) (Currie et al., 2009; Weinstock et al., 2007)
7. Reporting the new moderate risk gambling cut-off proposed by Currie et al. (2013) (i.e., scoring ≥ 5 on the PGSI)
8. Reporting problem gambling on the PGSI (scoring ≥ 8 on the PGSI) (Brosowski et al., 2015; Weinstock et al., 2007; Weinstock et al., 2008)

Table 6. Classification of PGSI items as negative consequences or behavioural symptoms of gambling

Item	Item classification	
	Currie et al. (2009)	Ferris and Wynne (2001)
1. Have you bet more than you could really afford to lose?	Negative consequence	Behavioural symptom

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

Alternative gambling-related harm. A subset of gamblers in the third Tasmanian SEIS and the ACT survey, comprising those considered most at risk of harm from gambling, were asked a series of questions about their personal experience of harms they attributed to their gambling. In the Tasmanian survey, this group included those whose PGSI score classified them as low risk, moderate risk or problem gamblers; those who spent more than \$2,000 a year on gambling; and those who gambled 12 or more times a year on activities other than scratch tickets or lotteries (n=978). These respondents were asked how often in the last three years, their gambling had been associated with the following negative impacts: (1) resulted in you having difficulty paying bills, repaying debt, or meeting other expenses; (2) reduced how well you perform in undertaking daily tasks and activities; (3) resulted in you changing jobs or being dismissed from work; (4) left you with not enough time to look after your family's interests; (5) led to the breakup of an important relationship in your life; (6) led you to obtain money illegally, even if you intended to pay it back; (7) led to you to have contact with the police; and (8) resulted in you seriously thinking about, or attempting, suicide. Response options were: (1) almost always, (2) most of the time, (3) sometimes and (4) never. For the purpose of the ROC analyses, each alternative harm item was examined individually. Respondents were coded as experiencing gambling-related harm if they endorsed the alternative harm item as occurring 'almost always', 'most of the time' or 'sometimes'.

In the ACT survey, this group included those who had ever gambled 12 times in any 12-month period (excluding raffles, lottery and scratch tickets); those who had ever lost \$2,000 or more across all gambling activities in any 12-month period; and those who self-identified as having a gambling problem in their lifetime (n=612). These respondents were asked how often they had ever experienced any of the following in relation to their gambling: (1) not having enough money for household running costs, such as food, rent or bills; (2) not having enough money for family projects or

activities; (3) other financial difficulties; (4) feelings of stress or anxiety; (5) feeling depressed or sad; (6) having less quality time with your family; (7) a breakdown in communication with your family; (8) having arguments over your gambling; (9) the break-up of an important relationship; (10) employment issues; (11) legal issues; and (12) serious thoughts about suicide. A dichotomous response option was utilised for these items (yes/no). For the purpose of the ROC analyses, each gambling-related harm was examined separately based on the presence of each harm.

Quality of life. The 26-item World Health Organisation Quality of Life-Bref (WHOQOL-BREF; (World Health Organization (WHO), 1998) was employed to measure quality of life in the Tasmanian surveys. A description of this measure is provided in

Appendix 2.

Mental health. A range of mental health measures were administered in the third Tasmanian SEIS and the ACT gambling survey. A description of these measures is provided in

Appendix 2.

- depression (Tasmania: Patient Health Questionnaire-2 [PHQ-2] (Kroenke, Spitzer, & Williams, 2003))
- generalised anxiety symptoms (Tasmania: Generalised Anxiety Disorder-2 [GAD-2] (Kroenke, Spitzer, Williams, Monahan, & Löwe, 2007))
- panic symptoms (Tasmania: Autonomic Nervous System Questionnaire [ANS] (Stein et al., 1999))
- post-traumatic stress disorder symptoms (Tasmania: Primary Care Posttraumatic Stress Disorder [PC-PTSD] (Prins et al., 2004))
- generalised social anxiety symptoms (Tasmania: Social Phobia Inventory [Mini SPIN] (Connor, Kobak, Churchill, Katzelnick, & Davidson, 2001))
- attention-deficit hyperactivity disorder symptoms (Tasmania: ADHD Self-Report Scale [ASRS] (Kessler et al., 2005))
- psychological distress (ACT: Kessler 6 Psychological Distress Scale [K6] (Kessler et al., 2002)).

Substance use. A range of substance use measures were administered in the Tasmanian SEIS surveys and the ACT gambling survey. A description of these measures is provided in

Appendix 2.

- hazardous drinking (Alcohol Use Disorder Identification Test-3 [AUDIT-3] (Gordon et al., 2001) in the 2011 Tasmanian survey; Alcohol Use Disorder Identification Test – Consumption [AUDIT-C] (Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998) in the 2013 Tasmanian survey; first two items of the AUDIT-C in the ACT gambling survey)
- Smoking (Tasmania and ACT: single item)
- Illicit drug use and prescription drug use (Tasmania: single items based on a single-item screening test for drug use in primary care (Smith, Schmidt, Allensworth-Davies, & Saitz, 2010).

Measurement of profile characteristics

Several measures in the cross-sectional surveys were also employed to understand the characteristics of the population subgroup that will be targeted by the promotion of the responsible gambling limits. These included:

- Socio-demographic characteristics (age, gender, education, country of birth, main language spoken at home, employment status, gross personal income: Tasmania and ACT; marital status: ACT)
- Gambling participation and problem gambling severity categories (PGSI) (Tasmania and ACT, see description above)
- Hazardous drinking (AUDIT-C: ACT, see description above)
- Smoking (ACT, see description above)
- Psychological distress (K6 Psychological Distress Scale: ACT, see description above)
- General health (SF1: ACT): In general, would you say your health is: Excellent, very good, good, fair, poor.

Data analytic strategy

Analysis of the secondary data sets were focused initially on deriving the responsible gambling limits based on different definitions of harm, and characterising those individuals who met the harm and/or met the proposed limit using a range of correlates. Details of the analysis for each section is provided below. Unless otherwise stated, all analyses were conducted in Stata 14 (StataCorp, 2015). All inferential analyses were performed using a robust variance estimator to adjust for heteroscedasticity. Unless otherwise stated, weighted data were employed in the analyses and statistical testing was conducted at 0.05.

Responsible gambling limits for the population using PGSI definitions of harm

Risk (dose-response) curves. The dose-response relationships for the Tasmania and ACT data were examined across multiple gambling indices (gambling frequency, gambling expenditure, and gambling expenditure as a proportion of gross personal income) and the eight definitions of harm. Risk curves were explored using two separate approaches: those employed by Currie and colleagues (2006; 2008) and Markham et al. (2016). The approach by Currie and colleagues (2017; 2006; 2008) involves graphing the relationship between gambling behaviour (x-axis; representing increasing gambling behaviour, measured using ordered categories) and the proportion of people who met a definition of gambling harm (y-axis; measured using ordered categories) for each category on the x-axis. By contrast, dose-response curves using the approach adopted by Markham et al. (2016) plots a continuous measure of gambling behaviour (x-axis) against a continuous measure of gambling harm (y-axis, using the PGSI) and subsequently using a locally weighted, non-parametric polynomial regression (with bootstrapping), in order to visualise the relationship between gambling behaviour and risk of harm.

Responsible gambling limits for the population. Optimal responsible gambling limits were identified using ROC analyses across the multiple gambling indices and eight definitions of harm. Only gamblers (i.e., respondents who reported past-year gambling participation) were employed in these analyses. ROC analysis is an established statistical approach for examining the ability of a test (i.e. the responsible gambling limit) to correctly identify individuals in the population who actually have gambling-related harm (i.e., the presence or absence of harm according to each definition). For each level of gambling behaviour performed in the sample of interest, these analyses plot the relationship between the sensitivity (the ability of a responsible gambling limit to accurately identify individuals experiencing gambling-related harm) and the complement of specificity (i.e. 1- specificity; with specificity describing the ability of a responsible gambling limit to accurately identify individuals not experiencing gambling-related harm). After plotting the sensitivity and 1-specificity for each level of gambling behaviour in the sample, the area under the curve (AUCs) of the resulting ROC graph was calculated. A straight diagonal relationship in a ROC graph would result in an AUC = 0.50 and would suggest a useless test (i.e., at all levels of gambling behaviour, there is only a 50% probability the test will correctly identify individuals with harm and not identify people without harm). By contrast, a line that is closer to the top left of a ROC graph (i.e., indicating high sensitivity and specificity) would result in a higher AUC value. Thus, the AUC provides a valuable general index of the ability of a test to have a useful threshold for classification performance. AUC values range from 0 (100% misclassification) to 1 (100% correct classification), where 0.50 is representative of chance levels of correct classification (i.e., diagonal line on ROC graph). The classification accuracy of the AUCs were interpreted according to established guidelines, whereby an AUC between 0.50 and 0.70 is considered to be small, an AUC between 0.70 and 0.90 is considered to be moderate, and an AUC over 0.90 is considered to be high (Swets, Dawes, & Monahan, 2000). The limited amount of missing values were excluded from the analyses for each limit.

In this project, the optimal cut-off limit for the gambling behaviour being examined was considered acceptable for ROC models displaying moderate to high classification accuracy (i.e., an AUC value ≥ 0.70) (Brosowski et al., 2015; Swets et al., 2000). Although the choice of cut-off can be guided by several factors, there is currently no prevailing conceptual rationale for prioritising either sensitivity or specificity in the identification of responsible gambling limits. With the exception of the most recent longitudinal research (Currie et al., 2017), all of the previous research in this area has selected cut-offs that give equal weighting to the optimisation of sensitivity and specificity given the preliminary state of the evidence (Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008; Currie et al., 2009; Quilty et al., 2014; Weinstock et al., 2007; Weinstock et al., 2008). This method equally minimises false positives and false negatives (Gordon et al., 2001). To this end, unless otherwise noted, the level of gambling behaviour that had the maximum Youden Index value (Youden, 1950) relative to all other levels of gambling behaviour was deemed the optimal cut-off (with equal weighting given to sensitivity and specificity) (see (Ruopp, Perkins, Whitcomb, & Schisterman, 2008) for relevant formulas).

Proportion of the population exceeding the proposed responsible gambling limits. Once the proposed responsible gambling limits were identified, we examined the proportion of the Australian population who exceed them. Specifically, gamblers were classified as either not meeting (0) or meeting (1) the limit and this classification was used throughout subsequent analyses. Gamblers were only classified for a specific limit if they had the respective gambling behaviour data (e.g. it was not assumed that a gambler was under the frequency limit if they had not reported frequency data). For analyses concerning the population sample, all non-gamblers were classified as not meeting the limit. From this, the proportion of individuals meeting the limit in the population, and gambler specific sample, were reported. We also explored the proportion of gamblers exceeding multiple proposed responsible gambling limits.

Cross-sectional evaluation of the proposed responsible gambling limits. The cross-sectional association between the proposed responsible gambling limits and gambling-related harm (defined as two or more negative consequences on the PGSI) was explored using regression analyses. Logistic regression analyses with gamblers (i.e., respondents who had reported past-year gambling participation) were used for this purpose with the dependent variable being a binary measure of gambling-related harm (i.e., yes vs no) and the predictors being the proposed responsible gambling limits. First, the degree to which each of the proposed responsible gambling limits predicted gambling-related harm (adjusted for socio-demographic covariates) was explored, followed by the degree to which they independently predicted gambling-related harm after controlling for the other proposed responsible gambling limits (adjusted for socio-demographic covariates). The gambling expenditure as a proportion of gross personal income limit was removed from these analyses due to multicollinearity with the gambling expenditure limit. The gambling expenditure limit was retained in preference to the gambling expenditure as a proportion of gross personal income limit because the calculation of this latter variable was based on an estimate of total income using the midpoint of the particular category level of income endorsed by respondents. The level of risk for each predictor in these regression models are expressed as an odds ratio (OR), which is a measure of the increased odds for having gambling-related harm if the gambling limit is exceeded versus if the gambling limit is not exceeded. These analyses were conducted for the proposed population responsible gambling limits and gambling activity-specific responsible gambling limits. Additionally, the number of limits exceeded (range 0-4) was also explored as a predictor of gambling-related harm. Although these analyses are somewhat tautological as the limits are derived from the selected definition of gambling-related harm, we have conducted them to be consistent with the available literature in providing some limited evidence in support of the validity of the limits (Currie et al., 2017; Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008).

Longitudinal evaluation of the proposed responsible gambling limits. The transitions of Tasmanian longitudinal survey respondents in relation to exceeding each of the proposed responsible gambling limits across the three waves of the survey were explored. This transition data was unavailable for the responsible gambling limit relating to expenditure as a proportion of gross personal income as data relating to gross personal income was not collected at waves 2 and 3 of the survey. Subsequently, the prospective association between each of the proposed responsible gambling limits and gambling-related harm (defined as two or more negative consequences on the PGSI) across the three waves of the Tasmanian survey after controlling for socio-demographic characteristics was explored using the same approach as the cross-sectional regression analyses (i.e., separate logistic regression models from wave 1 to wave 2 and from wave 1 to wave 3 adjusted for socio-demographic characteristics). These analyses were then followed by an exploration of the prospective independent association of each of the proposed responsible gambling limits and gambling-related harm after also controlling for the other proposed responsible gambling limits (i.e., a logistic regression model adjusted for the other proposed responsible gambling limits and socio-demographic characteristics). The gambling expenditure as a proportion of gross personal income limit was removed from these analyses due to multicollinearity with the gambling expenditure limit. The gambling expenditure limit was retained in preference to the gambling expenditure as a proportion of gross personal income limit because the calculation of this latter variable was based on an estimate of total income using the midpoint of the particular category level of income endorsed by respondents. Finally, a logistic regression model (adjusted for socio-demographic characteristics) was conducted to examine the longitudinal association between the total number of proposed responsible gambling limits that a respondent exceeded and gambling-related harm for each subsequent wave. These analyses did not control for gambling-related harm at wave 1 because it is in the direct causal pathway of developing harm at waves 2 and 3. In these longitudinal analyses, only gamblers (i.e., respondents who reported past-year gambling participation) at wave 1 were included. Harm was calculated using the PGSI scores at wave 2 and wave 3 only for those who reported gambling in that wave, while non-gamblers were classified as having no harm. The longitudinal analyses were conducted with weights for the complete sample who provided longitudinal data.

Profiling the target population and audience. A series of analyses were employed to profile the target population for the promotion of the proposed responsible gambling limits (i.e., gamblers who meet the selected definition of gambling-related harm) and the target audience for the promotion of the proposed responsible gambling limits (i.e., gamblers who exceed each of the proposed responsible gambling limits). Respondents who met the selected definition of harm were compared to respondents who did not meet the selected definition of harm on PGSI category profiles using chi-square analyses. PGSI category was explored separately in this case due to the collinearity expected (since they are both derived from the same raw scores) with the outcome, and was used largely for descriptive purposes. Following this, differences in sample characteristics were explored using logistic regression. The odd ratios indicate the strength and direction of the differences. First, each sample characteristic was analysed as a predictor individually in a series of separate unadjusted univariable logistic regression analyses. Second, each characteristic that was found to be correlated with the outcome ($p < 0.100$) was entered into a single, multivariable model. Logistic regression modelling was also employed to identify the characteristics of the population subgroup who exceeded each of the proposed responsible gambling limits. Specifically, we used the same methodology that was employed in relation to gambling-related harm: a series of separate unadjusted univariable logistic regression analyses followed by a single multivariable regression analysis predicting exceeding each of the limits. These analyses employed the same set of measures for the gambling-related harm analyses above, with the exception of the inclusion of PGSI gambling severity. Given the number of statistical comparisons made in this section, tests of significance were adjusted to a more conservative level of 0.01 for these analyses.

Sensitivity analyses for responsible gambling limits: Excluding lottery only gamblers. To examine whether the inclusion of lottery only players influenced the main ROC analysis result, we conducted sensitivity ROC analyses that replicated the main ROC analyses but excluded gamblers for whom lottery was their *only* gambling activity.

The relative and absolute risk associated with exceeding the proposed responsible gambling limits. Further exploration of the usefulness of the responsible gambling limits were characterised using the measure of relative risk. Specifically, this is defined as the ratio of the absolute risk for the harm outcome in those who did, and did not meet the responsible gambling limit. Put another way, the relative risk is the proportion of people who actually experience gambling-related harm in those people who met the responsible gambling limit, divided by the proportion of people who met the gambling-related harm in those who did not meet the limit. This measure allows for a comparison of the extent to which meeting the responsible gambling limit is associated with increased risk for gambling-related harm relative to the risk for gambling-related harm in those who do not meet the limit. Relative risk is calculated based on the occurrence of both a risk and outcome factor. The formula is as such:

	Outcome (e.g. gambling harm)	
Risk (e.g. gambling limit)	Present	Absent
Present	a	b
Absent	c	d

$$\text{Relative risk} = (a/(a+b))/(c/(c+d))$$

Risk ratios are provided in this section in preference to other measures of effect size as they are standard in epidemiological research but are more easily understood by the general population (including gamblers) and other gambling stakeholders. The purpose of these analyses is so that gamblers can estimate their individual level of risk of experiencing gambling-related harm based on their gambling frequency, expenditure, expenditure as a proportion of income, and number of gambling activities.

Another important consideration when considering the utility of the proposed responsible gambling limits is the *absolute risk* associated with exceeding the limits (i.e., the number of people experiencing an event in relation to the population at risk). The absolute risk figures identified in this study were explored using unweighted data.

A set of sliding scales highlighting the relative and absolute risk associated with different levels of gambling behaviour (gambling frequency, gambling expenditure, gambling expenditure as a proportion of gross personal income, and number of gambling activities) was created for each of the Tasmanian and ACT datasets. The aim of this analysis was to demonstrate to what extent the relative and absolute risk for gambling-related harm changes depending on the level of gambling behaviour. The proposed limits were used as a basic metric and the relative and absolute risk was calculated for gambling behaviour at levels below the proposed limit (i.e., one-quarter of the proposed limit, half the proposed limit, three-quarters of the proposed limit), equal to the limit, then equal to increasing multiples of the proposed limit. Each sliding scale was discontinued when the cell size contained fewer than 20 gamblers. This allowed us to examine the relative and absolute risk of experiencing gambling-related harm associated with increases and decreases in gambling behaviour relative to the proposed responsible gambling limits.

Consideration of the base prevalence rate of gambling-related harm. Another method to investigate absolute risk is to evaluate the positive predictive values (PPV) and negative predictive values (NPV) for each of the proposed responsible gambling limits depending on the prevalence of the selected definition of gambling-related harm. The PPV describes the predicted proportion of individuals who meet the gambling limit that will actually experience gambling-related harm. The NPV

describes the proportion of people who do not meet the gambling limit and do not experience gambling-related harm. The PPV and NPV is based on assumption about the likely true prevalence of gambling-related harm in the population. For example, in the general population (where the true prevalence of gambling-related harm is low), it is expected that a smaller proportion of individuals who meet the gambling limit will actually have gambling-related harm (i.e., low PPV). By contrast, in a treatment clinic where the expected true prevalence of gambling-related harm, it is expected that meeting the gambling limit is likely to be associated with a high probability of also meeting the gambling-related harm. PPVs and NPVs were graphed using the sensitivity and specificity from ROC analyses against prevalence rates of harm ranging from 0% to 100% prevalence, which indicated the predictive power of the limits in different samples with different base-rate prevalence of harm. The PPVs and NPVs were explored in both the population and gambling samples from the Tasmanian and ACT datasets. In order to illustrate that PPVs increase substantially in higher prevalence settings, we also calculated the PPVs and NPVs for several other settings: Victorian EGM venue employees, Victorian mental health services, the Australian national online gambling support service (Gambling Help Online), and an Australian online self-directed gambling program (GAMBLINGLESS).

Responsible gambling limits for the population using PGSI definitions of harm: Maximising specificity and sensitivity

Given the inherent assumption of the Youden Index approach to deriving the optimal cut-off that sensitivity and specificity have equal weighting, we also examined the impact on the identified PGSI-based limits of maximising specificity only or sensitivity only. Specifically, we employed ROC analyses maximising specificity by dropping sensitivity as close as possible to 0.50 and subsequently maximising sensitivity by dropping specificity as close as possible to 0.50. A value of 0.50 for sensitivity would indicate a test that correctly identifies those *with* the outcome at least 50% of the time and a value of 0.50 for specificity would indicate a test that correlation identifies those *without* the outcome 50% of the time. We chose 0.50 as the minimum values of either sensitivity or specificity since no values in the original ROC analysis results fell below this level.

Responsible gambling limits for population subgroups

A series of binary logistic regressions that included the interaction effects between the responsible gambling limits and gender in predicting gambling-related harm were conducted. These regressions were replicated across different age categories (i.e., 18-34 years, 35-49 years, 50-64 years, 65+ years). Given there were no significant interaction effects, responsible gambling limits for each gender and different age groups were not identified.

Gambling activity-specific responsible gambling limits using the PGSI definition of harm

Optimal responsible gambling limits for each gambling activity (EGMs, horse/dog racing, instant scratch tickets, lottery, keno, casino table gambling, bingo, and sports/other event betting) were identified. Specifically, for each analysis an identical methodology was utilised, as described previously to: (a) derive responsible gambling limits using ROC analyses, (b) examine the proportion of people who met the limit, and (c) examine the cross-sectional relationship between the gambling limits and gambling-related harm. For each of these different analyses, we utilised the same methodology as discussed previously except that we used gambling behaviour measures specific to each activity (e.g. for EGM gamblers we look at EGM expenditure, not overall expenditure) and the sample for analysis was limited to only those who met the category under examination (e.g., EGM-specific limits were derived only using EGM gamblers). The cross-sectional evaluation of the proposed gambling activity-specific responsible gambling limits must be interpreted with caution because smaller cell sizes can lead to large confidence intervals around some estimates.

Because the PGSI was only asked once, rather than for every gambling activity, the derivation of gambling activity-specific responsible gambling limits is fundamentally limited by the inability to link gambling-related harms to specific gambling activities. This is of concern given that some gambling activities, predominantly including EGMs, are thought to contribute more to gambling-related harm than others (Dowling, Smith, & Thomas, 2005). In order to identify which of the proposed responsible gambling limits relating to specific gambling activities contributed most to gambling-related harm, a series of analyses were conducted for each of the gambling behaviour indices (gambling frequency, gambling expenditure, gambling expenditure as a proportion of gross personal income, session expenditure, and session duration). These analyses are distinct from the previous analyses presented in this section as they were conducted across the entire gambling samples from both the Tasmanian and ACT data (i.e., they were not restricted to the group of gamblers participating in each specific gambling activity). The purpose of these analyses are to ascertain the contribution of exceeding the limits pertaining to each specific gambling activity.

Responsible gambling limits for the population using alternative measures of harm

We also employed ROC analyses to examine the performance of various other definitions of harm using several other gambling-related harm (including alternative gambling-related harm items and measures of quality of life, mental health, and substance use).

Results

Responsible gambling limits for the population using PGSI definitions of gambling-related harm

Risk (dose-response) curves

The dose-response relationships for the Tasmania and ACT data were examined across multiple gambling indices (gambling frequency, gambling expenditure, and gambling expenditure as a proportion of gross personal income) and the eight definitions of harm. Both the methodologies utilised by Currie and colleagues (2017; 2006; 2008) and Markham et al. (2016) were employed. Using the Tasmanian and ACT data in the current project, the risk curves for gambling behaviours across definitions of gambling-related harm were generally J-shaped when employing the Currie and colleagues (2017; 2006; 2008) methodology, indicating that the chances of experiencing gambling-related harm remained constant at low levels of each of the gambling indices then increased sharply when a certain threshold of gambling behaviour was reached (see Figure 1). The sample sizes for each of the categories employed on the x-axis for these illustrative figures are displayed in Appendix 3. In contrast, curves for gambling behaviours across PGSI scores were generally r-shaped when employing the Markham et al. (2016) methodology, indicating that there is a level of risk associated with even low levels on the gambling indices (see Figure 2). Given the statistical robustness of the Markham et al. (2016) approach, the data from the present study suggest that even low levels of gambling behaviour is associated with harm; and that this harm increases rapidly with even small increases in gambling consumption.

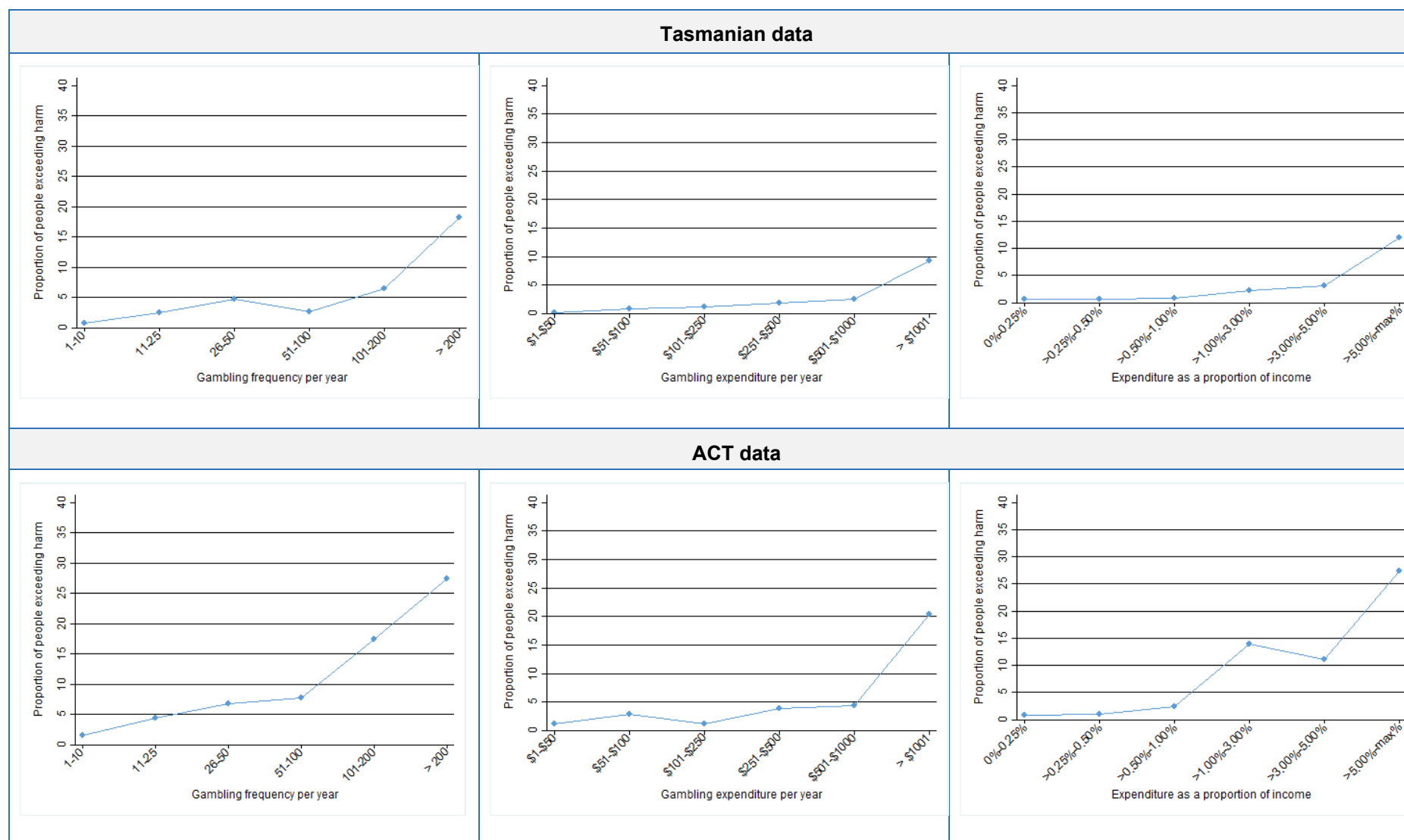


Figure 1. Illustrative “J-shaped risk curves” derived from the Tasmanian and ACT data using Currie et al.’s (2017; 2006; 2008) methodology

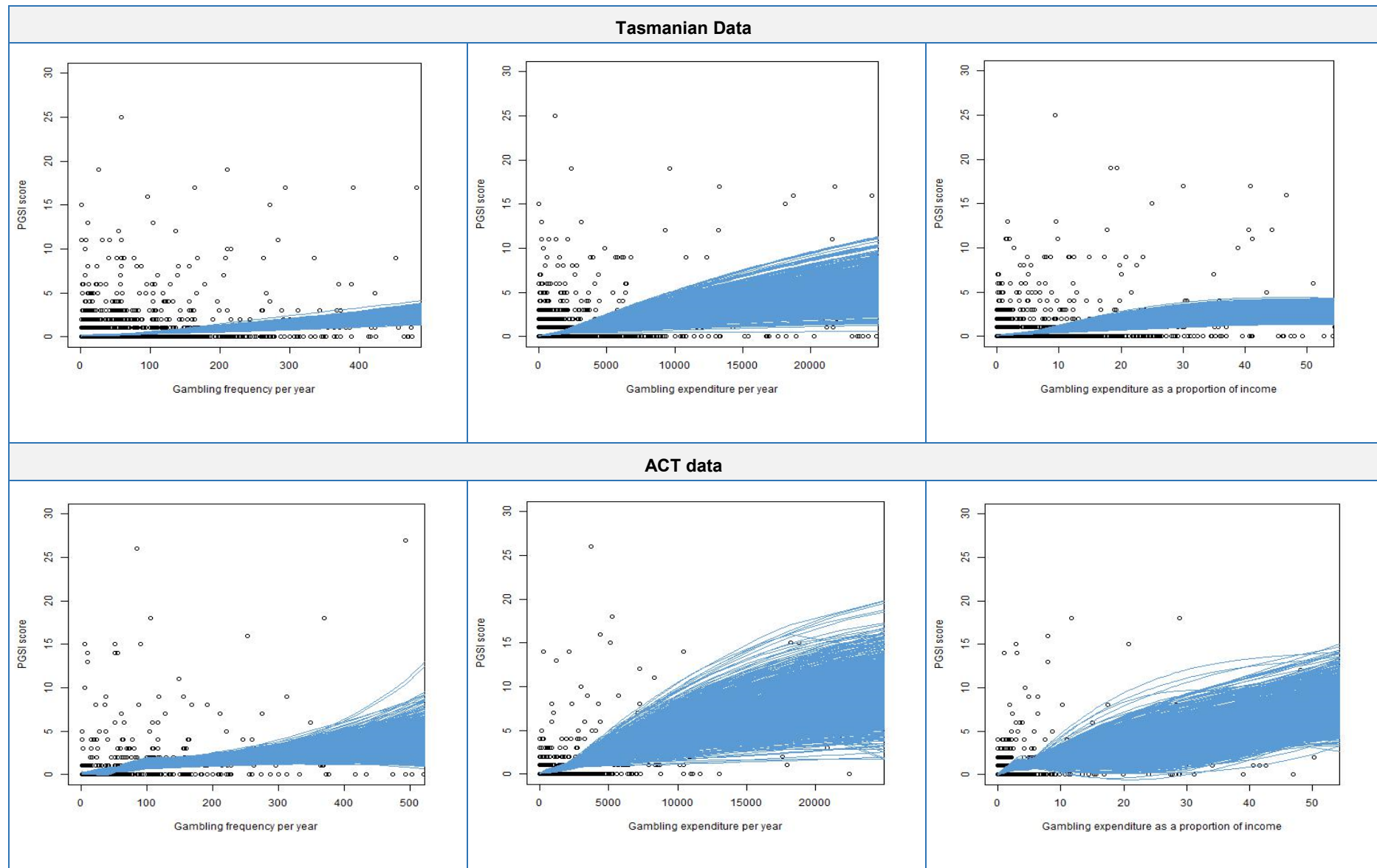


Figure 2. Illustrative “r-shaped risk curves” derived from the Tasmanian and ACT data using Markham et al.’s (2016) methodology

Proposed responsible gambling limits for the population

Responsible gambling limits for the Tasmania and ACT data were identified by exploring the optimal cut-offs in ROC analyses across the multiple gambling indices and the eight definitions of harm based on the PGSI (see tables Table 51 and Table 52 in Appendix 4). The optimal responsible gambling limits were generally robust to variations in definitions of harm, with generally moderate classification accuracy (AUC = 0.70-0.90). The various definitions of harm produced relatively consistent responsible gambling limits across the four gambling indices, with the exception of the definition of harm based on the problem gambling cut-off (i.e., PGSI scores ≥ 8), particularly in the Tasmanian dataset, which derived much higher responsible gambling limits.

Excluding this definition, the Tasmanian responsible gambling limits ranged from:

- 25 to 38 times per year for gambling frequency
- \$418 to \$745 per year for gambling expenditure
- 1.08 to 1.96% for gambling expenditure as a proportion of gross personal income, and
- 2 to 3 gambling activities for number of activities.

The corresponding ACT responsible gambling limits were consistently slightly more conservative; they ranged from:

- 17 to 26 times per year for gambling frequency
- \$275 to \$728 per year for gambling expenditure
- 0.61 to 1.93% for gambling expenditure as a proportion of gross personal income, and
- 2 gambling activities for number of activities.

Although the highest classification accuracy (as indicated by the AUCs) for both samples was obtained using the problem gambling cut-off (i.e., PGSI scores ≥ 8), this definition of harm captures the least number of people in the population experiencing harm (0.6% in Tasmania, 0.4% in ACT). The next highest classification accuracy is obtained when employing: (a) the new moderate risk gambling cut-off (i.e., PGSI scores ≥ 5); (b) endorsing two or more gambling-related problems on any of the 7 negative consequence PGSI items; and (c) the traditional moderate risk gambling cut-off (PGSI scores ≥ 3) (particularly in the ACT data). Of these three definitions, the definition of harm based on two or more negative consequences was superior in that it captured the highest proportion of individuals in the general population (2.3% in Tasmania, 1.9% in ACT) or gamblers (i.e., people who had gambled on at least one gambling activity in the previous 12 months) (3.7% in Tasmania, 3.5% in ACT). The ROC analyses for the Tasmanian and ACT data according to this definition of harm are displayed in Table 7. The responsible gambling limits presented in the remainder of this section are therefore based on this definition of harm.

Using this definition of harm produces relatively consistent responsible gambling limits across the two jurisdictions, although the ACT limits are consistently slightly lower than the Tasmanian limits. Using the selected definition of harm, the proposed responsible gambling limits for the Australian population are estimated to be:

- a gambling frequency of 20 to 30 times per year

- a gambling expenditure of \$380 to \$615 per year
- a gambling expenditure comprising 0.83% to 1.68% of an individual's gross personal income, and
- 2 gambling activities.

Table 7. ROC analyses for the Tasmanian and ACT data according to the selected definition of harm based on the PGSI^a

Responsible gambling limit		Endorsement of ≥ 2 PGSI negative consequence items	
		<i>Tasmanian data</i>	<i>ACT data</i>
Proportion of population exceeding each definition of harm		2.30% (95% CI 1.81, 2.91)	1.92% (95% CI 1.39, 2.65)
Proportion of gamblers exceeding each definition of harm		3.68% (95% CI 2.90, 4.64)	3.54% (95% CI 2.56, 4.88)
Gambling frequency per year	Cut off	30	20
	AUC (95% CI)	0.76 (0.70, 0.81)	0.79 (0.72, 0.86)
	sens, spec	0.71, 0.67	0.75, 0.69
	N	5754	1215
Gambling expenditure per year	Cut off	615	380
	AUC (95% CI)	0.86 (0.82, 0.90)	0.84 (0.78, 0.91)
	sens, spec	0.78, 0.77	0.78, 0.74
	N	5498	1157
Gambling expenditure as proportion of gross personal income	Cut off	1.68	0.83
	AUC (95% CI)	0.84 (0.79, 0.89)	0.85 (0.77, 0.92)
	sens, spec	0.78, 0.74	0.77, 0.76
	N	4954	1014
Number of gambling activities	Cut off	2	2
	AUC (95% CI)	0.78 (0.73, 0.83)	0.73 (0.65, 0.82)
	sens, spec	0.82, 0.58	0.69, 0.65
	N	5860	1208

^a Bold typeface indicates AUC ≥ 0.70

Proportion of the population exceeding the proposed responsible gambling limits

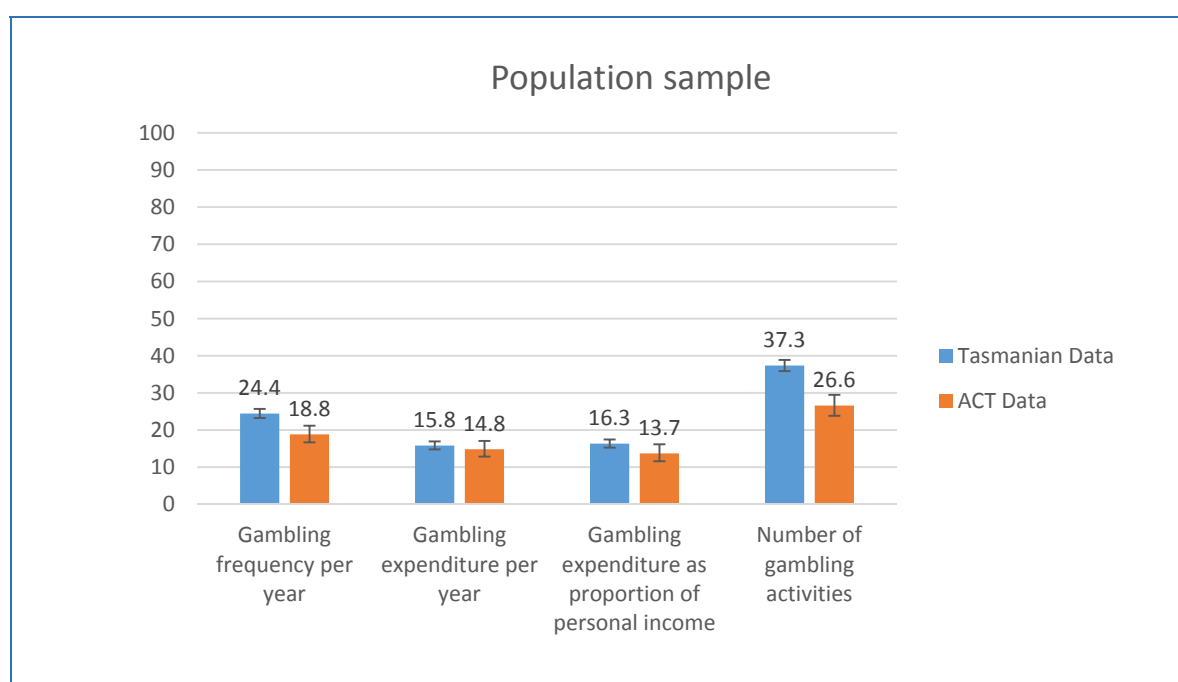
Proportion of the population exceeding the proposed responsible gambling limits

Figure 3 displays the proportion of the Tasmanian and ACT population and gambling samples who exceeded each of the proposed responsible gambling limits derived from the selected definition of harm (two or more negative consequences on the PGSI).

This figure reveals that between 16 and 37% of the Tasmanian general population exceeded the limits whilst between 14 and 27% of the ACT general population exceeded the limits. When examining only the subset of the population who had gambled in the previous 12 months, it was found that 26 to 60% of Tasmanian gamblers and 27 to 50% of ACT gamblers exceeded the limits.

The largest proportion of people exceeded the number of gambling activities limit (27-37% of the population; 50-60% of gamblers), followed by the gambling frequency limit (19-24% of the population; 35-39% of gamblers). The gambling expenditure (15-16% of the population; 26-28% of gamblers) and gambling expenditure as a proportion of gross personal income limits (14-16% of the population; 27-28% of gamblers) were exceeded by a smaller proportion of people.

These groups of people comprise the target audience for the promotion of the proposed responsible gambling limits in order to identify gamblers who are at risk for gambling-related harm.



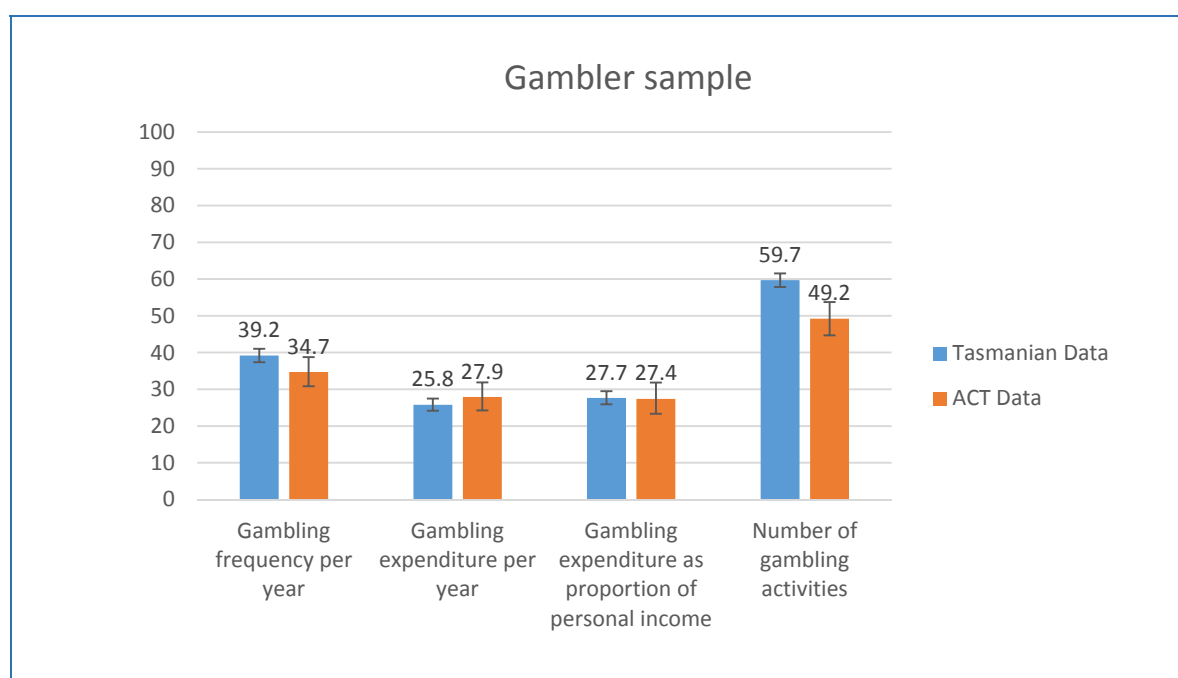


Figure 3. Proportion of the Tasmanian and ACT samples exceeding the proposed responsible gambling limits

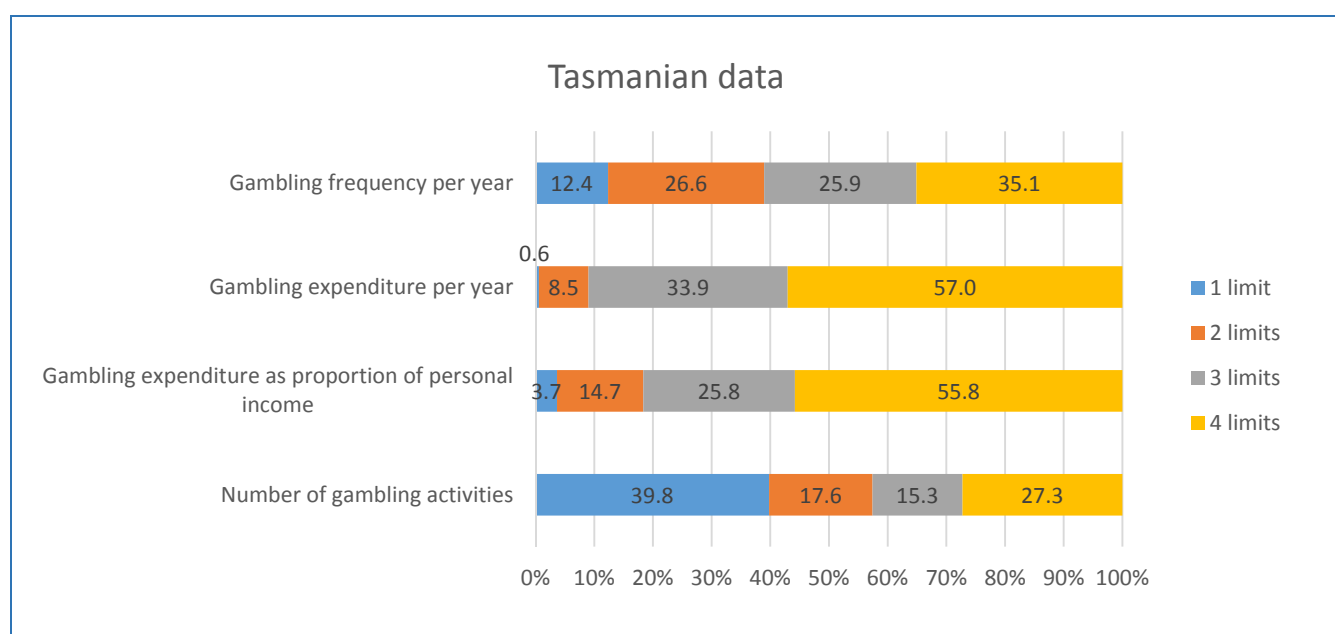
Proportion of gamblers exceeding multiple proposed responsible gambling limits

The proportion of the Tasmanian and ACT samples exceeding each of the proposed responsible gambling limits who also met the other proposed responsible gambling limits is displayed in Table 8. The findings across both datasets indicates that of those who exceeded the gambling frequency limit, 62 to 76% also exceeded the gambling expenditure limit, 66 to 72% also exceeded the gambling expenditure as a proportion of gross personal income limit, and 71 to 76% also exceeded the number of gambling activities limit. Of those who exceeded the gambling expenditure limit, 62 to 76% also exceeded the gambling frequency limit, 82 to 85% also exceeded the gambling expenditure as a proportion of gross personal income limit, and 81% also exceeded the number of gambling activities limit. Of those who exceeded the gambling expenditure as a proportion of gross personal income limit, 66 to 72% also exceeded the gambling frequency limit, 82 to 85% also exceeded the gambling expenditure limit, and 75 to 82% also exceeded the number of gambling activities limit. Finally, of those who exceeded the number of gambling activities limit, 71 to 76% also exceeded the gambling frequency limit, 81% also exceeded the gambling expenditure limit, and 75 to 82% also exceeded the gambling expenditure as a proportion of gross personal income limit.

These findings suggest that a considerable proportion of gamblers who exceed a particular proposed responsible gambling limit will also exceed other proposed responsible gambling limits. They imply that promotion of a proposed responsible gambling limit related to one index of gambling behaviour will also likely identify individuals who exceed other proposed responsible gambling limits. This is particularly true for the gambling expenditure and gambling expenditure as a proportion of gross personal income limits.

Table 8. Proportion of gamblers exceeding each proposed responsible gambling limit who also exceed other responsible gambling limits

Responsible gambling limit	Gambling expenditure per year	Gambling expenditure as proportion of gross personal income	Number of gambling activities
Tasmanian data			
Gambling frequency per year	61.60%	65.61%	71.17%
Gambling expenditure per year		81.57%	80.50%
Gambling expenditure as proportion of gross personal income			74.74%
ACT data			
Gambling frequency per year	76.09%	71.48%	76.28%
Gambling expenditure per year		85.43%	80.99%
Gambling expenditure as proportion of gross personal income			81.78%



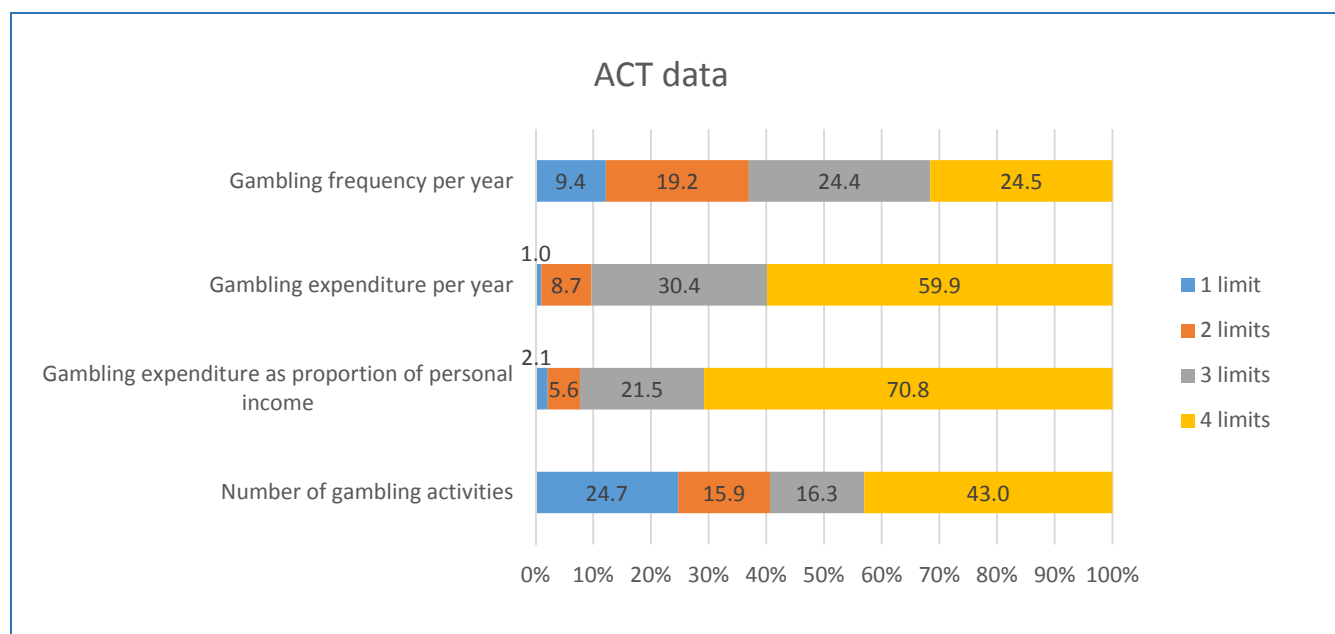


Figure 4 displays the proportion of the Tasmanian and ACT samples exceeding each of the proposed responsible gambling limits who exceeded only that limit, as well as those who exceeded one other limit, two other limits, or all four limits. The findings across both datasets revealed that of those who exceeded the gambling frequency limit, 9 to 12% exceeded only that limit, with the remainder of the sample exceeding one other limit (19-27%), two other limits (24-26%), or all four limits (25-35%). Of those who exceeded the gambling expenditure limit, only 1% exceeded only that limit, with the remainder exceeding one other limit (9%), two other limits (30-34%), or all four limits (57-60%). Of those who exceeded the gambling as a proportion of gross personal income limit, only 2 to 4% exceeded only that limit, with the remainder exceeding one other limit (6-15%), two other limits (22-26%), or all four limits (56-71%). Of those who exceeded the number of gambling activities limits, however, a considerable proportion exceeded only that limit (25-40%), with the rest of the sample exceeding one other limit (16-18%), two other limits (15-16%), or all four limits (27-43%).

These findings suggest that few gamblers exceed only one of the proposed responsible gambling limits and that a considerable proportion of gamblers exceed all four limits. This is particularly true for the limits relating to gambling expenditure and gambling expenditure as a proportion of gross personal income. These findings confirm that promoting a responsible gambling limit relating to one gambling index will also likely identify individuals who exceed at least one of the other responsible gambling limits.

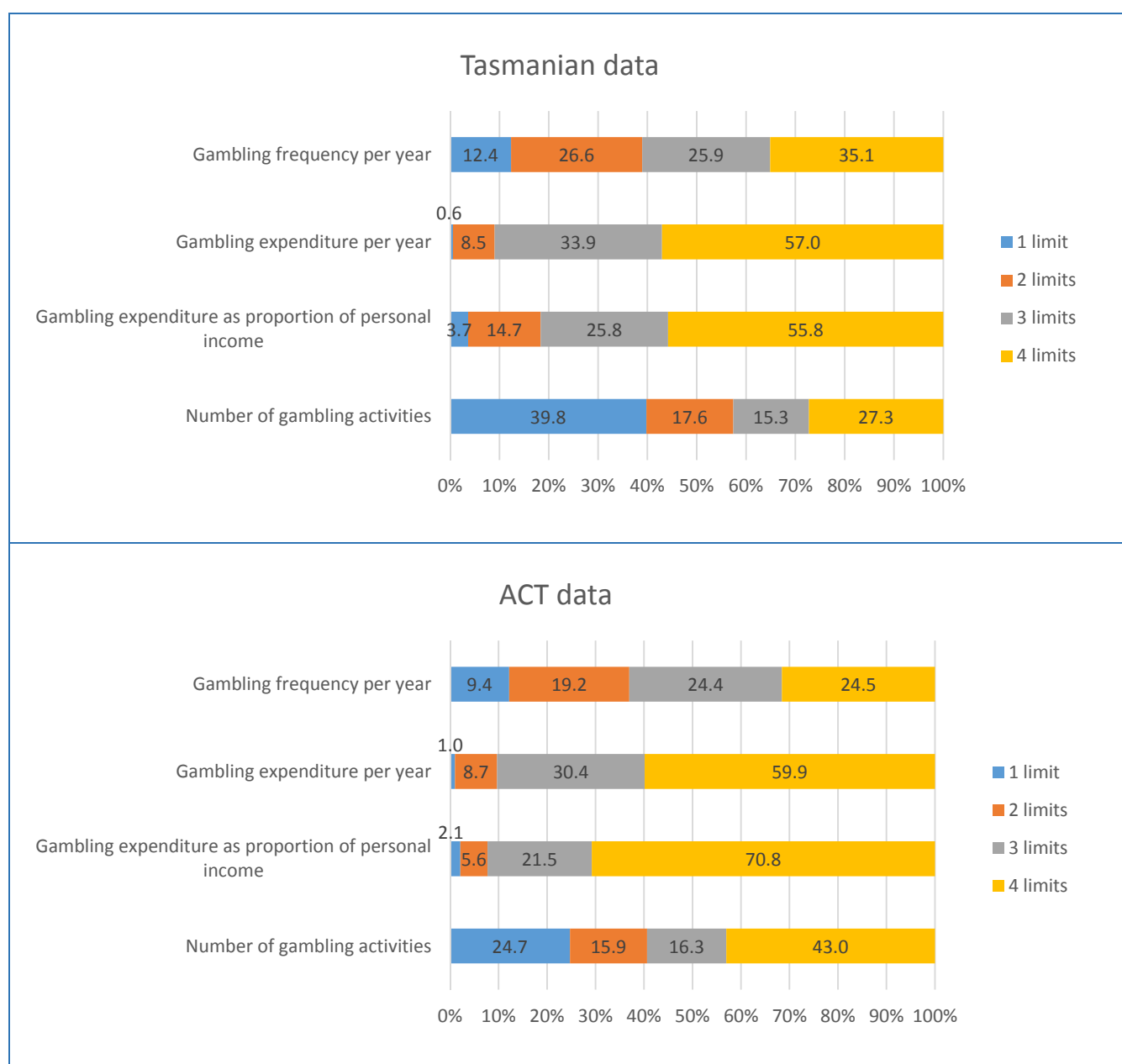


Figure 4. Proportion of the Tasmanian and ACT samples exceeding multiple proposed responsible gambling limits

Cross-sectional evaluation of the proposed responsible gambling limits

The association between the proposed responsible gambling limits and gambling-related harm (defined as two or more negative consequences on the PGSI) was explored. First, the degree to which each of the proposed responsible gambling limits predicted gambling-related harm (adjusted for socio-demographic covariates) was explored, followed by the degree to which they independently predicted gambling-related harm after controlling for the other proposed responsible gambling limits (adjusted for socio-demographic covariates). Finally, the degree to which the number of proposed limits exceeded predicted gambling-related harm was explored.

Cross-sectional evaluation of each of the proposed responsible gambling limits

Separate logistic regression models (adjusted for socio-demographic characteristics) exploring whether each of the proposed responsible gambling limits predicted gambling-related harm across both datasets are displayed in Table 9. The findings suggest that separately, exceeding each of the proposed responsible gambling limits significantly predicted gambling-related harm in both the Tasmanian and ACT data. They suggest that the odds of experiencing 2 or more negative consequences on the PGSI increased by a factor of between 5 and 23 when the proposed responsible gambling limits were exceeded.

A logistic regression model (adjusted for the other proposed responsible gambling limits and socio-demographic characteristics) examining the independent association between the proposed responsible gambling limits and gambling-related harm in each of the datasets is also displayed in Table 9. These analyses revealed that exceeding the gambling expenditure limit and number of gambling activities limit significantly independently predicted gambling-related harm in the Tasmanian data, but only exceeding the gambling expenditure limit significantly independently predicted gambling-related harm in the ACT data. The odds of experiencing gambling-related harm increased by a factor of between 4 and 9 when the proposed gambling expenditure limit was exceeded (Tasmania and ACT); the odds of experiencing gambling-related harm increased by a factor of 3 when the proposed number of gambling activities limit (Tasmania) was exceeded. These findings indicate that only the limit relating to gambling expenditure, and to a lesser extent, number of gambling activities, independently predicted gambling-related harm after controlling for the other proposed responsible gambling limits and socio-demographic characteristics.

Taken together, these findings suggest that exceeding the proposed responsible gambling limits were generally good predictors of gambling-related harm. An examination of the results in relation to each of the proposed responsible gambling limits across both sets of analyses revealed that:

- **Gambling expenditure limits:** Exceeding the proposed gambling limits related to gambling expenditure (gambling expenditure and gambling expenditure as a proportion of gross personal income limits) were consistently the strongest predictors of gambling-related harm. Exceeding these limits were the strongest predictors of gambling-related harm across both datasets; and exceeding the gambling expenditure limit was the only independent significant predictor of gambling-related harm after controlling for the other proposed responsible gambling limits in both datasets.
- **Gambling frequency limit:** Exceeding the proposed gambling frequency limit significantly predicted gambling-related harm across both datasets; however, the relationships were not as strong as those for the limits relating to gambling expenditure. Exceeding this limit was not a significant independent predictor of gambling-related harm after controlling for the other limits in either dataset.

- **Number of gambling activities limit:** Exceeding the proposed number of gambling activities limit significantly predicted gambling-related harm across both datasets; however, the relationships were not as strong as those for the limits relating to gambling expenditure. Moreover, exceeding this limit was a significant independent predictor of gambling-related harm after controlling for the other limits in the Tasmania data, but not in the ACT data.

Table 9. Cross-sectional prediction of the selected definition of gambling-related harm in Tasmania and the ACT by the proposed responsible gambling limits

Responsible gambling limit	OR	Robust standard error	z	p	95% CI		r ²	OR	Robust standard error	z	p	95% CI		r ²
	Adjusted for socio-demographics ^a							Adjusted for other limits/socio-demographics ^{b,c}						
	Tasmanian data													
Gambling frequency per year	4.90	1.58	4.91	0.000	2.60	9.23	0.08	0.79	0.27	-0.68	0.497	0.40	1.55	0.17
Gambling expenditure per year	9.75	3.31	6.71	0.000	5.01	18.95	0.15	8.59	3.11	5.95	0.000	4.23	17.46	
Gambling expenditure as proportion of gross personal income	13.46	4.80	7.28	0.000	6.69	27.09	0.18							
Number of gambling activities	5.64	1.64	5.94	0.000	3.19	9.98	0.07	3.06	1.10	3.11	0.002	1.51	6.20	
	ACT data													
Gambling frequency per year	5.62	2.49	3.90	0.000	2.36	13.38	0.09	1.66	0.82	1.02	0.308	0.63	4.38	0.14
Gambling expenditure per year	8.08	3.88	4.36	0.000	3.16	20.69	0.13	4.05	2.06	2.74	0.006	1.49	10.98	
Gambling expenditure as proportion of gross personal income	22.90	15.64	4.58	0.000	6.00	87.32	0.22							
Number of gambling activities	4.09	1.61	3.58	0.000	1.89	8.83	0.07	2.47	1.40	1.59	0.111	0.81	7.48	

^a Separate regressions predicting gambling-related harm by each of the proposed responsible gambling limits after controlling for socio-demographic characteristics (age, gender, education, country of birth)

^b Prediction of gambling-related harm by each responsible gambling limit after controlling for the other proposed responsible gambling limits and socio-demographic characteristics (age, gender, education, country of birth)

^c Gambling expenditure as a proportion of gross personal income limit removed due to multicollinearity with gambling expenditure limit

Cross-sectional prediction of gambling-related harm by the number of limits exceeded

A logistic regression model (adjusted for socio-demographic characteristics) exploring the degree to which the total number of proposed responsible gambling limits that a respondent exceeded predicted gambling-related harm for each of the datasets is displayed in Table 10. The findings suggest that the number of responsible gambling limits exceeded significantly predicted gambling-related harm in both the Tasmanian and ACT data ($p < 0.001$). They suggest that for a one unit increase in the number of limits exceeded, the odds of experiencing gambling-related harm increased by a factor of 2.

Table 10. Cross-sectional prediction of the selected definition of gambling-related harm in Tasmania and the ACT by the number of exceeded gambling limits

	OR	Robust standard error	z	p	95% CI		r ²
	Tasmanian data						
Number of gambling limits	2.00	0.20	7.07	0.000	1.65	2.43	0.13
	ACT data						
Number of gambling limits	2.20	0.28	6.26	0.000	1.72	2.81	0.16

^a Covariates included age, gender, education, country of birth

Longitudinal evaluation of the proposed responsible gambling limits

The descriptive statistics for each wave of the Tasmanian Longitudinal Gambling Study are displayed in Appendix 5 (wave 1: n=561, 74.8%; wave 2: n=531, 68.4%; wave 3: n=530, 70.7%). The transitions of the survey respondents in relation to exceeding each of the proposed responsible gambling limits across the three waves of the survey were explored. The prospective association between each of the proposed responsible gambling limits and gambling-related harm (defined as two or more negative consequences on the PGSI) across the three waves of the Tasmanian survey after controlling for socio-demographic characteristics was explored. These analyses were then followed by an exploration of the prospective independent association of each of the proposed responsible gambling limits and gambling-related harm after also controlling for the other proposed responsible gambling limits. These analyses did not control for gambling-related harm at wave 1 because it is in the direct causal pathway of developing harm at waves 2 and 3.

Transitions of the population in relation to exceeding the proposed responsible gambling limits

Figure 5 displays the transitions of Tasmanian longitudinal survey respondents in relation to exceeding each of the proposed responsible gambling limits across the three waves of the survey. There was considerable stability over time, with the majority of respondents remaining in the same category of exceeding the limit over time. In the case of those who were found to meet the gambling limits at wave 1, between 75 to 86% of respondents also met the limit at the subsequent time point, depending on the specific limit under examination.

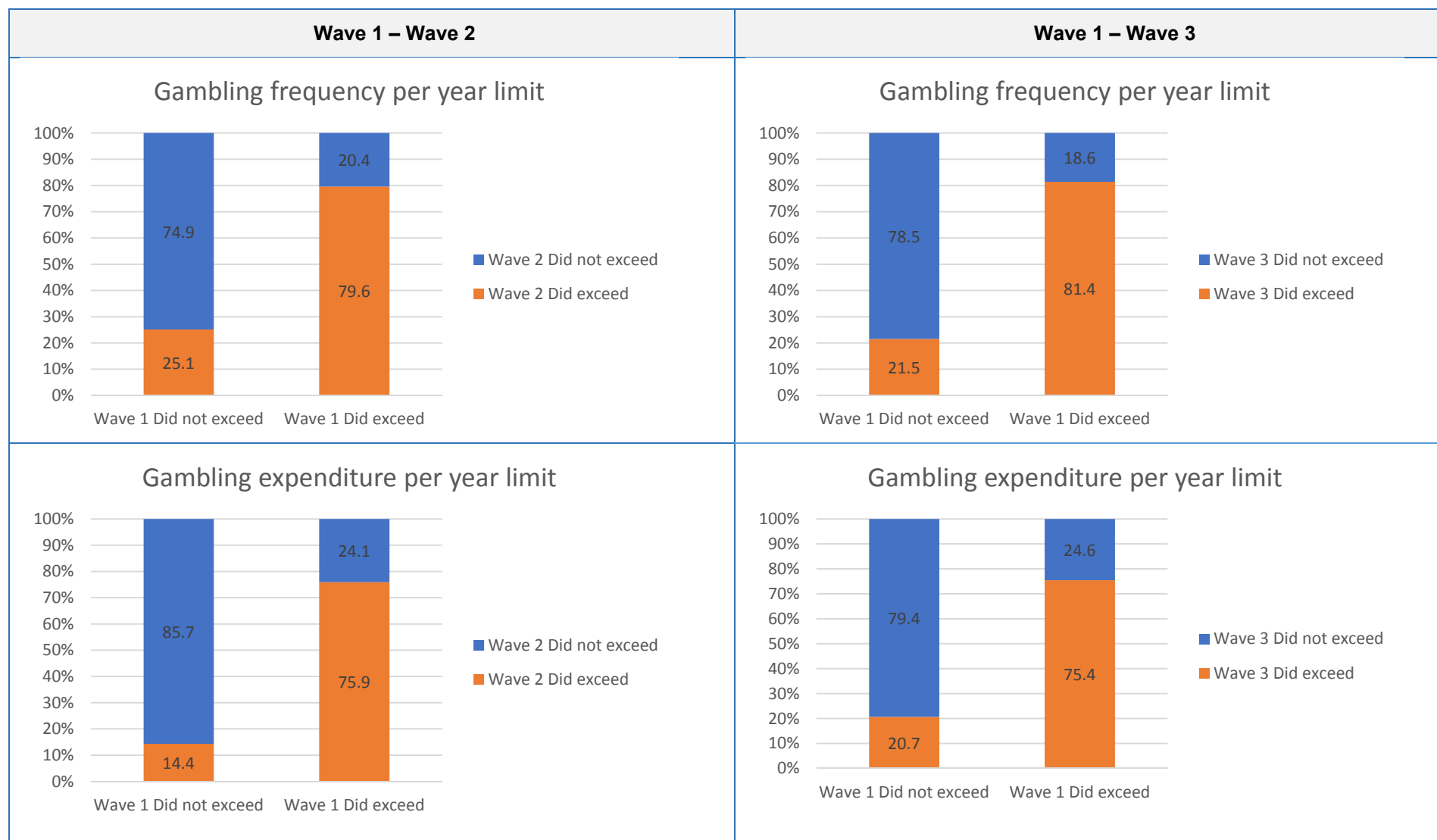


Figure 5. Conditional probabilities of exceeding the proposed responsible gambling limits across the three waves of the Tasmanian longitudinal survey ^{a,b,c}

^a Transition data relating to gambling expenditure as a proportion of gross personal income limit not calculated as gross personal income data was not collected in waves 2 and 3

^b All 2x2 chi-square analyses significant ($p < 0.001$)

^c Likelihood of exceeding responsible gambling limits relative to wave 1

Longitudinal evaluation of each of the proposed responsible gambling limits

Separate logistic regression models (adjusted for socio-demographic characteristics) systematically examining the prospective association between each of the proposed responsible gambling limits and gambling-related harm across the three waves of the Tasmanian survey (wave 1 to wave 2; wave 1 to wave 3) are displayed in Table 11. The findings suggest that separately, exceeding the gambling frequency and gambling expenditure as a proportion of gross personal income limits in wave 1 significantly predicted gambling-related harm in both waves 2 and 3. When considering the magnitude of the observed effects, the odds of experiencing gambling-related harm in subsequent waves increased by a factor of between 6 and 21 when these limits were exceeded. Exceeding the gambling expenditure limit in wave 1 was associated with approximately 14 times the odds of gambling-related harm in wave 2, but there was no significant effect when predicting harm at wave 3. Exceeding the number of gambling activities responsible gambling limits at wave 1 was not, however, significantly associated with gambling-related harm in either wave 2 or 3.

A logistic regression model (adjusted for the other proposed responsible gambling limits and socio-demographic characteristics) that examined the prospective independent association between the proposed responsible gambling limits at wave 1 and gambling-related harm measured at each of wave 2 and wave 3, respectively, is also displayed in Table 11. This analysis revealed that the gambling expenditure limit in wave 1 was the only limit that significantly independently predicted gambling-related harm in wave 2; the odds of experiencing gambling-related harm in wave 2 increased by a factor of 11 when this responsible gambling limit was exceeded. In contrast, the gambling frequency limit in wave 1 was the only limit that significantly independently predicted gambling-related harm in wave 3; the odds of experiencing gambling-related harm in wave 3 increased by a factor of 20 when this responsible gambling limit was exceeded. Exceeding any of the remaining limits in wave 1 were not independently associated with gambling-related harm in waves 2 or 3.

Taken together, these findings suggest exceeding the proposed limits relating to gambling frequency and gambling expenditure as a proportion of income are the only significant predictors of subsequent gambling-related harm across both waves. Moreover, exceeding these limits were the only ones that independently predicted subsequent gambling-related harm after controlling for the other proposed responsible gambling limits. However, the gambling expenditure as a proportion of income limit, however, was only significant from wave 1 to wave 2; and the gambling frequency limit was only significant from wave 1 to wave 3. None of the other proposed responsible gambling limits were significant independent longitudinal predictors of gambling-related harm.

Table 11. Longitudinal prediction of the selected definition of gambling-related harm in Tasmania by the proposed responsible gambling limits

Responsible gambling limit	OR	Robust standard error	z	p	95% CI		r ²	OR	Robust standard error	z	p	95% CI		r ²	
	Adjusted for socio-demographics ^a							Adjusted for other limits/socio-demographics ^{b,c}							
	Wave 1 to Wave 2														
Gambling frequency per year	6.11	4.63	2.39	0.017	1.38	26.95	0.07	1.91	1.28	0.96	0.335	0.51	7.12	0.14	
Gambling expenditure per year	14.23	13.10	2.89	0.004	2.34	86.43	0.13	10.67	6.21	4.07	0.000	3.41	33.36		
Gambling expenditure as proportion of gross personal income	15.39	14.06	2.99	0.003	2.57	92.23	0.17								
Number of gambling activities	2.82	2.46	1.19	0.234	0.51	15.55	0.03	0.83	0.84	-0.18	0.854	0.11	6.07		
	Wave 1 to Wave 3														
Gambling frequency per year	14.26	10.77	3.52	0.000	3.24	62.63	0.18	20.45	21.22	2.91	0.004	2.68	156.20	0.21	
Gambling expenditure per year	3.54	3.31	1.35	0.177	0.57	22.13	0.12	1.32	1.56	0.24	0.812	0.13	13.39		
Gambling expenditure as proportion of gross personal income	21.11	16.52	3.90	0.000	4.56	97.86	0.25								
Number of gambling activities	1.22	0.74	0.32	0.748	0.37	4.02	0.08	0.60	0.49	-0.62	0.534	0.12	3.03		

^a Separate regressions predicting gambling-related harm by each of the proposed responsible gambling limits after controlling for socio-demographic characteristics (age, gender, education, country of birth)

^b Prediction of gambling-related harm by each responsible gambling limit after controlling for the other proposed responsible gambling limits and socio-demographic characteristics (age, gender, education, country of birth)

^c Gambling expenditure as a proportion of gross personal income limit removed due to multicollinearity with gambling expenditure limit

Longitudinal prediction of the selected definition of gambling-related harm by the number of limits exceeded

A logistic regression model (adjusted for socio-demographic characteristics) examining the longitudinal association between the total number of proposed responsible gambling limits that a respondent exceeded and gambling-related harm for each subsequent wave are displayed in Table 12. The findings suggest that the number of responsible gambling limits exceeded in wave 1 significantly predicted subsequent gambling-related harm in both waves 2 and 3. They suggest that for every additional limit exceeded, the odds of experiencing gambling-related harm increased by a factor of 2.1.

Table 12. Longitudinal prediction of the selected definition of gambling-related harm in Tasmania by the number of exceeded gambling limits^a

	OR	Robust standard error	z	p	95% CI		r ²
	Wave 1 to Wave 2						
Number of gambling limits	2.05	0.55	2.67	0.008	1.21	3.46	0.09
	Wave 1 to Wave 3						
Number of gambling limits	2.09	0.30	5.13	0.000	1.58	2.77	0.17

^a Covariates included age, gender, education, country of birth

Profiling the target population and audience

A series of analyses were conducted to profile the target population for the promotion of the proposed responsible gambling limits (i.e., gamblers who meet the selected definition of gambling-related harm) and the target audience for the promotion of the proposed responsible gambling limits (i.e., gamblers who exceed each of the proposed responsible gambling limits). Given the number of statistical comparisons made in this section, tests of significance were adjusted to a more conservative level of 0.01 for these analyses.

Profiles of gamblers meeting the selected definition of gambling-related harm

The group of gamblers who meet the selected definition of harm (i.e., endorsement of 2 or more negative consequences on the PGSI) are the target population for the promotion of the proposed responsible gambling limits. The findings from the Tasmanian and ACT data suggest that gamblers who met the selected definition of gambling-related harm display significantly different PGSI profiles compared to gamblers who do not report gambling-related harm (Table 13). Gamblers meeting the selected definition of gambling-related harm were most likely to be moderate risk gamblers, with smaller proportions of problem gamblers and low risk gamblers. In contrast, gamblers not meeting the selected definition of gambling-related harm were most likely to be non-problem gamblers, with much smaller proportions of low risk gamblers and moderate risk gamblers. These findings suggest that the target population of gamblers experiencing harm related to their gambling are not restricted to the higher end of the problem gambling severity continuum as they comprise a considerable proportion of moderate and low risk gamblers.

Table 13. Comparison of PGSI category profiles of Tasmanian and ACT gamblers meeting and not meeting the selected definition of gambling-related harm

PGSI category	Gamblers meeting definition of gambling-related harm (2 or more negative consequences)	Gamblers not meeting definition of gambling-related harm (2 or more negative consequences)	<i>p</i>
	Tasmanian data		
	(n = 183)	(n = 5677)	0.000
Non-problem gambling	0	92.27% (91.05, 93.33)	
Low risk gambling	19.26% (10.55, 32.54)	6.84% (5.81, 8.03)	
Moderate risk gambling	53.21% (41.18, 64.89)	0.87% (0.63, 1.24)	
Problem gambling	27.53% (18.74, 38.48)	0.01% (0.00, 0.01)	
	ACT data		
	(n=90)	(n=1125)	0.000
Non-problem gambling	0	92.71% (89.88, 94.80)	
Low risk gambling	21.45% (11.62, 36.20)	7.12% (5.04, 9.96)	
Moderate risk gambling	57.36% (41.73, 71.64)	0.17% (0.05, 0.51)	
Problem gambling	21.19% (11.63, 35.46)	0	

A range of other demographic, gambling, and psychological measures employed in the Tasmanian and ACT surveys were also used to predict the selected definition of gambling-related harm: demographic (age, gender, marital status, education, country of birth, main language spoken at home, employment status, gross personal income), gambling participation (EGMs, horse/dog races, instant scratch tickets, lotteries, keno, casino table games, bingo, sport/other event betting), substance use (hazardous drinking, smoking), psychological distress, and general health. A series of separate unadjusted univariable logistic regression analyses were conducted to identify the characteristics that predict gambling-related harm in the Tasmanian and ACT datasets (see Table 14 for a summary). Characteristics displaying relationships with gambling-related harm in these datasets ($p < 0.100$) (see Table 15 for a summary) were then entered into a multivariable regression analysis predicting the selected definition of gambling-related harm.

The series of separate unadjusted univariable analyses using the Tasmanian data revealed that EGM participation, horse/dog race participation, keno participation, casino table games participation, and sports/other event betting participation were significant positive predictors of gambling-related harm; while age was a significant negative predictors of gambling-related harm. The multivariable analysis revealed that only EGM participation and sports/other event betting participation were significant independent positive predictors of gambling-related harm.

The series of separate unadjusted univariable analyses using the ACT data revealed that EGM participation, instant scratch ticket participation, keno participation, sports/other event betting, hazardous drinking, smoking, and psychological distress were significant positive predictors of gambling-related harm; while general health were significant negative predictors of gambling-related harm. In the ACT data, there were no significant independent predictors of gambling-related harm.

Taken together, these findings suggest that the likely profile of the target gambling population for the proposed responsible gambling limits are EGM and sports/other event betting gamblers. There were some other factors, such as lower age, participation in some gambling activities (horse/dog races, instant scratch tickets, keno, and casino table games) and some psychological characteristics (hazardous drinking, smoking, psychological distress, and general health) that were no longer significantly associated with gambling-related harm after controlling for other characteristics.

Table 14. Summary of separate unadjusted univariable regression analyses predicting the selected definition of gambling-related harm and exceeding each proposed responsible gambling limit in Tasmania and the ACT

Characteristic	Gamblers meeting definition of gambling-related harm ^a	Gamblers exceeding gambling frequency limit	Gamblers exceeding gambling expenditure limit	Gamblers exceeding gambling expenditure as proportion of gross personal income limit	Gamblers exceeding number of gambling activities limit
Tasmanian data					
	(n = 183)	(n=2608)	(n=1606)	(n=1641)	(n=3361)
Age (mean)	0.97*	1.03**	1.01**	1.02**	0.99**
Gender (male)	1.24	1.53**	1.88**	1.17	0.98
Education					
Less than year 12	(base)	(base)	(base)	(base)	(base)
Year 12	0.89	0.80	0.73	0.68*	1.22
Vocational/trade	0.81	0.84	0.83	0.53**	0.96
Tertiary	0.72	0.48**	0.48**	0.27**	0.73*
Country of birth (Australia)	1.97	0.68*	0.90	0.88	1.59**
Main language spoken at home (English)	0.28	0.48	0.31	0.59	1.14
Employment status (in paid employment)	1.72	0.77*	0.97	0.46**	1.46**
Gross personal income					
<\$25,000	(base)	(base)	(base)	(base)	(base)
\$25,000-\$39,999	1.27	1.36*	1.42*	0.60**	1.31
\$40,000-\$64,999	1.60	1.19	1.31	0.30**	1.26
\$65,000-\$79,999	1.50	1.20	1.53*	0.31**	1.15
\$80,000-\$129,999	0.35	1.09	1.42	0.17**	1.11
\$130,000+	2.83	0.92	1.90	0.15**	0.99
EGM participation	9.86**	1.84**	3.58**	3.18**	10.33**
Horse/dog race participation	3.52**	2.52**	3.66**	2.18**	7.57**
Instant scratch ticket participation	1.59	1.41**	1.42**	1.58**	6.76**
Lotteries participation	1.07	4.60**	3.17**	2.48**	2.70**
Keno participation	2.14*	2.06**	2.72**	2.26**	11.52**
Casino table game participation	5.07**	1.53	2.94**	2.13**	8.26**
Bingo participation	1.40	2.73**	4.21**	3.89**	3.27**
Sports/other event betting participation	4.82**	3.15**	4.42**	2.81**	10.41**

PGSI problem gambling category					
Non-problem gambling		(base)	(base)	(base)	(base)
Low risk gambling		2.44**	3.75**	3.50**	3.44**
Moderate risk gambling		2.13*	4.47**	3.85**	2.93**
Problem gambling		14.60**	49.75**	227.74**	8.63**
ACT data					
	(n=90)	(n=643)	(n=506)	(n=427)	(n=698)
Age (mean)	0.99	1.03**	1.02**	1.01	1.00
Gender (male)	1.97	1.49	2.22**	3.17**	1.40
Marital status (married/cohabiting)	1.42	0.69	1.31	0.68	0.88
Education					
Less than year 12	(base)	(base)	(base)	(base)	(base)
Year 12	0.57	0.25**	0.48*	0.58	0.62
Vocational/trade	0.66	0.35*	0.65	0.43	0.70
Tertiary	0.61	0.21**	0.34**	0.21**	0.53
Country of birth (Australia)	1.53	0.95	1.07	0.98	0.68
Main language spoken at home (English)	1.31	2.89	4.88	1.03	1.90
Employment status (in paid employment)	0.90	0.72	0.75	0.65	1.22
Gross personal income					
<\$30,000	(base)	(base)	(base)	(base)	(base)
\$30,000-\$49,999	0.53	2.48*	2.56*	1.07	0.66
\$50,000-\$59,999	0.37	0.96	1.86	0.51	0.59
\$60,000-\$79,999	0.33	0.97	2.27	0.41	0.82
\$80,000-\$124,999	0.74	1.97	1.80	0.39*	0.74
\$125,000+	0.58	1.66	2.88*	0.13**	1.43
EGM participation	4.40**	2.24**	2.99**	3.50**	4.81**
Horse/dog race participation	1.31	2.12**	2.87**	3.08**	7.94**
Instant scratch ticket participation	2.74*	1.49	1.58	2.17*	9.66**
Lotteries participation	1.33	4.28**	3.79**	1.75	3.82**
Keno participation	4.41*	7.10*	3.77*	11.88**	42.66**
Casino table game participation	4.88	2.20	3.67**	3.81**	13.89**
Bingo participation	1.23	0.87	0.83	1.67	4.12
Sports/other event betting participation	3.30*	2.96*	3.68**	2.98*	5.26**
PGSI problem gambling category					
Non-problem gambling		(base)	(base)	(base)	(base)
Low risk gambling		2.58*	4.30**	4.88**	3.08*
Moderate risk gambling		3.88	6.04*	18.96**	7.02*

Problem gambling		10.58**	41.40**	(empty)	6.35*
AUDIT-C hazardous drinking	3.79*	2.94*	5.03**	2.16	2.79
Smoking	3.17*	1.57	2.19*	1.84	2.19*
K6 psychological distress (mean)	1.11*	0.96	0.97	1.01	1.04
SF1 general health (mean)	0.69*	0.83	0.77*	0.78	0.85

^a PGSI problem gambling severity removed from the analyses as it was used to derive the selected definition of gambling-related harm (2 or more negative consequences PGSI items).

**p<.001, *p<.01

Table 15. Summary of multivariable regression analyses predicting the selected definition of gambling-related harm and exceeding each proposed responsible gambling limit in Tasmania and the ACT

Characteristic	Gamblers meeting definition of gambling-related harm ^a	Gamblers exceeding gambling frequency limit	Gamblers exceeding gambling expenditure limit	Gamblers exceeding gambling expenditure as proportion of gross personal income limit	Gamblers exceeding number of gambling activities limit ^b
<i>Tasmanian data</i>					
Age (mean)	1.01	1.04**	1.03**	1.03**	0.99*
Gender (male)		1.55**	1.93**	1.98**	
Education					
Less than year 12		(base)	(base)	(base)	(base)
Year 12		1.08	0.71	0.79	1.08
Vocational/trade		0.81	0.76	0.71	0.84
Tertiary		0.56**	0.49**	0.48**	0.62**
Country of birth (Australia)	1.31	0.71			1.39*
Main language spoken at home (English)	0.08		0.26		
Employment status (in paid employment)	1.38	1.14		1.10	1.20
Gross personal income					
<\$25,000	(base)	(base)	(base)	(base)	(base)
\$25,000-\$39,999	1.09	1.35	1.45	0.41**	1.31
\$40,000-\$64,999	1.30	1.14	1.24	0.15**	1.18
\$65,000-\$79,999	1.17	1.16	1.57	0.16**	1.13
\$80,000-\$129,999	0.29	1.25	1.76*	0.10**	1.28
\$130,000+	2.40	0.75	1.73	0.04**	1.02

EGM participation	7.13**	1.73**	3.48**	2.86**	
Horse/dog race participation	1.59	2.31**	2.96**	2.34**	
Instant scratch ticket participation	1.27	1.54**	1.27	1.53*	
Lotteries participation		5.32**	4.35**	4.58**	
Keno participation	1.29	1.82**	1.79**	1.78**	
Casino table game participation	2.35	1.59	2.47*	2.87**	
Bingo participation		3.29	6.23*	4.56*	
Sports/other event betting participation	2.83*	3.94**	3.59**	2.97**	
PGSI problem gambling category					
Non-problem gambling		(base)	(base)	(base)	(base)
Low risk gambling		2.26**	2.96**	2.69**	3.86**
Moderate risk gambling		1.72	3.20**	3.10**	2.61**
Problem gambling		10.74**	32.06**	181.40**	8.54**
ACT data					
Age (mean)		1.04**	1.04**	1.05**	
Gender (male)	1.76	1.29	1.73	4.17**	1.30
Marital status (married/cohabiting)		1.09		0.67	
Education					
Less than year 12		(base)	(base)	(base)	(base)
Year 12		0.39	1.10	0.76	0.62
Vocational/trade		0.34*	0.95	0.55	0.65
Tertiary		0.21**	0.45	0.47	0.56
Country of birth (Australia)					
Main language spoken at home (English)		3.04	7.85		
Employment status (in paid employment)		1.33		3.43*	
Gross personal income					
<\$30,000	(base)	(base)	(base)	(base)	
\$30,000-\$49,999	0.81	3.09	3.77*	0.93	
\$50,000-\$59,999	0.48	1.48	5.23*	0.56	
\$60,000-\$79,999	0.61	0.96	3.60*	0.26*	
\$80,000-\$124,999	1.09	3.05*	3.68*	0.21**	
\$125,000+	0.91	1.90	4.60*	0.03**	
EGM participation	2.90	2.30*	2.61*	2.38*	
Horse/dog race participation		1.62	2.50*	2.66*	
Instant scratch ticket participation	2.27	1.42	1.76	1.94	
Lotteries participation		4.14**	3.93**	2.94*	
Keno participation	0.87	2.79	0.80	5.26*	

Casino table game participation	1.81	1.50	2.82	2.40	
Bingo participation					
Sports/other event betting participation	1.39	3.48*	3.42*	1.10	
PGSI problem gambling category					
Non-problem gambling		(base)	(base)	(base)	(base)
Low risk gambling		2.32	3.96*	3.20*	2.70
Moderate risk gambling		2.92	5.14	12.61*	6.29*
Problem gambling		3.71	22.48	(empty)	2.83
AUDIT-C hazardous drinking	1.73	2.64	6.42*	5.11*	2.27
Smoking	1.50	0.73	0.81	0.87	1.69
K6 psychological distress (mean)	1.11				
SF1 general health (mean)	0.85	0.97	0.86	0.89	0.94

^a PGSI problem gambling severity removed from the analyses as it was used to derive the selected definition of gambling-related harm (2 or more negative consequences PGSI items).

^b Gambling activity participation variables removed from the analyses due to close relationship with the number of activities limit

**p<.001, *p<.01

Profiles of gamblers exceeding the proposed responsible gambling limits

In addition to profiling the group of gamblers who meet the selected definitions of gambling-related harm, it was also of interest to profile the group of gamblers who exceeded the proposed responsible gambling limits. These groups of gamblers are the target audience for the promotion of the proposed responsible gambling limits in order to identify gamblers who are at risk for meeting the selected definition of harm. In this study, series of separate unadjusted univariable logistic regression analyses were initially employed to predict exceeding each of the responsible gambling limits (gambling frequency, gambling expenditure, gambling expenditure as a proportion of gross personal income, and number of gambling activities) in both the Tasmanian and ACT datasets (see Table 14 for a summary). Characteristics displaying relationships with exceeding each limit ($p < 0.100$) in these datasets were then entered into a multivariable regression analysis predicting exceeding each of the limits (see Table 15 for a summary).

Profiles of gamblers exceeding the proposed gambling frequency limit

The series of separate unadjusted univariable analyses using the Tasmanian data revealed that age, male gender, a gross personal income of \$25,000-\$39,999 (relative to less than \$25,000), EGM participation, horse/dog race participation, instant scratch ticket participation, lottery participation, keno participation, bingo participation, sports/other event betting participation, low risk gambling (relative to non-problem gambling), moderate risk gambling (relative to non-problem gambling), and problem gambling (relative to non-problem gambling) were significant positive predictors of exceeding the proposed gambling frequency limit; while tertiary education (relative to less than year 12), Australian-born status, and being in paid employment were significant negative predictors of exceeding this limit. The multivariable analysis revealed that age, male gender, EGM participation, horse/dog race participation, instant scratch ticket participation, lottery participation, keno participation, sports/other event betting participation, low risk gambling (relative to non-problem gambling), and problem gambling (relative to non-problem gambling) were significant independent positive predictors of exceeding the proposed gambling frequency limit; while tertiary education (relative to less than year 12) was a significant independent negative predictor of exceeding this limit.

The series of separate unadjusted univariable analyses using the ACT data revealed that age, a gross personal income of \$30,000-\$49,999 (relative to less than \$30,000), EGM participation, horse/dog race participation, lottery participation, keno participation, sports/other event betting participation, low risk gambling (relative to non-problem gambling), problem gambling (relative to non-problem gambling), and hazardous drinking were significant positive predictors of exceeding the proposed gambling frequency limit; while year 12 education (relative to less than year 12), a vocational/trade qualification (relative to less than year 12), and tertiary education (relative to less than year 12) were significant negative predictors of exceeding this limit. The multivariable analysis revealed that age, a gross personal income of \$80,000-\$124,999 (relative to less than \$30,000), EGM participation, lottery participation, and sports/other event betting participation were significant positive independent predictors of exceeding the proposed gambling frequency limit; while vocational/trade qualification (relative to less than year 12) and tertiary education (relative to less than year 12) were significant independent negative predictors of exceeding this limit.

Profile of gamblers exceeding the proposed gambling expenditure limit

The series of separate unadjusted univariable analyses using the Tasmanian data revealed that age, male gender, a gross personal income of \$25,000-\$39,999 (relative to less than \$25,000), a gross personal income of \$65,000-\$79,999 (relative to less than \$25,000), EGM participation, horse/dog race participation, instant scratch ticket participation, lottery participation, keno participation, casino table game participation, bingo participation, sports/other event betting participation, low risk gambling

(relative to non-problem gambling), moderate risk gambling (relative to non-problem gambling), and problem gambling (relative to non-problem gambling) were significant positive predictors of exceeding the proposed gambling expenditure limit; while tertiary education (relative to less than year 12) was a significant negative predictor of exceeding this limit. The multivariable analysis revealed that age, male gender, a gross personal income of \$80,000-\$129,999 (relative to less than \$25,000), EGM participation, horse/dog race participation, lottery participation, keno participation, casino table game participation, bingo participation, sports/other event betting participation, low risk gambling (relative to non-problem gambling), moderate risk gambling (relative to non-problem gambling), and problem gambling (relative to non-problem gambling) were significant independent positive predictors of exceeding the proposed gambling expenditure limit; while tertiary education (relative to less than year 12) was a significant independent negative predictor of exceeding this limit.

The series of separate unadjusted univariable analyses using the ACT data revealed that age, male gender, a gross personal income of \$30,000-\$49,999 (relative to less than \$30,000), a gross personal income of more than \$125,000 (relative to less than \$30,000), EGM participation, horse/dog race participation, lottery participation, keno participation, casino table game participation, sports/other event betting participation, low risk gambling (relative to non-problem gambling), moderate risk gambling (relative to non-problem gambling), problem gambling (relative to non-problem gambling), hazardous drinking, and smoking were significant positive predictors of exceeding the proposed gambling expenditure limit; while year 12 education (relative to less than year 12), tertiary education (relative to less than year 12), and general health were significant negative predictors of exceeding this limit. The multivariable analysis revealed that age, a gross personal income of \$30,000-\$49,999 (relative to less than \$30,000), a gross personal income of \$50,000-\$59,999 (relative to less than \$30,000), a gross personal income of \$60,000-\$79,999 (relative to less than \$30,000), a gross personal income of \$80,000-\$124,999 (relative to less than \$30,000), a gross personal income of more than \$125,000 (relative to less than \$30,000), EGM participation, horse/dog race participation, lottery participation, sports/other event betting participation, low risk gambling (relative to non-problem gambling), and hazardous drinking were significant independent positive predictors of exceeding the proposed gambling expenditure limit. There were no significant independent negative predictors of exceeding this limit.

Profile of gamblers exceeding the proposed gambling expenditure as proportion of gross personal income limit

The series of separate unadjusted univariable analyses using the Tasmanian data revealed that age, EGM participation, horse/dog race participation, instant scratch ticket participation, lottery participation, keno participation, casino table game participation, bingo participation, sports/other event betting participation, low risk gambling (relative to non-problem gambling), moderate risk gambling (relative to non-problem gambling), and problem gambling (relative to non-problem gambling) were significant positive predictors of exceeding the proposed gambling expenditure as a proportion of gross personal income limit; while year 12 education (relative to less than year 12), a vocational/trade education (relative to less than year 12), tertiary education (relative to less than year 12), being in paid employment, a gross personal income of \$25,000-\$39,999 (relative to less than \$25,000), a gross personal income of \$40,000-\$64,999 (relative to less than \$25,000), a gross personal income of \$65,000-\$79,999 (relative to less than \$25,000), a gross personal income of \$80,000-\$129,999 (relative to less than \$25,000), and a gross personal income of more than \$130,000 (relative to less than \$25,000) were significant negative predictors of exceeding this limit. The multivariable analysis revealed that age, male gender, EGM participation, horse/dog race participation, instant scratch ticket participation, lottery participation, keno participation, casino table game participation, bingo participation, sports/other event betting participation, low risk gambling (relative to non-problem gambling), moderate risk gambling (relative to non-problem gambling), and problem gambling (relative to non-problem gambling) were significant independent positive predictors of exceeding the proposed gambling expenditure as a proportion of gross personal income limit; while

a tertiary education (relative to less than year 12), a gross personal income of \$25,000-\$39,999 (relative to less than \$25,000), a gross personal income of \$40,000-\$64,999 (relative to less than \$25,000), a gross personal income of \$65,000-\$79,999 (relative to less than \$25,000), a gross personal income of \$80,000-\$129,999 (relative to less than \$25,000), a gross personal income of more than \$130,000 (relative to less than \$25,000) were significant negative independent predictors of exceeding this limit.

The series of separate unadjusted univariable analyses using the ACT data revealed that male gender, EGM participation, horse/dog race participation, instant scratch ticket participation, keno participation, casino table game participation, sports/other event betting participation, low risk gambling (relative to non-problem gambling), and moderate risk gambling (relative to non-problem gambling) were significant positive predictors of exceeding the proposed gambling expenditure as a proportion of gross personal income limit; while a tertiary education (relative to less than year 12), a gross personal income of \$80,000-\$124,999 (relative to less than \$30,000) and a gross personal income of more than \$125,000 (relative to less than \$30,000) were significant negative predictors of exceeding this limit. The multivariable analysis revealed that age, male gender, being in paid employment, EGM participation, horse/dog race participation, lottery participation, keno participation, low risk gambling (relative to non-problem gambling), moderate risk gambling (relative to non-problem gambling), and hazardous drinking were significant independent positive predictors of exceeding the proposed gambling expenditure as a proportion of gross personal income limit; while a gross personal income of \$60,000-\$79,999 (relative to less than \$30,000), a gross personal income of \$80,000-\$124,999 (relative to less than \$30,000), and a gross personal income of more than \$125,000 (relative to less than \$30,000) were significant independent negative predictors of exceeding this limit.

Profile of gamblers exceeding the proposed number of gambling activities limit

The series of separate unadjusted univariable analyses using the Tasmanian data revealed that Australian-born status, being in paid employment, EGM participation, horse/dog race participation, instant scratch ticket participation, lottery participation, keno participation, casino table game participation, bingo participation, sports/other event betting participation, low risk gambling (relative to non-problem gambling), moderate risk gambling (relative to non-problem gambling), and problem gambling (relative to non-problem gambling) were significant positive predictors of exceeding the proposed number of gambling activities limit; while age and tertiary education (relative to less than year 12) were significant negative predictors of exceeding this limit. The multivariable analysis revealed that Australian-born status, low risk gambling (relative to non-problem gambling), moderate risk gambling (relative to non-problem gambling), and problem gambling (relative to non-problem gambling) were significant independent positive predictors of exceeding the proposed number of gambling activities limit; while age and tertiary education (relative to less than year 12) were significant negative independent predictors of exceeding this limit.

The series of separate unadjusted univariable analyses using the ACT data revealed that EGM participation, horse/dog race participation, instant scratch ticket participation, lottery participation, keno participation, casino table game participation, sports/other event betting participation, low risk gambling (relative to non-problem gambling), moderate risk gambling (relative to non-problem gambling), problem gambling (relative to non-problem gambling), and smoking were significant positive predictors of exceeding the proposed number of gambling activities limit. The multivariable analysis revealed that only moderate risk gambling (relative to non-problem gambling) were significant independent positive predictors of exceeding the proposed number of gambling activities limit; there were no significant independent negative predictors of exceeding this limit.

Summary of profiles of gamblers exceeding the proposed responsible gambling limits

Taken together, these findings suggest that there is generally good consistency in the variables that predict exceeding each of the proposed responsible gambling limits. Across both datasets, when examining each of the predictors in separate univariable analyses, results revealed that exceeding the limits was generally positively predicted by age, male gender, participation on most gambling activities, classification within any of the PGSI risk categories, hazardous drinking, and smoking; and generally negatively predicted by higher education levels, and higher gross personal incomes. Many of these variables remained statistically significant independent predictors of exceeding the proposed limits in the multivariable analyses. The clear exception was smoking, which failed to remain a significant independent predictor of exceeding the proposed limits after controlling for multiple demographic, gambling, and psychological characteristics. The findings therefore suggest that the population of gamblers who will be the target audience for the promotion of the proposed limits will display a broad range of characteristics, such as older age, male gender, lower gross personal incomes, lower education levels, participation on most gambling activities, classification within any of the PGSI risk categories, and hazardous drinking.

Excluding lottery only gamblers

ROC analyses presented in the earlier sections of this report were repeated excluding people who *only* played lottery from the analyses to explore the degree to which the inclusion of these respondents changed the optimal responsible gambling limits. Sensitivity analyses for responsible gambling limits for the Tasmania and ACT data were conducted by exploring the optimal cut-offs in ROC analyses excluding lottery only gamblers across the multiple gambling indices and multiple definitions of harm based on the PGSI (see Table 54 and Table 55 in Appendix 6). Most of the optimal responsible gambling limits were acceptable across the various definitions of harm ($AUC \geq 0.70$); and most of the limits were in the moderate classification accuracy range ($AUC = 0.70-0.90$). The optimal responsible gambling limits relating to gambling expenditure (gambling expenditure and gambling expenditure as a proportion of income) were acceptable across all definitions of harm in both sets of data. While the optimal responsible gambling limits relating to gambling frequency were acceptable across all definitions of harm in the ACT data, they were acceptable across only 5 of the 8 definitions of harm in the Tasmania data. The optimal responsible gambling limits relating to number of gambling activities were acceptable across 4 of the definitions of harm in the Tasmanian data and ACT data.

Consistent with the ROC analyses including all gamblers, the various definitions of harm in these sensitivity analyses produced relatively consistent responsible gambling limits across the four gambling indices, with the exception of the definition of harm based on the problem gambling cut-off (i.e., PGSI scores ≥ 8), particularly in the Tasmanian dataset, which derived much higher responsible gambling limits.

Excluding this definition, the responsible gambling limits across both datasets ranged from:

- 16 to 40 times per year for gambling frequency;
- \$275 to \$920 per year for gambling expenditure;
- 0.65 to 2.11% for gambling expenditure as a proportion of gross personal income; and
- 2 to 3 gambling activities for number of activities.

The selected definition of harm produced acceptable responsible gambling limits for all of the four gambling indices across both datasets in these sensitivity analyses, excluding the number of gambling activities limit in the ACT (Table 16). The limits identified in these analyses were relatively consistent

across the two jurisdictions, although the ACT limits were consistently slightly lower than the Tasmanian limits.

Excluding lottery only gamblers, the responsible gambling limits for the Australian population based on the selected definition of harm are estimated to be:

- a gambling frequency of 19 to 32 times per year (cf. 20-30 times per year);
- a gambling expenditure of \$389 to \$649 per year (cf. \$380-\$615 per year);
- a gambling expenditure comprising 0.87% to 1.80% of an individual's gross personal income (cf. 0.83-1.68%); and
- 3 gambling activities (cf. 2 activities).

Taken together, these ROC analyses excluding people who *only* played lottery derived less consistently acceptable responsible gambling limits but similar limits (1.0 to 1.5 times higher). These findings imply that lottery play should be included in the development of responsible gambling limits.

Table 16. ROC analyses excluding lottery only gamblers for the Tasmanian and ACT data according to the selected definition of harm based on the PGSI^a

Responsible gambling limit		Endorsement of ≥ 2 PGSI negative consequence items	
		<i>Tasmanian data</i>	<i>ACT data</i>
Proportion of population exceeding each definition of harm		2.30% (95% CI 1.81, 2.91)	1.92% (95% CI 1.39, 2.65)
Proportion of gamblers exceeding each definition of harm		4.68% (95% CI 3.69, 5.93)	4.58% (95% CI 3.29, 6.33)
Gambling frequency per year	Cut off	32	19
	AUC (95% CI)	0.74 (0.69, 0.80)	0.79 (0.72, 0.87)
	sens, spec	0.70, 0.66	0.78, 0.66
	N	4176	942
Gambling expenditure per year	Cut off	649	389
	AUC (95% CI)	0.84 (0.89, 0.89)	0.84 (0.77, 0.91)
	sens, spec	0.78, 0.75	0.79, 0.73
	N	3956	896
Gambling expenditure as proportion of gross personal income	Cut off	1.80	0.87
	AUC (95% CI)	0.83 (0.77, 0.88)	0.83 (0.75, 0.91)
	sens, spec	0.77, 0.72	0.77, 0.73
	N	3576	794
Number of gambling activities	Cut off	3	2
	AUC (95% CI)	0.72 (0.67, 0.78)	0.67 (0.58, 0.77)
	sens, spec	0.57, 0.75	0.70, 0.54
	N	4272	935

^a Bold typeface indicates AUC ≥ 0.70

The relative and absolute risk associated with exceeding the proposed responsible gambling limits

The relative risk associated with exceeding the proposed responsible gambling limits

The relative risk of experiencing gambling-related harm (i.e., endorsement of 2 or more negative consequences on the PGSI) cross-sectionally associated with increases and decreases in gambling behaviour relative to the proposed responsible gambling limits from both the Tasmanian and ACT datasets was explored. Relative risk ratios describe the relative or proportional difference between two groups of people and can be used to determine if belonging to a group increases or decreases the risk of developing a certain disease. For example, one group may be five times more likely to develop a certain disease compared to (relative to) another group. In the context of this study, relative risk ratios provide an indication of the risk of experiencing gambling-related harm in gamblers who exceed a proposed responsible gambling limit, relative to the risk of experiencing gambling-related harm in gamblers who do not exceed the respective limit.

A set of sliding scales highlighting the relative risk associated with different levels of gambling behaviour (gambling frequency, gambling expenditure, gambling expenditure as a proportion of gross personal income, and number of gambling activities) was created for each of the Tasmanian and ACT datasets. The aim of this analysis was to demonstrate to what extent the relative risk for gambling-related harm changes depending on the level of gambling behaviour. A summary of the sliding scale for each of the proposed responsible gambling limits is provided in Table 17.

The risk ratio calculations indicate that exceeding the proposed responsible gambling limits is associated with a high degree of risk for gambling-related harm relative to people who do not exceed the proposed limit. This is particularly true of the proposed gambling expenditure and gambling expenditure as a proportion of gross personal income limits. The risk ratio calculations across the two datasets revealed that:

- gamblers who exceeded the gambling frequency limit were 3.4-6.4 times more likely than gamblers who did not exceed this limit to experience gambling-related harm;
- gamblers who exceeded the gambling expenditure limit were 6.5-11.3 times more likely to report gambling-related harm than gamblers who did not exceed this limit;
- gamblers who exceeded the expenditure as a proportion of gross personal income limit were 7.5-20.2 times more likely to report gambling-related harm than gamblers who did not exceed this limit; and
- gamblers who exceeded the number of gambling activities limit were 3.6-4.5 times more likely to report gambling-related harm than gamblers who did not exceed this limit.

This information can be used in the promotion of the limits so that gamblers can estimate their individual level of risk of experiencing gambling-related harm based on their gambling frequency, expenditure, expenditure as a proportion of income, and number of gambling activities. For example, a Tasmanian gambler who estimates gambling losses of approximately \$3000 per year is 11 times more likely to experience gambling-related harm than people who gamble less than \$3000 per year.

Interestingly, these risk ratios only slightly increased as the gambling behaviour increased. For example, in the Tasmania data, even individuals who gambled three times the frequency limit (i.e., gambled 90 times a year) were 4.6 times more likely to report gambling-related harm than individuals who did not exceed this frequency; individuals who gambled three times the expenditure limit (i.e., gambled \$1845 per year) were 9.5 times more likely to report gambling-related harm than individuals who did not exceed this expenditure; individuals who gambled three times the expenditure as a

proportion of gross personal income limit (i.e., gambled 5.04% of their gross personal income) were 8.2 times more likely to report gambling-related harm than individuals who did not exceed this expenditure as a proportion of their gross personal income; and individuals who gambled three times the number of activities limit (i.e., 6 gambling activities) were 4.9 times more likely to report gambling-related harm than individuals who did not exceed this number of gambling activities. These findings suggest that, at least from a risk ratio perspective, there is little utility in increasing the limits because there is little change in the relative risk with increasing gambling behaviour. These findings therefore provide additional support for the proposed responsible gambling limits.

The relative risk ratio data across both datasets also, however, suggests that levels of gambling behaviour that are lower than the proposed responsible gambling limits also confer a considerable degree of risk. For example, in the Tasmanian data, individuals reporting half the frequency limit (i.e., gambled 15 times a year) were 3.6 times more likely to report gambling-related harm than individuals who did not exceed this frequency; individuals who gambled half the expenditure limit (i.e., gambled \$308 per year) were 6.5 times more likely to report gambling-related harm than individuals who did not exceed this expenditure; and individuals who gambled half the expenditure as a proportion of gross personal income limit (i.e., gambled 0.84% of their gross personal income) were 8.1 times more likely to report gambling-related harm than individuals who did not exceed this expenditure as a proportion of their gross personal income. These findings again raise questions regarding the degree to which there is any level of gambling that is not associated with harm.

The absolute risk associated with exceeding the proposed responsible gambling limits

Another important consideration when considering the utility of the proposed responsible gambling limits is the absolute risk associated with exceeding the limits (i.e., the number of people experiencing an event in relation to the population at risk). The replication of the linear and r-shaped curves using the Markham et al. (2016) approach suggests that limits may be adopted on the basis of tolerable levels of absolute risk (Markham et al., 2016). Absolute risk is the number of people experiencing an event in relation to the population at risk, expressed as a rate. For example, a 1 in 10 risk of developing a certain disease can be expressed as a 10% risk. The absolute risk of experiencing gambling-related harm cross-sectionally associated with increases and decreases in gambling behaviour relative to the proposed responsible gambling limits from both the Tasmanian and ACT datasets was explored. In the context of this study, absolute risk estimates provide an indication of the risk of gambling harms when gamblers exceed the proposed responsible gambling limits.

The same set of sliding scales were created for each of the Tasmanian and ACT datasets to highlight the absolute risk associated with different levels of gambling behaviour (Table 17). The absolute risk calculations revealed that, across the two datasets:

- gamblers who exceeded the gambling frequency limit had a 4.9-12.2% risk of experiencing gambling-related harm;
- gamblers who exceeded the gambling expenditure limit had a 7.0-15.4% risk of experiencing gambling-related harm;
- gamblers who exceeded the expenditure as a proportion of personal income limit had a 6.8-17.1% risk of experiencing gambling-related harm; and
- gamblers who exceeded the number of gambling activities limit had a 4.7-10.7% risk of experiencing gambling-related harm.

In contrast to the relative risk ratios, these estimates suggest that the degree of absolute risk incrementally increases as the responsible gambling limit increases. These estimates allow for the selection of responsible gambling limits depending on the tolerable levels of absolute risk.

Table 17. Summary of the relative and absolute risk associated with exceeding the proposed responsible gambling limits in the Tasmanian and ACT data

	Gambling frequency per year			Gambling expenditure per year			Gambling expenditure as proportion of gross personal income			Number of gambling activities		
	Gambling frequency	Relative risk ratio	Absolute risk	Gambling expenditure	Relative risk ratio	Absolute risk	Gambling expenditure as proportion of gross personal income	Relative risk ratio	Absolute risk	Number of gambling activities	Relative risk ratio	Absolute risk
Tasmanian data												
0.25 x limit	8	6.25	4.03	154	9.04	4.41	0.42	7.51	4.29			
0.5 x limit	15	3.64	4.40	308	6.52	5.21	0.84	8.09	5.28	1	-	-
0.75 x limit	23	3.39	4.61	462	6.77	6.16	1.26	7.96	6.08			
At limit	30	3.36	4.91	615	6.47	6.98	1.68	7.48	6.77	2	4.49	4.67
1.5 x limit	45	3.04	5.01	923	7.42	8.87	2.52	7.22	7.99	3	3.70	6.40
2 x limit	60	4.10	7.44	1230	9.39	11.34	3.36	9.00	9.79	4	5.33	10.66
3 x limit	90	4.62	9.38	1845	9.46	14.34	5.04	8.21	11.44	6	4.92	14.71
4 x limit	120	5.58	12.42	2460	10.50	17.15	6.72	9.31	13.91			
5 x limit	150	5.95	13.95	3075	11.09	19.50	8.40	9.09	15.42			
6 x limit	180	6.90	16.96	3690	11.28	21.32	10.08	8.94	16.47			
7 x limit	210	7.48	18.78	4305	11.66	22.77	11.76	8.79	17.31			
8 x limit	240	7.75	20.14	4920	12.12	24.24	13.44	8.93	18.53			
9 x limit	270	8.29	22.02	5535	13.20	26.55	15.12	9.13	19.42			
10 x limit	300	7.89	21.59	6150	12.03	25.47	16.80	10.26	21.91			
20 x limit				12300	14.11	33.80	33.60	12.63	31.25			
30 x limit				18450	12.25	31.25	50.40	8.87	24.14			
40 x limit				24600	9.30	25.00						
ACT data												
0.25 x limit	5	9.46	9.46	95	20.09	10.75	0.21	20.96	11.55			
0.5 x limit	10	8.93	10.63	190	12.55	12.42	0.42	33.98	14.10	1	-	-
0.75 x limit	15	9.29	12.13	285	10.82	14.21	0.62	21.35	15.61			
At limit	20	6.38	12.23	380	11.29	15.42	0.83	20.23	17.06	2	3.64	10.65
1.5 x limit	30	5.36	13.10	570	11.85	17.72	1.25	11.43	18.87	3	4.12	15.36
2 x limit	40	4.74	13.20	760	11.76	19.47	1.66	9.14	20.39	4	4.59	22.75
3 x limit	60	5.68	18.13	1140	10.86	22.70	2.49	5.87	21.01	6	5.52	37.50
4 x limit	80	5.76	21.43	1520	9.56	25.83	3.32	5.43	21.95			

5 x limit	100	4.98	20.76	1900	9.58	28.10	4.15	5.36	23.43			
6 x limit	120	4.61	23.65	2280	9.16	29.89	4.98	6.14	27.27			
7 x limit	140	4.51	24.06	2660	10.48	34.19	5.81	5.91	28.81			
8 x limit	160	4.26	24.75	3040	9.16	34.78	6.64	5.63	28.97			
9 x limit	180	4.28	25.93	3420	8.76	35.43	7.47	6.43	32.63			
10 x limit	200	4.42	27.03	3800	8.38	36.61	8.30	6.01	32.18			
20 x limit				7600	8.30	48.84	16.60	8.08	43.48			
30 x limit				11400	9.96	63.64	24.90	5.62	37.50			

Consideration of the base prevalence rate of gambling-related harm

Another method to investigate absolute risk is to evaluate the positive and negative predictive values for each of the proposed responsible gambling limits depending on the prevalence of the selected definition of gambling-related harm (endorsement of 2 or more negative consequence PGSI items) for the Tasmanian and ACT data (Figure 6). Positive predictive values refer to the probability that the disease is present when the test is positive (i.e., the proportion of people exceeding the responsible gambling limits who are actually experiencing gambling-related harm); while negative predictive values refer to the probability that the disease is not present when the test is negative (i.e., the proportion of people not exceeding the responsible gambling limits who are actually not experiencing gambling-related harm). Positive and negative predictive values are influenced by the prevalence of gambling-related harm in the population that is being tested. In other words, the probability of the proposed responsible gambling limits to detect people who are truly experiencing gambling-related harm is lower when applied to a general population sample where the base-rate proportion of individuals experiencing gambling-related harm is low. By contrast, in a clinical settings where the base-rate prevalence of experiencing gambling-related harm is high, there is a stronger probability that meeting the proposed gambling limits will indicate an individual is experiencing gambling-related harm.



Figure 6. Positive and negative predictive values for each responsible gambling limit based on the prevalence of the selected definition of gambling-related harm for the Tasmanian and ACT data

Positive and negative predictive values of the proposed responsible gambling limits for the population

Table 18 displays the positive and negative predictive values based on the prevalence of gambling-related harm in Tasmanian and ACT data used in the current study. We have previously reported that 2.3% of adults in the Tasmanian general population and 1.9% of adults in the ACT general population met the selected definition of gambling-related harm (2 or more negative consequences on the PGSI); and that 3.7% of Tasmanian and 3.5% of ACT gamblers met the selected definition of gambling-related harm. The findings from this table reveal that, in the Tasmanian and ACT general populations, between 3.7% and 7.4% of people who exceed the limits will actually be experiencing gambling-related harm and between 99.0 and 99.4% of people who stay within the limits will not be experiencing gambling-related harm. Between 6.8% and 11.5% of Tasmanian and ACT gamblers who exceed the limits will actually be experiencing gambling-related harm and between 98.3% and 98.9% of gamblers who stay within the limits will not be experiencing gambling-related harm. The positive predictive values in this section differ from the absolute risk estimates for each limit provided in the previous section due to the use of weighting employed in this, but not the previous, section.

Across both datasets, the highest positive predictive values were displayed by the gambling expenditure limit (9.9-11.5% of gamblers) and the gambling expenditure as a proportion of gross personal income limit (10.3-10.5% of gamblers), followed by the gambling frequency limit (7.6-8.2% of gamblers), and the number of gambling activities limit (6.8-6.9% of gamblers). The highest negative predictive values were displayed by the gambling expenditure limit and the gambling expenditure as a proportion of gross personal income limit (98.9% of gamblers), followed by the gambling frequency limit (98.4-98.7% of gamblers), and the number of gambling activities limit (98.3-98.8% of gamblers). When considering all the proposed gambling limits, these findings suggest that the limits relating to gambling expenditure were able to identify the highest proportion of people who exceed the responsible gambling limits who are actually experiencing gambling-related harm.

The high negative predictive values in population and gambling samples, however, suggest that gamblers who do not exceed the limits are very likely to not be at risk for gambling-related harm. The positive predictive values in these samples, however, are generally low due to the low prevalence of people endorsing two or more negative consequences on the PGSI in the population. They suggest caution when these limits are promoted to gamblers within the population as only a small proportion of gamblers will actually be experiencing gambling-related harm.

Table 18. Positive and negative predictive values based on the prevalence of gambling-related harm in the Tasmanian and ACT population and gambling samples

Responsible gambling limit	Positive and negative predictive values based on the prevalence of gambling-related harm in the population				Positive and negative predictive values based on the prevalence of gambling-related harm in gamblers			
	<i>Tasmanian data</i> (prevalence = 2.30%)		<i>ACT data</i> (prevalence = 1.92%)		<i>Tasmanian data</i> (prevalence = 3.68%)		<i>ACT data</i> (prevalence = 3.54%)	
	Positive predictive value (%)	Negative predictive value (%)	Positive predictive value (%)	Negative predictive value (%)	Positive predictive value (%)	Negative predictive value (%)	Positive predictive value (%)	Negative predictive value (%)
Gambling frequency per year	4.82	98.99	4.52	99.30	7.60	98.37	8.15	98.69
Gambling expenditure per year	7.39	99.33	5.55	99.42	11.47	98.92	9.92	98.92
Gambling expenditure as proportion of gross personal income	6.60	99.30	5.91	99.41	10.28	98.88	10.53	98.90
Number of gambling activities	4.39	99.27	3.72	99.08	6.94	98.83	6.75	98.28

Positive and negative predictive values of the responsible gambling limits in higher prevalence settings

Positive predictive values increase substantially in higher prevalence settings, such as gambling venues, mental health services, and clinical services. To illustrate, Table 19 displays the positive and negative predictive values based on the prevalence of gambling-related harm in multiple settings in which the prevalence of people experiencing gambling-related harm is much higher than in the general population:

- Victorian EGM venue employees (prevalence = 13.1%);
- Victorian mental health services (Problem Gambling in People Seeking Treatment for Mental Illness project: Lubman et al., 2017) (prevalence = 36.2%);
- the Australian national online gambling support service (Gambling Help Online) (prevalence = 97.0%); and
- an Australian online gambling self-directed program (GAMBLINGLESS trial: (Dowling et al., 2017; Merkouris et al., 2017) (prevalence = 99.6%).

The positive and negative predictive values displayed in this table were calculated using the Tasmanian data for each of the proposed responsible gambling limits.

In Victorian EGM venue employees, in which the prevalence of gambling-related harm is somewhat higher than in the general population:

- between 22.7% and 33.8% of employees who exceed the limits will actually experience gambling-related harm, and
- between 93.9% and 95.9% of employees who stay within the limits will not experience gambling-related harm.

In samples recruited from Victorian mental health services, in which the proportion of clients experiencing gambling-related harm is higher again:

- between 52.6% and 65.8% of clients who exceed the limits will actually experience gambling-related harm, and
- between 80.3% and 86.0% of clients who stay within the limits will not experience gambling-related harm.

In the Gambling Help Online service and GamblingLess program, in which almost all clients report gambling-related harm:

- between 98.4% and 99.9% of clients who exceed the limits will actually experience gambling-related harm, and
- between 0.9% and 9.8% of clients who stay within the limits will not experience gambling-related harm.

These findings confirm that a higher proportion of people who exceed the proposed responsible gambling limits within these settings will truly experience gambling-related harm than those in

the general population. Settings in which there is likely a high proportion of people experiencing gambling-related harm, such as venues, mental health services, general practitioner (GP) offices, and gambling counselling services are therefore appropriate settings in which to promote the proposed responsible gambling limits.

Table 19. Positive and negative predictive values based on the prevalence of gambling-related harm in higher prevalence settings

	EGM venue employees (prevalence = 13.1%)		Mental health services (prevalence = 36.2%)		Gambling Help Online (prevalence 97.0%)		GAMBLINGLESS (prevalence = 99.6%)	
	Positive predictive value (%)	Negative predictive value (%)	Positive predictive value (%)	Negative predictive value (%)	Positive predictive value (%)	Negative predictive value (%)	Positive predictive value (%)	Negative predictive value (%)
Gambling frequency per year	24.49	93.87	54.98	80.28	98.58	6.67	99.82	0.87
Gambling expenditure per year	33.83	95.87	65.81	86.04	99.10	9.77	99.89	1.32
Gambling expenditure as proportion of gross personal income	31.14	95.71	63.00	85.56	98.98	9.42	99.87	1.27
Number of gambling activities	22.74	95.53	52.57	85.02	98.44	9.06	99.81	1.21

Maximising specificity and sensitivity

The analyses presented in the preceding chapters have indicated that the likelihood of harm increases with multiple indices of gambling behaviour. ROC analyses, which attempt to identify a threshold of gambling behaviour at which harm is most likely to occur, necessarily involve a trade-off between sensitivity and specificity. Given the early state of the available evidence, all but one previous studies attempting to derive responsible gambling limits have attempted to balance sensitivity and specificity. For this reason, we have employed the Youden index, which also balances sensitivity and specificity. As previously reported, we identified that the application of the Youden index in the general population produces a very high proportion of false positives (i.e., identifies mostly people who are not experiencing gambling-related harm). In the Tasmanian and ACT general populations, between 6.8% and 11.5% of Tasmanian and ACT gamblers who exceed the limits will actually be experiencing gambling-related harm.

The purpose of the following set of analyses is therefore to explore the impact of maximising specificity on the responsible gambling limits and the associated positive predictive values. In these analyses, sensitivity in the ROC analyses was reduced to a minimum of 0.50 to determine the degree to which the responsible gambling limits increase and to provide an indication of the most extreme upper estimates for each of the responsible gambling limits. The associated positive and negative predictive values based on the prevalence of gambling-related harm in the population (2.30% Tasmania, 1.92% ACT) and gambling (3.68% Tasmania, 3.54% ACT) samples for both the Tasmanian and ACT data are also provided.

Effect of maximising specificity in ROC analyses on responsible gambling limits

The most extreme upper estimates for each of the responsible gambling limits for the Tasmania and ACT data were identified by exploring the optimal cut-offs in ROC analyses across the multiple definitions of harm based on the PGSI after reducing sensitivity to a minimum of 0.50 (see Table 58 and Table 59 in Appendix 7). The optimal responsible gambling limits were robust to variations in definitions of harm ($AUC \geq 0.70$), with most in the moderate classification accuracy range ($AUC = 0.70-0.90$). The various definitions of harm produced relatively consistent responsible gambling limits across the four gambling indices, with the exception of the definition of harm based on the problem gambling cut-off (i.e., PGSI scores ≥ 8) and the revised moderate risk gambling cut-off (i.e., PGSI scores ≥ 5), which derived much higher responsible gambling limits.

Excluding these definitions, the gambling limits across the two datasets ranged from:

- 33 to 65 times per year for gambling frequency
- \$770 to \$2,306 per year for gambling expenditure
- 1.79 to 6.19% for gambling expenditure as a proportion of gross personal income, and
- 2 to 3 gambling activities for number of activities.

The selected definition of harm based on two or more of the seven negative consequence PGSI items produced acceptable responsible gambling limits for all of the four gambling indices across both datasets in these analyses (Table 20). The limits identified in these analyses were relatively consistent across the two jurisdictions, although the ACT limits were consistently slightly lower than the Tasmanian limits.

Maximising specificity, the responsible gambling limits for the Australian population based on the selected definition of harm are estimated to be:

- a gambling frequency of 49 to 65 times per year (cf. 20-30 times per year);
- a gambling expenditure of \$1,380 to \$2,306 per year (cf. \$380-\$615 times per year);
- a gambling expenditure comprising 3.03% to 6.19% of an individual's gross personal income (cf. 0.83-1.68%); and
- 2 to 3 gambling activities (cf. 2 activities).

These responsible gambling limits were generally 2.2 to 3.7 times the proposed responsible gambling limits identified using the Youden index.

Table 20. ROC analyses maximising specificity (sensitivity > 0.50) analyses for the Tasmanian and ACT data according to the selected definition of harm based on the PGSIa

Responsible gambling limit		Endorsement of ≥ 2 PGSI negative consequence items	
		Tasmanian data	ACT data
Proportion of population exceeding each definition of harm		2.30% (95% CI 1.81, 2.91)	1.92% (95% CI 1.39, 2.65)
Proportion of gamblers exceeding each definition of harm		3.68% (95% CI 2.90, 4.64)	3.54% (95% CI 2.56, 4.88)
Gambling frequency per year	Cut off	65	49
	AUC (95% CI)	0.76 (0.70, 0.81)	0.79 (0.72, 0.86)
	sens, spec	0.50, 0.83	0.50, 0.86
	N	5754	1215
Gambling expenditure per year	Cut off	2306	1380
	AUC (95% CI)	0.86 (0.82, 0.90)	0.84 (0.78, 0.91)
	sens, spec	0.50, 0.93	0.51, 0.91
	N	5498	1157
Gambling expenditure as proportion of gross personal income	Cut off	6.19	3.03
	AUC (95% CI)	0.84 (0.79, 0.89)	0.85 (0.77, 0.92)
	sens, spec	0.50, 0.91	0.50, 0.92
	N	4954	1014
Number of gambling activities	Cut off	3	2
	AUC (95% CI)	0.78 (0.73, 0.83)	0.73 (0.65, 0.82)
	sens, spec	0.54, 0.83	0.69, 0.65
	N	5860	1208

^a Bold typeface indicates AUC ≥ 0.70

Table 21 displays the positive and negative predictive values based on the prevalence of gambling-related harm in the population (2.30% Tasmania, 1.92% ACT) and gambling (3.68% Tasmania, 3.54% ACT) samples for both the Tasmanian and ACT data after maximising specificity. The findings from this table reveal that, in the Tasmanian and ACT general populations, between 3.7% and 14.4% of people who exceed the limits will actually be experiencing gambling-related harm; this is an increase from the 3.7 to 7.4% of the general population using the Youden Index. Between 98.6% and 99.1% of people who stay within the limits will not be experiencing gambling-related harm; this compares to the 99.0% and 99.4% of the population using the Youden Index. Between 6.8% and 21.4% of Tasmanian and ACT gamblers who exceed the limits will actually be experiencing gambling-related harm; this is an increase from the 6.8 to 11.5% of gamblers using the Youden Index. Between 97.8% and 98.3% of gamblers who stay within the limits will not be experiencing gambling-related harm; this compares to the 98.3% to 98.9% of gamblers using the Youden Index. Taken together, these findings suggest that increasing the responsible gambling limits to those identified after maximising specificity would identify a larger proportion of gamblers exceeding the limits who are actually experiencing gambling-related

harm, without considerably impacting on the identification of gamblers who stay within the limits and do not experience gambling-related harm.

Effect of maximising sensitivity in ROC analyses on responsible gambling limits

For the sake of completeness, we have also included the effect of reducing specificity to a minimum of 0.50 to provide an indication of the most extreme lower estimates for each of the responsible gambling limits (see Table 58 and Table 59 in Appendix 8).

Table 21. Positive and negative predictive values based on the prevalence of gambling-related harm in the Tasmanian and ACT population and gambling samples after maximising specificity

Responsible gambling limit	Positive and negative predictive values based on the prevalence of gambling-related harm in the population				Positive and negative predictive values based on the prevalence of gambling-related harm in gamblers			
	<i>Tasmanian data</i> (prevalence = 2.30%)		<i>ACT data</i> (prevalence = 1.92%)		<i>Tasmanian data</i> (prevalence = 3.68%)		<i>ACT data</i> (prevalence = 3.54%)	
	Positive predictive value (%)	Negative predictive value (%)	Positive predictive value (%)	Negative predictive value (%)	Positive predictive value (%)	Negative predictive value (%)	Positive predictive value (%)	Negative predictive value (%)
Gambling frequency per year	6.48	98.60	6.53	98.87	10.10	97.75	11.59	97.91
Gambling expenditure per year	14.39	98.75	9.99	98.96	21.44	97.99	17.22	98.06
Gambling expenditure as proportion of gross personal income	11.57	98.72	10.90	98.95	17.51	97.94	18.66	98.04
Number of gambling activities	6.96	98.71	3.72	99.08	10.82	97.93	6.75	98.28

Responsible gambling limits for population subgroups using the PGSI definitions of gambling-related harm

In order to determine the degree to which gender- and age-specific limits were warranted, interaction effects between the responsible gambling limits and gender/age in predicting the selected definition of harm (endorsement of two or more of the seven negative consequence PGSI items).

Gender-specific responsible gambling limits

The interaction effects between the responsible gambling limits and gender in predicting gambling-related harm are displayed in Table 22. There were no significant interaction effects, indicating that each limit predicts gambling-related harm equally for men and women. The calculation of gender-specific limits was therefore deemed unwarranted.

Table 22. Gender interactions with responsible gambling limits predicting the selected definition of harm

	OR	Robust standard error	z	p	95% CI	
	Tasmanian data					
Gambling frequency per year limit	3.18	1.51	2.44	0.015	1.26	8.05
Male gender	0.93	0.44	-0.16	0.873	0.36	2.36
Gambling frequency per year limit x Gender	1.33	0.77	0.50	0.617	0.43	4.12
Gambling expenditure per year limit	7.42	3.96	3.76	0.000	2.61	21.11
Male gender	0.88	0.46	-0.24	0.809	0.32	2.44
Gambling expenditure per year limit x Gender	1.24	0.77	0.34	0.732	0.37	4.18
Gambling expenditure as proportion of gross personal income limit	13.00	6.90	4.83	0.000	4.59	36.80
Male gender	2.40	1.26	1.66	0.096	0.85	6.74
Gambling expenditure as proportion of gross personal income limit x Gender	0.69	0.44	-0.57	0.569	0.20	2.43
Number of gambling activities limit	5.62	2.60	3.74	0.000	2.27	13.90
Male gender	0.98	0.51	-0.03	0.974	0.36	2.70
Number of gambling activities x Gender	1.30	0.77	0.45	0.651	0.41	4.12
	ACT data					
Gambling frequency per year limit	4.55	2.86	2.41	0.016	1.32	15.59
Male gender	1.75	1.34	0.73	0.465	0.39	7.88
Gambling frequency per year limit x Gender	0.98	0.84	-0.02	0.982	0.18	5.26
Gambling expenditure per year limit	16.49	13.99	3.30	0.001	3.12	87.03
Male gender	3.90	3.66	1.45	0.147	0.62	24.53

Gambling expenditure per year limit x Gender	0.26	0.26	-1.33	0.183	0.04	1.90
Gambling expenditure as proportion of gross personal income limit	23.38	24.78	2.97	0.003	2.93	186.74
Male gender	1.95	2.32	0.56	0.577	0.19	20.15
Gambling expenditure as proportion of gross personal income limit x Gender	0.55	0.70	-0.47	0.641	0.05	6.64
Number of gambling activities limit	2.58	1.56	1.56	0.119	0.79	8.47
Male gender	1.02	0.67	0.02	0.980	0.28	3.69
Number of gambling activities x Gender	2.09	1.62	0.95	0.343	0.46	9.58

Age-specific responsible gambling limits

The interaction effects between the responsible gambling limits and age categories in predicting gambling-related harm are displayed in Table 23. There were no significant interaction effects, indicating that each limit predicts gambling-related harm equally across age categories. The calculation of age-specific limits was therefore deemed unwarranted.

Table 23. Age interactions with responsible gambling limits predicting the selected definition of harm

	OR	Robust standard error	z	p	95% CI	
	Tasmanian data					
Gambling frequency per year limit	11.54	10.36	2.72	0.006	1.99	67.04
Age	0.98	0.01	-1.70	0.089	0.95	1.00
Gambling frequency per year limit x Age	0.98	0.02	-1.20	0.229	0.95	1.01
Gambling expenditure per year limit	11.45	10.82	2.58	0.010	1.80	72.93
Age	0.97	0.01	-2.36	0.018	0.94	0.99
Gambling expenditure per year limit x Age	1.00	0.02	-0.21	0.837	0.96	1.03
Gambling expenditure as proportion of gross personal income limit	20.33	16.45	3.72	0.000	4.17	99.26
Age	0.97	0.01	-2.26	0.024	0.95	1.00
Gambling expenditure as proportion of gross personal income limit x Age	0.99	0.02	-0.75	0.455	0.96	1.02
Number of gambling activities limit	21.17	19.44	3.32	0.001	3.50	128.05
Age	1.00	0.01	0.16	0.870	0.97	1.03
Number of gambling activities limit x Age	0.97	0.02	-1.62	0.104	0.94	1.01
	ACT data					

Gambling frequency per year limit	7.61	8.29	1.86	0.062	0.90	64.37
Age	0.98	0.02	-0.81	0.420	0.95	1.02
Gambling frequency per year limit x Age	0.99	0.02	-0.31	0.753	0.95	1.04
Gambling expenditure per year limit	4.27	5.03	1.23	0.217	0.43	42.88
Age	0.97	0.02	-1.35	0.176	0.92	1.02
Gambling expenditure per year limit x Age	1.02	0.03	0.67	0.501	0.97	1.07
Gambling expenditure as proportion of gross personal income limit	32.34	27.72	4.06	0.000	6.03	173.55
Age	1.00	0.01	-0.08	0.937	0.98	1.02
Gambling expenditure as proportion of gross personal income limit x Age	0.99	0.01	-0.97	0.330	0.96	1.01
Number of gambling activities limit	5.85	5.43	1.91	0.057	0.95	36.03
Age	1.00	0.01	-0.13	0.893	0.97	1.03
Number of gambling activities limit x Age	0.99	0.02	-0.47	0.641	0.96	1.03

Gambling activity-specific responsible gambling limits using the PGSI definition of gambling-related harm

Gambling activity-specific responsible gambling limits

ROC analyses for subgroups of gamblers gambling on different gambling activities in the Tasmanian and ACT data were employed to identify responsible gambling limits across the multiple gambling indices (gambling frequency, gambling expenditure, gambling expenditure as a proportion of gross personal income, session expenditure, and session duration relating specifically to the gambling activity in question) and the eight definitions of harm based on the PGSI. Some of the optimal responsible gambling limits for different gambling activities (EGMs, horse/dog racing, instant scratch tickets, lottery, keno, casino table gambling, bingo, and sports/other event betting) according to each definition of harm in both datasets were robust to variations in definitions of harm ($AUC \geq 0.70$), although many AUCs ranged between 0.50 and 0.70 (small classification accuracy) (gambling activity-specific responsible gambling limits across all definitions of harm are available from the authors on request).

Table 24 displays the responsible gambling limits for both jurisdictions using the selected definition of harm (2 or more of the seven negative consequence PGSI items). Although many of the optimal responsible gambling limits for different gambling activities were acceptable ($AUC \geq 0.70$), some AUCs ranged between 0.50 and 0.70 (small classification accuracy). The limits relating to expenditure (gambling expenditure and gambling expenditure as a proportion of gross personal income) were the most likely to be acceptable ($AUC \geq 0.70$) for the selected definition of harm. The gambling expenditure as a proportion of gross personal income limit was acceptable for 5 of the 8 gambling activities from the Tasmanian dataset and 4 of the 8 gambling activities from the ACT dataset, and the gambling expenditure limit was acceptable for 5 of the 8 gambling activities from the Tasmanian dataset and 3 of the 8 gambling activities from the ACT dataset. The gambling frequency, session duration and session expenditure limits were less likely to be acceptable across gambling activities. The gambling frequency limit was acceptable for 3 of the 8 gambling activities from the Tasmanian dataset and 2 of the 8 gambling activities from the ACT dataset. The session duration limit for the ACT dataset was acceptable for 2 of the 4 gambling activities, and the session expenditure limit for the Tasmanian dataset was acceptable for 2 of the 8 gambling activities.

The acceptable responsible gambling limits using the selected definition of gambling-related harm are relatively consistent across the two jurisdictions, although the ACT limits are consistently slightly lower than the Tasmanian limits.

The responsible gambling limits for EGM gamblers are estimated to be:

- an EGM gambling frequency of 10 times per year;
- an EGM gambling expenditure of \$300 per year;
- an EGM gambling expenditure comprising 0.63% to 1.04% of an individual's gross personal income;
- an EGM session gambling expenditure of \$35; and
- an EGM session duration of 40 minutes.

The responsible gambling limits for horse/dog race gamblers are estimated to be:

- a horse/dog race gambling expenditure comprising 0.55% of an individual's gross personal income.

The responsible gambling limits for instant scratch ticket gamblers are estimated to be:

- an instant scratch ticket gambling expenditure of \$45 per year.

The responsible gambling limits for lottery gamblers are estimated to be:

- a lottery gambling expenditure comprising 0.45% of an individual's gross personal income.

The responsible gambling limits for keno gamblers are estimated to be:

- a keno gambling frequency of 4 to 13 times per year; and
- a keno gambling expenditure of \$45 to \$160 per year.

The responsible gambling limits for casino table game gamblers are estimated to be:

- a casino table game gambling expenditure of \$345 per year; and
- a casino table game gambling expenditure comprising 0.36% to 0.76% of an individual's gross personal income.

The responsible gambling limits for bingo gamblers are estimated to be:

- a bingo gambling expenditure of \$150 per year;
- a bingo gambling expenditure comprising 0.49% of an individual's gross personal income;
- a bingo session duration of 90 minutes; and
- a bingo session expenditure of \$17.

The responsible gambling limits for sports/other event betting gamblers are estimated to be:

- a sports/other event betting gambling frequency of 14 times per year;
- a sports/other event betting gambling expenditure of \$400 per year; and
- a sports/other event gambling expenditure comprising 0.55% to 0.86% of an individual's gross personal income.

Table 24. ROC analyses for each gambling activity according to the selected definition of harm^{a,b}

		EGMs	Horse/dog racing	Instant scratch tickets	Lottery	Keno	Casino table games	Bingo	Sports/other event betting
Tasmanian data									
Proportion of gamblers on the specific gambling activity exceeding selected definition of harm		9.43% (95% CI 7.18, 12.30)	8.34% (95% CI 5.80, 11.85)	4.78% (95% CI 3.31, 6.86)	3.74% (95% CI 2.78, 5.02)	5.36% (95% CI 4.11, 6.96)	12.78% (95% CI 7.81, 20.22)	5.02% (95% CI 1.91, 12.53)	13.49% (95% CI 8.27, 21.24)
Gambling frequency per year	Cut off	10	15	8	17	13	5	260	14
	AUC (95% CI)	0.73 (0.65, 0.81)	0.67 (0.58, 0.77)	0.63 (0.53, 0.72)	0.51 (0.43, 0.60)	0.70 (0.62, 0.78)	0.69 (0.59, 0.79)	0.38 (0.17, 0.59)	0.72 (0.59, 0.85)
	sens, spec	0.59, 0.75	0.55, 0.71	0.55, 0.63	0.42, 0.60	0.56, 0.73	0.51, 0.79	0.00, 0.99	0.59, 0.73
	N	1706	1091	1926	4415	2232	317	153	232
Gambling expenditure per year	Cut off	300	288	45	221	160	345	32	400
	AUC (95% CI)	0.81 (0.75, 0.87)	0.67 (0.56, 0.78)	0.70 (0.62, 0.79)	0.61 (0.51, 0.70)	0.73 (0.65, 0.80)	0.71 (0.57, 0.84)	0.54 (0.37, 0.71)	0.75 (0.64, 0.87)
	sens, spec	0.70, 0.77	0.58, 0.68	0.66, 0.64	0.52, 0.63	0.58, 0.76	0.51, 0.83	0.86, 0.27	0.58, 0.81
	N	1643	1064	1906	4339	2196	294	142	223
Gambling expenditure as proportion of gross personal income	Cut off	1.04	0.55	0.11	0.62	0.49	0.76	0.49	0.55
	AUC (95% CI)	0.77 (0.69, 0.85)	0.71 (0.62, 0.80)	0.65 (0.57, 0.73)	0.60 (0.51, 0.69)	0.69 (0.62, 0.77)	0.73 (0.61, 0.85)	0.73 (0.54, 0.92)	0.73 (0.60, 0.86)
	sens, spec	0.65, 0.77	0.68, 0.63	0.66, 0.56	0.53, 0.62	0.54, 0.76	0.57, 0.77	0.82, 0.56	0.64, 0.70
	N	1481	963	1714	3911	1999	274	121	212
Session expenditure	Cut off	35	23	8	17	15	97	17	29
	AUC (95% CI)	0.76 (0.68, 0.85)	0.59 (0.50, 0.68)	0.67 (0.58, 0.76)	0.66 (0.57, 0.75)	0.67 (0.60, 0.74)	0.61 (0.47, 0.75)	0.77 (0.64, 0.91)	0.67 (0.55, 0.80)
	sens, spec	0.65, 0.74	0.55, 0.58	0.53, 0.73	0.52, 0.73	0.49, 0.77	0.39, 0.81	0.88, 0.60	0.55, 0.70
	N	1653	1076	1923	4364	2235	305	151	240
ACT data									
Proportion of gamblers on the specific gambling activity exceeding selected definition of harm		6.72% (95% CI 4.57, 9.78)	4.17% (95% CI 2.74, 6.29)	6.43% (95% CI 3.83, 10.60)	3.89% (95% CI 2.58, 5.83)	12.38% (95% CI 6.10, 23.49)	11.55% (95% CI 5.95, 21.21)	4.28% (95% CI 1.77, 9.97)	8.61% (95% CI 4.69, 15.28)
Gambling frequency per year	Cut off	10	8	12	16	4	4	6	20
	AUC (95% CI)	0.80 (0.74, 0.87)	0.68 (0.58, 0.79)	0.58 (0.41, 0.74)	0.54 (0.42, 0.66)	0.71 (0.53, 0.88)	0.66 (0.53, 0.79)	0.65 (0.46, 0.84)	0.61 (0.42, 0.80)
	sens, spec	0.72, 0.73	0.48, 0.82	0.32, 0.84	0.42, 0.63	0.63, 0.67	0.51, 0.74	0.50, 0.73	0.37, 0.82
	N	528	478	321	820	78	109	68	159

Gambling expenditure per year	Cut off	300	200	100	170	45	130	150	140
	AUC (95% CI)	0.86 (0.78, 0.95)	0.67 (0.57, 0.77)	0.57 (0.40, 0.74)	0.65 (0.52, 0.78)	0.81 (0.67, 0.95)	0.58 (0.41, 0.74)	0.72 (0.53, 0.92)	0.65 (0.50, 0.80)
	sens, spec	0.79, 0.78	0.49, 0.77	0.31, 0.86	0.62, 0.59	0.67, 0.81	0.54, 0.57	0.55, 0.80	0.59, 0.62
	N	474	374	311	791	73	85	58	121
Gambling expenditure as proportion of gross personal income	Cut off	0.63	0.4	0.34	0.45	0.13	0.36	0.21	0.86
	AUC (95% CI)	0.84 (0.77, 0.92)	0.67 (0.58, 0.76)	0.50 (0.37, 0.62)	0.71 (0.59, 0.83)	0.67 (0.48, 0.86)	0.76 (0.63, 0.90)	0.58 (0.35, 0.81)	0.72 (0.53, 0.91)
	sens, spec	0.76, 0.77	0.49, 0.78	0.13, 0.88	0.60, 0.71	0.48, 0.80	0.80, 0.60	0.53, 0.59	0.53, 0.82
	N	423	337	280	696	69	80	47	114
Session duration	Cut off	40				20	50	90	
	AUC (95% CI)	0.81 (0.75, 0.87)	-- ^c	-- ^c	-- ^c	0.65 (0.46, 0.84)	0.68 (0.54, 0.83)	0.83 (0.70, 0.96)	-- ^c
	sens, spec	0.82, 0.66				0.72, 0.49	0.75, 0.53	0.94, 0.63	
	N	515				76	102	68	

^a Bold typeface indicates AUC \geq 0.70

^b Endorsement of 2 or more PGSI negative consequence items selected as definition of harm for derivation of responsible gambling limits

^c No responsible gambling limit identified as data relating to this gambling behaviour index was not collected in the survey

Proportion of the gambling activity subgroups exceeding the proposed gambling activity-specific responsible gambling limits

Table 25 reports the proportion of the Tasmanian and ACT sample gambling activity groups who exceeded each of the proposed responsible gambling limits derived from the selected definition of harm. This table reveals that, across limit types (relating to different gambling indices) and datasets (Tasmania and ACT), the limits were exceeded by 24 to 36% of EGM gamblers, 36% of horse/dog race gamblers, 37% of instant scratch tickets gamblers, 29% of lottery gamblers, 23 to 43% of keno gamblers, 22 to 33% of casino table gamblers, 20 to 56% of bingo gamblers, and 14 to 33% of sports/other event bettors.

Across the two datasets, each of the proposed gambling activity-specific responsible gambling limits for any specific gambling activity were exceeded by a roughly equal proportion of gamblers. The groups identified in this section comprise the target groups for the dissemination of each of the proposed gambling activity-specific responsible gambling limits in order to access the group of gamblers participating in different gambling activities who meet the selected definition of harm.

Table 25. Proportion of the Tasmanian and ACT gambling activity subgroups exceeding each of the proposed gambling activity-specific responsible gambling limits

Responsible gambling limit	Proportion of population exceeding each responsible gambling limit (% , 95% CI)	Proportion of gamblers exceeding each responsible gambling limit (% , 95% CI)	Proportion of gamblers on the specific gambling activity exceeding each responsible gambling limit (% , 95% CI)
EGMs			
<i>Tasmanian data</i>			
Gambling frequency per year	5.41 (4.81, 6.08)	8.59 (7.65, 9.63)	27.86 (24.89, 31.04)
Gambling expenditure per year	5.06 (4.42, 5.80)	8.04 (7.03, 9.19)	26.77 (23.6, 30.19)
Gambling expenditure as proportion of gross personal income	4.42 (3.84, 5.08)	7.02 (6.11, 8.04)	25.67 (22.51, 29.11)
Session expenditure	5.29 (4.59, 6.09)	8.40 (7.31, 9.64)	27.75 (24.43, 31.33)
<i>ACT data</i>			
Gambling frequency per year	7.38 (5.88, 9.22)	13.59 (10.88, 16.85)	35.98 (29.32, 43.22)
Gambling expenditure per year	4.94 (3.87, 6.30)	9.11 (7.13, 11.57)	27.06 (21.29, 33.72)
Gambling expenditure as proportion of gross personal income	4.04 (3.15, 5.17)	7.45 (5.80, 9.51)	24.12 (18.7, 30.52)
Session duration	7.21 (5.76, 8.98)	13.28 (10.65, 16.44)	35.76 (29.11, 43.00)
Horse/dog racing			
<i>Tasmanian data</i>			
Gambling expenditure as proportion of gross personal income	3.98 (3.44, 4.61)	6.33 (5.47, 7.30)	36.30 (31.98, 40.86)
Instant scratch tickets			
<i>Tasmanian data</i>			
Gambling expenditure per year	8.21 (7.31, 9.22)	13.04 (11.64, 14.58)	37.47 (34.03, 41.05)
Lottery			
<i>ACT data</i>			
Gambling expenditure as proportion of gross personal income	8.25 (6.80, 9.97)	15.19 (12.55, 18.27)	28.61 (23.95, 33.79)
Keno			
<i>Tasmanian data</i>			
Gambling frequency per year	5.64 (5.04, 6.30)	8.95 (8.01, 9.99)	22.99 (20.67, 25.48)
Gambling expenditure per year	5.77 (5.17, 6.44)	9.17 (8.22, 10.22)	23.81 (21.44, 26.36)

	ACT data		
Gambling frequency per year	1.12 (0.67, 1.89)	2.07 (1.23, 3.48)	43.44 (24.79, 64.15)
Gambling expenditure per year	0.68 (0.44, 1.05)	1.26 (0.81, 1.93)	27.15 (15.10, 43.86)
	Casino table games		
	Tasmanian data		
Gambling expenditure per year	1.11 (0.77, 1.60)	1.76 (1.22, 2.54)	21.70 (15.47, 29.56)
Gambling expenditure as proportion of gross personal income	1.44 (1.05, 1.97)	2.29 (1.67, 3.12)	29.93 (22.63, 38.42)
	ACT data		
Gambling expenditure as proportion of gross personal income	1.47 (0.83, 2.60)	2.71 (1.54, 4.75)	32.98 (19.07, 50.70)
	Bingo		
	Tasmanian data		
Gambling expenditure as proportion of gross personal income	0.59 (0.37, 0.94)	0.94 (0.59, 1.49)	45.56 (31.69, 60.16)
Session expenditure	0.86 (0.59, 1.25)	1.37 (0.94, 1.99)	55.92 (43.63, 67.54)
	ACT data		
Gambling expenditure per year	0.39 (0.23, 0.68)	0.72 (0.42, 1.25)	20.34 (9.31, 38.86)
Session duration	0.89 (0.59, 1.32)	1.63 (1.09, 2.44)	40.05 (21.11, 62.52)
	Sports/other event betting		
	Tasmanian data		
Gambling frequency per year	1.03 (0.74, 1.44)	1.64 (1.18, 2.28)	31.98 (24.06, 41.08)
Gambling expenditure per year	0.86 (0.62, 1.19)	1.36 (0.98, 1.89)	27.45 (20.26, 36.04)
Gambling expenditure as proportion of gross personal income	1.01 (0.74, 1.39)	1.61 (1.18, 2.20)	33.45 (25.36, 42.65)
	ACT data		
Gambling expenditure as proportion of gross personal income	0.72 (0.43, 1.20)	1.32 (0.79, 2.20)	13.50 (7.58, 22.90)

Cross-sectional evaluation of the proposed gambling activity-specific responsible gambling limits

The association between the proposed gambling activity-specific responsible gambling limits and gambling-related harm was explored. The cross-sectional evaluation of the proposed gambling activity-specific responsible gambling limits must be interpreted with caution because smaller cell sizes can lead to large confidence intervals around some estimates.

Separate logistic regression models (adjusted for socio-demographic characteristics) exploring whether each of the proposed gambling activity-specific responsible gambling limits predicted gambling-related harm are displayed in Table 26. The findings from these separate regressions suggest that:

- **EGMs:** Exceeding each of the five proposed EGM-specific responsible gambling limits (gambling frequency, gambling expenditure, gambling expenditure as a proportion of gross personal income, session expenditure, and session duration) significantly predicted gambling-related harm for EGM gamblers in both datasets.
- **Horse/dog racing:** Exceeding the one proposed horse/dog racing-specific responsible gambling limits (gambling expenditure as a proportion of gross personal income) did not significantly predict gambling-related harm for horse/dog race gamblers in the Tasmanian dataset.
- **Instant scratch tickets:** Exceeding the one proposed instant scratch ticket-specific responsible gambling limits (gambling expenditure) significantly predicted gambling-related harm for instant scratch ticket gamblers in the Tasmanian dataset.

- **Lottery:** Exceeding the one proposed lottery-specific responsible gambling limits (gambling expenditure as a proportion of gross personal income) significantly predicted gambling-related harm for lottery gamblers in the ACT dataset.
- **Keno:** Exceeding each of the two proposed keno-specific responsible gambling limits (gambling frequency and gambling expenditure) significantly predicted gambling-related harm for keno gamblers in both datasets.
- **Casino table games:** Exceeding each of the two proposed casino table games-specific responsible gambling limits (gambling expenditure and gambling expenditure as a proportion of gross personal income) significantly predicted gambling-related harm for casino table gamblers in the Tasmanian dataset; and exceeding the one proposed limit (gambling expenditure as a proportion of gross personal income) significantly predicted gambling-related harm for casino table gamblers in the ACT dataset.
- **Bingo:** Neither of the two proposed limits bingo-specific responsible gambling limits (gambling expenditure as a proportion of gross personal income and session expenditure) significantly predicted gambling-related harm for bingo gamblers in the Tasmanian dataset; and exceeding the one proposed limit (gambling expenditure) did not significantly predict gambling-related harm for bingo gamblers in the ACT dataset.
- **Sports/other betting:** Exceeding each of the two proposed sports/other event betting-specific responsible gambling limits (gambling frequency, gambling expenditure, and gambling expenditure as a proportion of gross personal income) in the Tasmanian dataset and the one proposed limit (gambling expenditure as a proportion of gross personal income) significantly predicted gambling-related harm for sports/other event gamblers.

A logistic regression model (adjusted for the other proposed gambling activity-specific responsible gambling limits and socio-demographic characteristics) examining the independent association between the proposed gambling activity-specific responsible gambling limits and gambling-related harm in each of the datasets is also displayed in Table 26. These analyses revealed that:

- **EGMs:** Exceeding the gambling frequency limit, gambling expenditure limit, and session expenditure limit significantly independently predicted gambling-related harm for EGM gamblers in the Tasmanian dataset; while exceeding the gambling frequency limit and the session duration limit, but not the gambling expenditure limit, independently significantly predicted gambling-related harm for this group of gamblers in the ACT dataset.
- **Keno:** Exceeding the gambling frequency limit, but not the gambling expenditure limit, significantly independently predicted gambling-related harm for keno gamblers in the Tasmanian data; whereas the converse effect was found in the ACT dataset, whereby exceeding the gambling expenditure limit, but not the gambling frequency limit, significantly independently predicted gambling-related harm for keno gamblers.
- **Bingo:** Neither of the valid gambling activity-specific responsible gambling limits (gambling expenditure as a proportion of gross personal income and session expenditure) significantly independently predicted gambling-related harm for bingo gamblers in the Tasmania data.
- **Sports/other event betting:** Exceeding the gambling expenditure limit, but not the gambling frequency limit, significantly independently predicted gambling-related harm for sports/other event betting gamblers in the Tasmanian data.

These findings indicate that the limits relating to gambling frequency, gambling expenditure, session expenditure, and session duration independently predicted gambling-related harm for EGM gamblers; the limit relating to gambling frequency and gambling expenditure independently predicted gambling-related harm for keno gamblers; only the limit relating to gambling expenditure independently predicted gambling-related harm for sports/other event betting gamblers; and that none of the proposed responsible gambling activity-specific limits independently predicted gambling-related harm for bingo gamblers.

Taken together, these findings suggest exceeding the proposed gambling activity-specific responsible gambling limits were generally good predictors of gambling-related harm in sub-groups of gamblers participating on these forms of gambling, but that there was little consistency in exceeding the proposed gambling activity-specific gambling responsible gambling limits as independent predictors of gambling-related harm after controlling for the other gambling activity-specific limits. An examination of the results in relation to each of the proposed gambling activity-specific responsible gambling limits across both sets of analyses revealed that:

- **Gambling frequency limit:** Exceeding the proposed gambling activity-specific gambling frequency limit was a significant predictor of gambling-related harm across all of the gambling activities (EGMs, keno, sports/other event betting), although these relationships were not as strong as those for the limits relating to gambling expenditure. Exceeding this limit was also a significant independent predictor of gambling-related harm for EGMs and keno, but not sports/other event betting, after controlling for the other limits.
- **Gambling expenditure limits:** Exceeding the proposed gambling activity-specific limits relating to gambling expenditure (gambling expenditure and gambling expenditure as a proportion of gross personal income) were significant predictors of gambling-related harm across all gambling activities except horse/dog race gambling and bingo; and were consistently the strongest predictors of gambling-related harm. After controlling for the other limits, exceeding the gambling expenditure limit was a significant independent predictor of gambling-related harm for EGMs (but only in the Tasmanian dataset), keno (but only in the ACT dataset), and sports/other event betting. Exceeding the proposed session expenditure limit also significantly predicted gambling-related harm for EGM gamblers, but not bingo gamblers; and remained a significant independent predictor of gambling-related harm for EGM gamblers after controlling for the other limits.
- **Session duration limit:** Finally, exceeding the proposed session duration limits (ACT data) was a significant predictor of gambling-related harm for EGM gamblers; and remained a significant independent predictor of gambling-related harm after controlling for the other limits.

Table 26. Cross-sectional prediction of the selected definition of gambling-related harm in Tasmania and the ACT by the proposed gambling activity-specific responsible gambling limits

Responsible gambling limit	OR	Robust standard error	z	p	95% CI		OR	Robust standard error	z	p	95% CI	
	Adjusted for socio-demographics ^a						Adjusted for other limits/socio-demographics ^{b,c}					
	EGMs											
	Tasmanian data											
Gambling frequency per year	6.76	2.24	5.75	0.000	3.52	12.95	2.62	1.17	2.16	0.031	1.09	6.31
Gambling expenditure per year	13.26	4.73	7.24	0.000	6.58	26.70	4.02	1.89	2.96	0.003	1.60	10.13
Gambling expenditure as proportion of gross personal income	9.27	3.47	5.95	0.000	4.45	19.30						
Session expenditure	7.28	2.31	6.25	0.000	3.90	13.58	2.98	0.90	3.63	0.000	1.65	5.38
	ACT data											
Gambling frequency per year	11.03	5.86	4.52	0.000	3.89	31.23	4.96	3.59	2.21	0.027	1.20	20.53
Gambling expenditure per year	11.31	6.26	4.38	0.000	3.82	33.49	2.99	2.01	1.63	0.103	0.80	11.16
Gambling expenditure as proportion of gross personal income	40.59	24.74	6.08	0.000	12.29	134.03						
Session duration	14.34	6.92	5.52	0.000	5.57	36.90	8.03	4.26	3.93	0.000	2.84	22.70
	Horse/dog racing											
	Tasmanian data											
Gambling expenditure as proportion of gross personal income	2.31	1.04	1.86	0.063	0.96	5.58						
	Instant scratch tickets											
	Tasmanian data											
Gambling expenditure per year	4.12	1.66	3.51	0.000	1.87	9.06						
	Lottery											
	ACT data											
Gambling expenditure as proportion of gross personal income	8.17	3.82	4.49	0.000	3.26	20.44						
	Keno											
	Tasmanian data											
Gambling frequency per year	5.18	1.55	5.48	0.000	2.88	9.33	3.09	1.36	2.57	0.010	1.31	7.33
Gambling expenditure per year	4.52	1.37	4.97	0.000	2.50	8.20	1.96	0.89	1.48	0.139	0.80	4.78
	ACT data											
Gambling frequency per year	7.57	7.45	2.06	0.040	1.10	52.14	2.21	2.05	0.86	0.391	0.36	13.57
Gambling expenditure per year	12.29	10.91	2.83	0.005	2.16	69.98	8.20	7.57	2.28	0.023	1.34	50.05
	Casino table games											

	Tasmanian data											
Gambling expenditure per year	11.62	7.03	4.05	0.000	3.55	38.06						
Gambling expenditure as proportion of gross personal income	9.52	6.52	3.29	0.001	2.49	36.45						
	ACT data											
Gambling expenditure as proportion of gross personal income	36.81	41.61	3.19	0.001	4.01	337.45						
	Bingo^d											
	Tasmanian data											
Gambling expenditure as proportion of gross personal income	13.7	22.86	1.57	0.117	0.52	360.19	13.90	22.61	1.62	0.106	0.57	336.91
Session expenditure	3.67	4.77	1.00	0.316	0.29	46.82	0.78	1.11	-0.18	0.860	0.05	12.95
	ACT data											
Gambling expenditure per year	3.28	5.53	0.70	0.482	0.12	89.68						
	Sports/other event betting											
	Tasmanian data											
Gambling frequency per year	3.6	1.98	2.33	0.020	1.22	10.60	0.99	0.61	-0.02	0.985	0.29	3.34
Gambling expenditure per year	7.3	4.27	3.4	0.001	2.32	22.96	7.35	4.51	3.25	0.001	2.21	24.48
Gambling expenditure as proportion of gross personal income	4.48	2.57	2.61	0.009	1.45	13.79						
	ACT data											
Gambling expenditure as proportion of gross personal income	9.61	7.31	2.97	0.003	2.16	42.69						

^a Separate regressions predicting gambling-related harm by each of the proposed responsible gambling limits after controlling for socio-demographic characteristics (age, gender, education, country of birth)

^b Prediction of gambling-related harm by each responsible gambling limit after controlling for the other proposed responsible gambling limits and socio-demographic characteristics (age, gender, education, country of birth)

^c Gambling expenditure as a proportion of gross personal income limit removed due to multicollinearity with gambling expenditure limit (exception was casino table gambling for ACT data as gambling expenditure limit was not valid)

^d Regression not conducted for session duration due to small cell size

Contribution of gambling activity-specific responsible gambling limits to gambling-related harm

Although we can make some inferences for some gambling activities, particularly those with higher AUCs such as EGMs, the derivation of gambling activity-specific responsible gambling limits in the previous sections are fundamentally limited by the inability to link gambling-related harms to specific gambling activities. This is because the PGSI was only asked once, rather than for every gambling activity. This is of concern given that some gambling activities, predominantly including EGMs, are thought to contribute more to gambling-related harm than others (Dowling et al., 2005). In order to identify which of the proposed responsible gambling limits relating to specific gambling activities contributed most to gambling-related harm, a series of analyses were conducted for each of the gambling behaviour indices (gambling frequency, gambling expenditure, gambling expenditure as a proportion of gross personal income, session expenditure, and session duration).

Separate logistic regression models (adjusted for socio-demographic characteristics) and a single multivariable regression model (adjusted for the other proposed gambling activity-specific responsible gambling limits and socio-demographic characteristics) were employed to explore whether the gambling activity-specific responsible gambling limits for each of the gambling behaviour indices across specific gambling activities predicted gambling-related harm for the whole gambling samples in each dataset are displayed in Appendix 9. These analyses are distinct from the previous analyses presented in this section as they were conducted across the entire gambling samples from both the Tasmanian and ACT data (i.e., they were not restricted to the group of gamblers participating in each specific gambling activity). The purpose of these analyses are to ascertain the contribution of exceeding the limits pertaining to each specific gambling activity.

An examination of the results in relation to the contribution of each of the proposed gambling activity-specific responsible gambling limits across both sets of analyses revealed that the proposed EGM-specific limits were generally the strongest predictors of gambling-related harm across all limits. Exceeding the proposed limits for casino table gambling and sports/other event betting were also strong significant predictors of gambling-related harm across limit types; but these relationships were not as strong as those for EGMs. The proposed limits for keno significantly predicted gambling-related harm; but these relationships were not as strong as those for EGMs, casino table games, or sports/other event betting. The proposed limits for horse/dog racing significantly predicted gambling-related harm; but these relationships were not as strong as the other gambling activities. Finally, the proposed limits for instant scratch tickets and bingo were the least strongly associated with gambling-related harm across limit types.

Responsible gambling limits for the population using alternative measures of gambling-related harm

All previous research has relied exclusively on measures of problem gambling severity, such as the PGSI and the SOGS, to derive responsible gambling limits. There is therefore a need to identify responsible gambling limits for the population using alternative measures of gambling-related harm. To date, this has been limited by the lack of a validated and interpretable measure of harms attributable to gambling. In this chapter, the possibility of deriving responsible gambling limits from ROC analyses based on alternative measures of harm is explored. These alternative measures of gambling-related harm include a series of alternative gambling-related harm items, quality of life measures, mental health measures, and substance use measures.

Responsible gambling limits for the population using alternative gambling-related harm items

Responsible gambling limits for the Tasmanian (Table 27) and ACT (Table 28) data were identified by exploring the optimal cut-offs in ROC analyses across the multiple gambling indices (gambling frequency, gambling expenditure, gambling expenditure as a proportion of gross personal income, and the number of gambling activities) and definitions of harm based on each of the gambling-related harm items. We selected to not combine these items to form an alternative gambling-related harm scale or combining these alternative harm items with the PGSI items as the items are not necessarily invariant (equivalent) and we have no evidence of the psychometric properties of these combinations of items. In the absence of an alternative measure of gambling-related harm, ROC analyses based on each individual item is presented to provide an indication of the magnitude of limits when gambling-related harms that are more severe than those from the PGSI are measured.

Examination of Table 27 and Table 28 reveals that although there were some responsible gambling limits that were robust to variations in definitions of harm ($AUC \geq 0.70$), many were in the small classification accuracy range ($AUC = 0.50-0.70$). The responsible gambling limit relating to gambling expenditure as a proportion of gross personal income was the most likely to be acceptable across the gambling-related harm items in both the Tasmanian and ACT datasets; endorsement of 5 of the 7 gambling-related harm from the Tasmanian dataset and 9 of the 11 harms from the ACT dataset resulted in acceptable responsible gambling limits. The gambling expenditure limit was also acceptable for most items across both datasets; this limit was acceptable for 5 of the 7 items from the Tasmanian dataset and for 6 of the 11 items from the ACT dataset. The gambling frequency limit was less likely to be acceptable across the items from both datasets; endorsement of 2 of the 7 items from the Tasmanian dataset and 4 of the 11 items from the ACT dataset resulted in acceptable limits. Finally, although the number of gambling activities was acceptable for 4 of the 7 items in the Tasmanian dataset, it failed to be acceptable for any of the 11 items in the ACT dataset. Moreover, across both the Tasmanian and ACT datasets, these items measuring harm attributable to gambling captured fewer respondents in the population than the selected definition of harm using the PGSI (i.e., endorsement of 2 or more of the 7 negative consequence items), suggesting that these items are measuring more severe or extreme harms.

As a result, the responsible gambling limits identified using these harms are somewhat higher than those identified using the selected definition of harm on the PGSI, although the trend for lower limits in the ACT than in Tasmania persisted in these analyses. The items, however, did produce relatively consistent responsible gambling limits across the four gambling indices, with the exception of the item relating to employment issues in the ACT dataset, which derived much higher responsible gambling limits.

Excluding this item, the responsible gambling limits across both datasets ranged from:

- 30 to 67 times per year for gambling frequency (cf. 20-30 times per year);
- \$770 to \$2954 per year for gambling expenditure (cf. \$380-615 times per year);
- 1.61 to 6.18% for gambling expenditure as a proportion of gross personal income (cf. 0.83-1.68%); and
- 3 to 4 gambling activities for number of activities (cf. 2 activities).

In the Tasmanian dataset, the highest classification accuracy estimates were obtained using the harm items relating to: (a) seriously thinking about, or attempting suicide; and (b) the breakup of an important relationship. The limits associated with these items, however, fail to capture a high proportion of people in the population experiencing harm (0.52-0.57%). In the ACT dataset, the highest classification accuracy estimates were obtained using the harm items relating to: (a) employment issues, (b) a breakdown in communication with family, (c) less quality time with family, and (d) serious thoughts about suicide. Again, however, few very people in the population (0.07-0.85%) report experiencing these harms.

Taken together, these findings suggest although the responsible gambling limits identified using these alternative gambling-related harm items are less conservative than those identified using the selected definition of harm on the PGSI or the individual PGSI items, extreme caution is required in their interpretation. These items did not produce consistently acceptable responsible gambling limits and captured few respondents in the population experiencing harm. Moreover, the items were different across the Tasmanian and ACT datasets and do not comprise validated instruments with interpretable scoring procedures. It is therefore likely very premature to base responsible gambling guidelines on these limits. These findings highlight the need for validated measures of harms attributable to gambling other than the PGSI or the SOGS, which can be subjected to ROC analyses to derive responsible gambling limits.

Table 27. ROC analyses for the Tasmanian data according to each alternative gambling-related harm item^a

Responsible gambling limit	Gambling resulted in...	...difficulty in paying bills, repaying debt, or meeting other expenses	...reduced performance in undertaking daily tasks and activities	...changing jobs or being dismissed from work	...not enough time to look after family's interests	...the breakup of an important relationship	...obtaining money illegally, even if intent was to pay it back	...seriously thinking about, or attempting, suicide
Proportion of population exceeding each definition of harm		1.11% (95% CI 0.63, 1.93)	1.00% (95% CI 0.55, 1.81)	0.09% (95% CI 0.03, 0.29)	0.50% (95% CI 0.22, 1.15)	0.57% (95% CI 0.24, 1.35)	0.07% (95% CI 0.02, 0.26)	0.52% (95% CI 0.22, 1.22)
Proportion of gamblers exceeding each definition of harm		3.42% (95% CI 1.97, 5.90)	3.08% (95% CI 1.70, 5.53)	0.29% (95% CI 0.09, 0.89)	1.55% (95% CI 0.68, 3.52)	1.76% (95% CI 0.74, 4.13)	0.22% (95% CI 0.06, 0.80)	1.61% (95% CI 0.68, 3.72)
Gambling frequency per year	Cut off	76	72	36	41	67	20	61
	AUC (95% CI)	0.61 (0.46, 0.77)	0.61 (0.44, 0.77)	0.63 (0.46, 0.81)	0.62 (0.41, 0.83)	0.72 (0.54, 0.90)	0.49 (0.32, 0.66)	0.76 (0.59, 0.92)
	sens, spec	0.50, 0.67	0.51, 0.65	0.81, 0.42	0.72, 0.47	0.70, 0.63	0.93, 0.25	0.80, 0.60
	N	925	924	922	923	925	924	926
Gambling expenditure per year	Cut off	2025	2170	820	1420	2080	320	2954
	AUC (95% CI)	0.73 (0.58, 0.89)	0.81 (0.65, 0.97)	0.70 (0.54, 0.86)	0.68 (0.47, 0.88)	0.85 (0.72, 0.97)	0.52 (0.33, 0.71)	0.92 (0.84, 1.00)
	sens, spec	0.61, 0.73	0.71, 0.75	0.87, 0.50	0.62, 0.64	0.80, 0.73	0.91, 0.27	0.89, 0.80
	N	871	870	869	870	871	870	872
Gambling expenditure as proportion of gross personal income	Cut off	4.25	5.08	2.59	7.54	3.45	1.02	6.18
	AUC (95% CI)	0.70 (0.47, 0.93)	0.72 (0.49, 0.95)	0.74 (0.59, 0.89)	0.55 (0.26, 0.84)	0.75 (0.54, 0.95)	0.56 (0.36, 0.75)	0.89 (0.82, 0.96)
	sens, spec	0.62, 0.68	0.60, 0.72	0.89, 0.55	0.30, 0.79	0.74, 0.63	0.90, 0.32	0.92, 0.76
	N	783	783	782	782	783	784	784
Number of gambling activities	Cut off	3	3	3	3	3	3	4
	AUC (95% CI)	0.67 (0.52, 0.82)	0.69 (0.53, 0.85)	0.68 (0.55, 0.81)	0.74 (0.65, 0.83)	0.76 (0.58, 0.95)	0.77 (0.62, 0.92)	0.88 (0.81, 0.96)
	sens, spec	0.63, 0.61	0.66, 0.61	0.74, 0.60	0.80, 0.61	0.77, 0.61	0.85, 0.60	0.84, 0.79
	N	958	957	955	956	958	957	958

^a Bold typeface indicates AUC ≥ 0.70

Table 28. ROC analyses for the ACT data according to each alternative gambling-related harm item^{a,b}

Responsible gambling limit	In relation to gambling, there was...	...not enough money for household running costs, such as food, rent or bills	...not enough money for family projects or activities	...other financial difficulties	...feelings of stress or anxiety	...feeling depressed or sad	...less quality time with family	...a breakdown in communication with family	...arguments over your gambling	...the break-up of an important relationship	...employment issues	...serious thoughts about suicide
Proportion of population exceeding each definition of harm		0.91% (95% CI 0.54, 1.52)	1.00% (95% CI 0.61, 1.62)	1.37% (95% CI 0.88, 2.12)	2.60% (95% CI 1.75, 3.83)	2.76% (95% CI 1.74, 4.35)	0.85% (95% CI 0.49, 1.48)	0.78% (95% CI 0.43, 1.41)	1.41% (95% CI 0.92, 2.15)	0.60% (95% CI 0.27, 1.33)	0.07% (95% CI 0.02, 0.20)	0.25% (95% CI 0.12, 0.53)
Proportion of gamblers exceeding each definition of harm		3.29% (95% CI 1.95, 5.50)	3.60% (95% CI 2.19, 5.88)	4.94% (95% CI 3.15, 7.66)	9.39% (95% CI 6.34, 13.69)	9.98% (95% CI 6.35, 15.34)	3.08% (95% CI 1.75, 5.35)	2.81% (95% CI 1.54, 5.10)	5.09% (95% CI 3.30, 7.77)	2.18% (95% CI 0.98, 4.78)	0.26% (95% CI 0.09, 0.74)	0.92% (95% CI 0.44, 1.92)
Gambling frequency per year	Cut off	30	30	51	80	126	37	38	60	30	82	28
	AUC (95% CI)	0.69 (0.59, 0.80)	0.70 (0.60, 0.80)	0.66 (0.50, 0.82)	0.53 (0.42, 0.63)	0.51 (0.35, 0.67)	0.73 (0.64, 0.82)	0.75 (0.67, 0.83)	0.62 (0.47, 0.77)	0.69 (0.56, 0.82)	0.89 (0.73, 1.04)	0.64 (0.50, 0.79)
	sens, spec	0.78, 0.51	0.79, 0.52	0.56, 0.67	0.28, 0.77	0.21, 0.87	0.78, 0.58	0.82, 0.58	0.47, 0.71	0.79, 0.51	0.84, 0.78	0.73, 0.49
	N	561	561	561	561	561	561	561	561	561	561	560
Gambling expenditure per year	Cut off	770	750	1040	1122	874	890	1040	1090	520	5275	1025
	AUC (95% CI)	0.72 (0.59, 0.85)	0.69 (0.56, 0.82)	0.70 (0.57, 0.84)	0.60 (0.49, 0.71)	0.61 (0.48, 0.73)	0.79 (0.71, 0.87)	0.84 (0.77, 0.90)	0.67 (0.53, 0.81)	0.68 (0.52, 0.84)	0.98 (0.95, 1.01)	0.81 (0.67, 0.94)
	sens, spec	0.68, 0.63	0.65, 0.63	0.6, 0.70	0.44, 0.72	0.49, 0.67	0.77, 0.67	0.84, 0.70	0.54, 0.71	0.73, 0.54	0.97, 0.92	0.78, 0.69
	N	543	543	543	543	543	543	543	543	543	543	542
Gambling expenditure as proportion of gross personal income	Cut off	2.50	2.50	2.12	1.85	1.73	2.51	2.50	2.55	2.50	15.29	1.61
	AUC (95% CI)	0.76 (0.61, 0.90)	0.71 (0.55, 0.86)	0.75 (0.63, 0.87)	0.63 (0.52, 0.74)	0.60 (0.47, 0.73)	0.81 (0.69, 0.92)	0.84 (0.72, 0.95)	0.70 (0.56, 0.84)	0.75 (0.58, 0.93)	0.99 (0.97, 1.00)	0.76 (0.59, 0.93)
	sens, spec	0.63, 0.75	0.56, 0.75	0.65, 0.72	0.50, 0.69	0.47, 0.68	0.71, 0.75	0.76, 0.75	0.55, 0.75	0.64, 0.74	0.99, 0.95	0.74, 0.65
	N	484	484	484	484	484	484	484	484	484	484	483
Number of gambling activities	Cut off	2	2	2	4	5	2	2	3	2	4	2
	AUC (95% CI)	0.60 (0.48, 0.72)	0.58 (0.46, 0.69)	0.62 (0.49, 0.75)	0.54 (0.39, 0.69)	0.50 (0.33, 0.66)	0.63 (0.52, 0.74)	0.68 (0.60, 0.77)	0.57 (0.44, 0.70)	0.69 (0.58, 0.80)	0.62 (0.28, 0.97)	0.64 (0.50, 0.78)
	sens, spec	0.76, 0.40	0.73, 0.40	0.76, 0.40	0.26, 0.82	0.14, 0.89	0.80, 0.40	0.93, 0.40	0.44, 0.66	0.93, 0.40	0.40, 0.81	0.88, 0.40
	N	560	560	560	560	560	560	560	560	560	560	559

^a Bold typeface indicates AUC ≥ 0.70^b No respondent in the ACT survey endorsed legal issues in relation to their gambling

Responsible gambling limits for the population using quality of life measures

An attempt was made to identify responsible gambling limits for the Tasmanian data by exploring the optimal cut-offs in ROC analyses across the multiple gambling indices (gambling frequency, gambling expenditure, gambling expenditure as a proportion of gross personal income, and the number of gambling activities) using multiple definitions of harm based on the subscales of the WHO-QoL BREF, a measure of quality of life: physical health, psychological health, social relationships, and environment. These analyses are based on the subsamples of the 2011 and 2013 Tasmanian studies who were administered the supplementary survey. Given that the optimal cut-offs were all classified in the small classification accuracy range (AUCs ranged from 0.50 to 0.59), no further analyses relating to the development of responsible gambling limits for the population using quality of life measures were conducted (Table 29).

Table 29. ROC analyses for the Tasmanian data according to quality of life measures^a

		WHO-QoL BREF Physical health quality of life	WHO-QoL BREF Psychologic al health quality of life	WHO-QoL BREF Social relationships quality of life	WHO-QoL BREF Environment quality of life
Proportion of population exceeding each definition of harm		23.91% (95% CI 21.85, 26.10)	27.14% (95% CI 24.86, 29.54)	28.82% (95% CI 26.28, 31.50)	29.68% (95% CI 27.38, 32.09)
Proportion of gamblers exceeding each definition of harm		23.50% (95% CI 21.07, 26.12)	26.77% (95% CI 24.09, 29.64)	28.53% (95% CI 25.54, 31.72)	29.74% (95% CI 27.01, 32.63)
Gambling frequency per year	Cut off	21	10	13	20
	AUC (95% CI)	0.54 (0.50, 0.58)	0.51 (0.48, 0.55)	0.53 (0.49, 0.57)	0.52 (0.48, 0.55)
	sens, spec	0.52, 0.54	0.68, 0.34	0.63, 0.42	0.50, 0.52
	N	2717	2742	2324	2746
Gambling expenditure per year	Cut off	265	128	100	252
	AUC (95% CI)	0.53 (0.49, 0.57)	0.51 (0.47, 0.55)	0.53 (0.48, 0.57)	0.52 (0.48, 0.55)
	sens, spec	0.52, 0.53	0.65, 0.36	0.72, 0.32	0.51, 0.51
	N	2587	2614	2226	2611
Gambling expenditure as proportion of gross personal income	Cut off	0.84	0.69	0.58	0.57
	AUC (95% CI)	0.59 (0.55, 0.63)	0.54 (0.50, 0.58)	0.56 (0.52, 0.60)	0.55 (0.51, 0.59)
	sens, spec	0.57, 0.56	0.56, 0.50	0.60, 0.48	0.61, 0.46
	N	2378	2407	2086	2407
Number of gambling activities	Cut off	1	1	2	1
	AUC (95% CI)	0.50 (0.46, 0.54)	0.50 (0.46, 0.54)	0.51 (0.47, 0.55)	0.50 (0.47, 0.54)
	sens, spec	0.92, 0.10	0.92, 0.09	0.56, 0.46	0.92, 0.10
	N	2785	2809	2375	2813

^a Bold typeface indicates AUC ≥ 0.70

Responsible gambling limits for the population using mental health measures

An attempt was made to identify responsible gambling limits by exploring the optimal cut-offs in ROC analyses across the multiple gambling indices (gambling frequency, gambling expenditure, gambling expenditure as a proportion of gross personal income, and the number of gambling activities) using multiple definitions of harm based on mental health measures. In the Tasmanian dataset, these measures were PHQ depression, GAD generalised anxiety, ANS panic symptoms, PC-PTSD post-traumatic stress disorder, Mini SPIN generalised social anxiety, and ASRS attention-deficit hyperactivity disorder from the Tasmanian dataset. These analyses are based on the subsample of the 2013 Tasmanian study who was administered the supplementary survey. In the ACT dataset, ROC analyses were also conducted using K6 psychological distress. Given that the optimal cut-offs

were all classified in the small classification accuracy range (AUCs ranged from 0.40 to 0.58), no further analyses relating to the development of responsible gambling limits for the population using mental health measures were conducted (Table 30).

Table 30. ROC analyses for the Tasmanian and ACT data according to mental health measures^a

Responsible gambling limit		PHQ Depression	GAD Generalised anxiety	ANS Panic symptoms	PC-PTSD Post- traumatic stress disorder	Mini SPIN Generalised social anxiety	ASRS Attention- deficit hyperactivity disorder	K6 Psychologic al distress
Dataset		Tasmanian	Tasmanian	Tasmanian	Tasmanian	Tasmanian	Tasmanian	ACT
Proportion of population exceeding each definition of harm		12.43% (95% CI 10.13, 15.18)	13.34% (95% CI 11.02, 16.06)	29.91% (95% CI 26.89, 33.11)	9.10% (95% CI 7.39, 11.15)	10.54% (95% CI 8.63, 12.83)	12.79% (95% CI 10.45, 15.57)	9.07% (95% CI 7.20, 11.38)
Proportion of gamblers exceeding each definition of harm		12.12% (95% CI 9.44, 15.43)	13.62% (95% CI 10.84, 16.98)	29.18% (95% CI 25.63, 33.01)	9.34% (95% CI 7.33, 11.84)	10.11% (95% CI 8.10, 12.55)	11.66% (95% CI 9.07, 14.85)	7.38% (95% CI 5.16, 10.44)
Gambling frequency per year	Cut off	647	647	647	647	647	647	710
	AUC (95% CI)	0.44 (0.36, 0.51)	0.42 (0.35, 0.49)	0.40 (0.34, 0.45)	0.44 (0.35, 0.52)	0.42 (0.36, 0.49)	0.40 (0.34, 0.47)	0.48 (0.39, 0.57)
	sens, spec	0.01, 0.99	0.01, 0.99	0.01, 0.99	0.01, 0.99	0.00, 0.99	0.00, 0.99	0.00, 1.00
	N	1242	1248	1264	1264	1253	1259	1196
Gambling expenditure per year	Cut off	2	77550	77550	10564	77550	77550	2780
	AUC (95% CI)	0.47 (0.40, 0.54)	0.45 (0.38, 0.52)	0.42 (0.36, 0.47)	0.44 (0.35, 0.54)	0.45 (0.37, 0.52)	0.44 (0.37, 0.50)	0.45 (0.34, 0.56)
	sens, spec	0.99, 0.01	0.00, 1.00	0.00, 1.00	0.02, 0.98	0.00, 1.00	0.00, 1.00	0.06, 0.95
	N	1200	1204	1219	1220	1209	1215	1140
Gambling expenditure as proportion of gross personal income	Cut off	0.27	0.18	96.10	4.55	96.10	0.01	0.53
	AUC (95% CI)	0.55 (0.48, 0.61)	0.52 (0.46, 0.58)	0.46 (0.41, 0.51)	0.50 (0.41, 0.59)	0.47 (0.40, 0.54)	0.47 (0.40, 0.53)	0.58 (0.50, 0.67)
	sens, spec	0.74, 0.34	0.78, 0.26	0, 1	0.16, 0.86	0, 1	0.99, 0.01	0.46, 0.66
	N	1106	1109	1122	1125	1116	1120	1002
Number of gambling activities	Cut off	8	8	8	7	2	1	2
	AUC (95% CI)	0.47 (0.40, 0.54)	0.45 (0.39, 0.52)	0.44 (0.39, 0.50)	0.46 (0.37, 0.55)	0.51 (0.44, 0.58)	0.48 (0.41, 0.54)	0.54 (0.43, 0.64)
	sens, spec	0.00, 0.99	0.00, 0.99	0.01, 0.99	0.02, 0.98	0.52, 0.49	0.91, 0.11	0.41, 0.64
	N	1283	1290	1306	1306	1294	1300	1189

^a Bold typeface indicates AUC ≥ 0.70

Responsible gambling limits for the population using substance use measures

An attempt was made to identify responsible gambling limits by exploring the optimal cut-offs in ROC analyses across the multiple gambling indices (gambling frequency, gambling expenditure, gambling expenditure as a proportion of gross personal income, and the number of gambling activities) using multiple definitions of harm based on substance use measures. In the Tasmanian dataset, these included measures of hazardous drinking, smoking, illicit drug use, and prescription drug misuse. These analyses are based on the subsamples of the 2011 and 2013 Tasmanian studies who were administered the supplementary survey. In the ACT dataset, these included measures of hazardous drinking and smoking. Given that optimal cut-offs all produced AUCs classified in the small classification accuracy range (AUCs ranged from 0.48 to 0.69), no further analyses relating to the development of responsible gambling limits for the population using substance use measures were conducted (Table 31).

Table 31. ROC analyses for the Tasmanian and ACT data according to substance use measures^a

Responsible gambling limit		Hazardous drinking	Smoking	Illicit drug use	Prescription drug misuse	Hazardous drinking	Smoking
Dataset		Tasmanian	Tasmanian	Tasmanian	Tasmanian	ACT	ACT
Proportion of population exceeding each definition of harm		48.07% (95% CI 45.45, 50.71)	25.25% (95% CI 23.03, 27.62)	9.78% (95% CI 8.16, 11.68)	8.95% (95% CI 7.56, 10.57)	4.88% (95% CI 3.68, 6.45)	11.13% (95% CI 9.18, 13.43)
Proportion of gamblers exceeding each definition of harm		51.07% (95% CI 48.02, 54.11)	27.98% (95% CI 25.30, 30.84)	11.21% (95% CI 9.18, 16.61)	9.21% (95% CI 7.52, 11.23)	5.46% (95% CI 3.85, 7.69)	12.82% (95% CI 10.13, 16.08)
Gambling frequency per year	Cut off	1620	6	3	3	12	16
	AUC (95% CI)	0.49 (0.46, 0.52)	0.50 (0.47, 0.54)	0.49 (0.43, 0.55)	0.50 (0.44, 0.55)	0.61 (0.55, 0.67)	0.66 (0.56, 0.77)
	sens, spec	0.00, 1.00	0.79, 0.22	0.90, 0.11	0.89, 0.11	0.59, 0.56	0.60, 0.63
	N	2520	2789	2788	2792	1214	1210
Gambling expenditure per year	Cut off	373	237	115	1169	237	296
	AUC (95% CI)	0.53 (0.49, 0.56)	0.54 (0.50, 0.58)	0.54 (0.48, 0.59)	0.50 (0.45, 0.56)	0.63 (0.55, 0.70)	0.69 (0.58, 0.79)
	sens, spec	0.44, 0.6	0.55, 0.5	0.72, 0.34	0.21, 0.8	0.52, 0.66	0.58, 0.7
	N	2392	2650	2648	2652	1156	1152
Gambling expenditure as proportion of gross personal income	Cut off	0.07	0.44	0.28	0.02	0.71	0.69
	AUC (95% CI)	0.50 (0.46, 0.53)	0.56 (0.52, 0.59)	0.55 (0.50, 0.60)	0.48 (0.43, 0.53)	0.59 (0.52, 0.66)	0.63 (0.52, 0.75)
	sens, spec	0.89, 0.11	0.68, 0.41	0.79, 0.31	0.97, 0.03	0.42, 0.73	0.49, 0.71
	N	2206	2433	2431	2435	1014	1011
Number of gambling activities	Cut off	2	2	2	2	2	2
	AUC (95% CI)	0.54 (0.50, 0.57)	0.54 (0.51, 0.58)	0.56 (0.50, 0.61)	0.54 (0.49, 0.59)	0.64 (0.56, 0.72)	0.63 (0.54, 0.72)
	sens, spec	0.58, 0.47	0.59, 0.47	0.61, 0.47	0.60, 0.46	0.54, 0.67	0.54, 0.64
	N	2570	2858	2857	2860	1207	1203

^a Bold typeface indicates AUC ≥ 0.70

Expert and public opinion about the promotion of responsible gambling limits

Project methodology

Sample recruitment

Experts

A mailing list for a target sample of 100 Australian gambling researchers, clinicians, and policy makers was identified using the following sources: (1) contacts of members of the research team; (2) contacts suggested by the Foundation; (3) state and local governments; (4) gambling counselling services (including Gamblers Help, Gamblers Helpline and Gambling Help Online); (4) industry bodies such as the Australasian Gaming Council and Crown Casino; and (5) stakeholder organisations such as the National Association for Gambling Studies.

The survey was conducted online through Qualtrics. Experts on the mailing list were sent personalised emails with a unique link to the survey. Experts who did not complete the survey were sent two personalised follow-up reminders via email, approximately 3 weeks apart. In addition, a snowball sampling method was employed, whereby the personalised email included an anonymous link to the survey for experts to forward on.

From September 2016 to November 2016, 100 Australian gambling experts participated in the survey. A total of 202 experts were invited to participate in this study via a personalised email. Of these, 76 experts completed the survey, indicating a response rate of 37.6%. In addition, 24 experts completed the survey via the anonymous link. The median time the survey link was open was 28.0 minutes.

Public

A brief CATI survey with a random sample of 200 Victorian adults was conducted. This study employed random digit dialling of a frame of landline telephone numbers which allowed the sampling of households with listed and unlisted telephone numbers. Quotas were employed to achieve a sample representative of the Victorian population, based on age, gender and geographic location (see Table 32 below for quotas employed). Pilot testing was conducted with five participants to determine the feasibility of the items and the survey length (M=28.5 minutes). After pilot testing was conducted, the survey was shortened (M=18.2 minutes). There was no provision for multilingual interviewing. Where a household contained two or more residents eligible to participate in the survey, the youngest person in the household was prioritised as younger age groups are more difficult to reach via CATI sampling. The data for this study was collected in September, 2016. A total of 3,705 calls were placed to achieve the completion of 200 surveys. Overall, there were 652 refusals and 11 surveys were terminated during the telephone interview. The overall response rate was 19%.

Table 32. Quotas employed in Victorian public opinion survey

Variable	Percentage of sample
Region	
Metro	75.0
Regional	25.0
Gender	
Male	49.0
Female	51.0
Age	
18-34	31.5
35-49	27.0
50-64	23.0
65+	18.5

Measures

The surveys utilised in the expert and public opinion studies were adapted from the 35-item survey employed by Currie, Hodgins, Wang, El-Guebaly, and Wynne (2008). While the integrity of the Currie, Hodgins, Wang, El-Guebaly, and Wynne (2008) survey was maintained to allow for direct comparisons with the data derived from the Canadian and American experts, some items (e.g., benefits of responsible gambling) were replaced in order to ascertain more detailed opinions on the best ways to promote responsible gambling limits. Due to differences in data collection procedures (see Sample Recruitment section below), the survey administered to the public was necessarily more brief than the expert opinion survey. The content of the expert and public opinion studies are provided in Table 33.

Table 33. The content of the expert and public opinion surveys

Items	Expert survey	Public survey
Demographic/gambling information	Age, gender, primary position in the gambling field (i.e., researcher, clinical, industry, and government), years of experience in the gambling field and highest level of education achieved	Age, gender, annual personal income, highest education level achieved and employment status, gambling symptom severity (PGSI), past year gambling participation (electronic gaming machines, horse or greyhound races, instant scratch tickets, lottery, keno, casino table games, bingo, sports or other event and informal private games)
Perceived importance of responsible gambling limits in preventing gambling-related harm	Single item: 4-point scale ranging from 1 = 'very important' to 4 = 'not at all important'	
The scope of responsible gambling guidelines	7 items: 5-point scale, ranging from 1 = 'strongly disagree' to 5 = 'strongly agree'.	5 items: 5-point scale, ranging from 1 = 'strongly disagree' to 5 = 'strongly agree'.
Suggestions for an appropriate label for responsible gambling limits	Six labels provided: 10-point scale, ranging from 1 = 'not at all comfortable' to 10 = 'very comfortable', with a mid-point of 5 = 'neutral'.	
The face validity of the PGSI-based overall responsible gambling limits	10 point scale, ranging from 1 = 'very conservative (i.e., too low)' to 10 = 'very liberal (i.e., too high)', with a mid-point of 5 = 'just right'.	

The face validity of the responsible gambling limits derived from the alternative gambling-related harm items	10 point scale, ranging from 1 = 'very conservative (i.e., too low)' to 10 = 'very liberal (i.e., too high)', with a mid-point of 5 = 'just right'.	
The face validity of the PGSI-based gambling activity-specific responsible gambling limits	10 point scale, ranging from 1 = 'very conservative (i.e., too low)' to 10 = 'very liberal (i.e., too high)', with a mid-point of 5 = 'just right'. Only participants from the public reporting past-year gambling on specific gambling activities asked these items (e.g., only EGM gamblers were asked about the face validity of the EGM-specific responsible gambling limits).	
The relative importance of each of the responsible gambling limit dimensions of gambling behaviour (i.e., frequency, expenditure, expenditure as a proportion of income and number of gambling activities).	10 point scale, ranging from 1 = 'not at all important' to 10 = 'very important'.	
The importance of the ten qualitative responsible gambling guidelines currently promoted by the Victorian Responsible Gambling Foundation	10 point scale, ranging from 1 = 'not at all important' to 10 = 'very important'.	
The presentation of the likelihood of gambling-related harm risk	3 items: 5-point scale, ranging from 1 = 'strongly disagree' to 5 = 'strongly agree'.	
The appropriate target group/s for responsible gambling limits	9 items: 5-point scale, ranging from 1 = 'strongly disagree' to 5 = 'strongly agree'.	5 items: 5-point scale, ranging from 1 = 'strongly disagree' to 5 = 'strongly agree'.
The location of responsible gambling limit promotion	10 items: 5-point scale, ranging from 1 = 'strongly disagree' to 5 = 'strongly agree'.	11 items: 5-point scale, ranging from 1 = 'strongly disagree' to 5 = 'strongly agree'.
Preference of the four gambling limit dimensions	Ranking of the four dimensions of gambling behaviour in order of importance (1 = 'most important and 4 = 'least important').	
Preferences in the timeframe of the gambling frequency and gambling expenditure responsible gambling limits	Ranking of the three timeframes (yearly, monthly or weekly) in order of comfort, with 1 being 'most comfortable' and 3 being 'least comfortable'.	
Open-ended questions	(i) further recommendations for the promotion of responsible gambling limits; (ii) concerns with promoting responsible gambling limits; (iii) suggestions for addressing these concerns; and (iv) any further comments on these issues.	

Data analytic strategy

Descriptive statistics were used to present the majority of the data. Means and standard deviations were presented for continuous variables and count and percentages for categorical variables. Normality was assessed using the Kolmogorov-Smirnov test for normality across the expert and public datasets. The majority of the continuous variables were not normally distributed. For ease of interpretation, means and standard deviations have been presented in the following chapter, where applicable. Where data was not normally distributed, to examine differences within the expert and public groups, parametric and the equivalent non-parametric tests were conducted. Where no differences in the results were identified, the results of the parametric tests were reported. Where differences in the results were identified, the results of both the parametric and non-parametric were reported.

Based on their respective sample sizes, comparisons were made between three expert groups: research (n = 48), clinical (n = 28), and government (n = 20) stakeholders. Gambling industry representatives (n=4) were not included in the within the expert analyses due to their small sample size. In addition, comparisons were made between three public groups: non-gamblers (n = 62), non-problem gamblers (n = 119), and any-risk gamblers (gamblers who scored one or more on the PGSI; n=19). Differences within the expert and public sample were examined using one-way analysis of variance (ANOVA) and Kruskal-Wallis tests for continuous data and chi-square tests for independence for categorical data. Where differences were identified within the expert or public samples, post hoc comparisons, using Tukey HSD tests, were conducted. In addition, open-ended qualitative data was analysed using thematic analysis.

Results

Demographic characteristics of expert sample

Table 34 displays the demographic characteristics of the Australian gambling experts. Over half were female, and most were aged between 35 and 64 years. Just under half work primarily as researchers in the gambling field. Nearly half had completed a PhD and the average duration working in the gambling field was nearly 10 years.

Table 34. Demographic and gambling-related characteristics of expert sample

Total sample (N=100)	n (%)
Gender	
Male	42 (42.0)
Female	58 (58.0)
Age group	
18-24	2 (2.0)
25-34	17 (17.0)
35-49	39 (39.0)
50-64	34 (34.0)
65+	8 (8.0)
Highest level of education	
PhD	45 (45.0)
Masters degree	23 (23.0)

Medical doctor	1 (1.0)
Bachelor degree	22 (22.0)
Certificate/ diploma in addiction counselling	3 (3.0)
No formal degree/ diploma	1 (1.0)
Other	5 (5.0)
Years working in gambling field M (SD)	9.87 (7.1)
Primary position	
Research	48 (48.0)
Clinical	28 (28.0)
Government	20 (20.0)
Industry	4 (4.0)

Demographic characteristics of public sample

Table 35 displays the socio-demographic and gambling-related characteristics of the Victorian public who participated in the survey. Just over half of the sample was female and most were aged between 25 and 49 years. One-third reported the highest level of education they had achieved was a vocational or trade diploma or certificate. Over one-third (39.5%) were employed full-time, followed by 22.0% who were retired and 20.0% who were employed on a part-time or casual basis. Just over one-quarter of the sample (26.5%) had a personal income ranging from \$40,000 to \$64,999, while an additional 21.5% earned less than \$25,000. The use of quotas ensured that this sample was sex- and age-representative of the Victorian population. Compared to census and other statistical data for the adult Victorian population, this sample was also generally representative in educational qualification, employment level, and personal income (Australian Bureau of Statistics, 2012, 2016).

Of the 200 participants, 69.0% indicated that they had gambled in the previous 12 months, predominantly on lotteries (53.0%), followed by horse or greyhound racing (23.0%) and EGMs (21.0%). Based on PGSI scores, the majority of the sample were classified within the non-problem gambling category (90.5%), 6.5% were classified within the low-risk gambling category, 1.5% were classified within the moderate-risk gambling category, and 1.5% were classified within the problem gambling category. These findings are similar to those identified in the most recent Victorian problem gambling prevalence survey (Hare, et al. 2015), indicating the representativeness of the current sample in terms of gambling participation and problem severity.

Table 35. Demographic and gambling-related characteristics of public sample

Total sample (N=200)	n (%)
Male	
Male	98 (49.0)
Female	102 (51.0)
Age group	
18-24	8 (4.0)
25-34	55 (27.5)
35-49	54 (27.0)
50-64	46 (23.0)
65+	37 (18.5)
Highest level of education	

Postgraduate qualification	46 (23.0)
Higher education / University undergraduate degree	36 (18.0)
Vocational or Trade (e.g. Certificate or diploma)	60 (30.0)
Completed secondary school	30 (15.0)
Completed some secondary school (did not complete year 12)	28 (14.0)
Completed primary school	0 (0.0)
Employment status	
Full-time employment	79 (39.5)
Part-time or casual employment	40 (20.0)
Household duties	10 (5.0)
Full-time student	5 (2.5)
Retired	44 (22.0)
Looking for employment	7 (3.5)
Unable to work / Pension	8 (4.0)
Unpaid voluntary work	1 (0.5)
Other	6 (3.0)
Personal income^a	
Less than \$25,000	43 (21.5)
\$25,000 to \$39,999	22 (11.0)
\$40,000 to \$64,999	53 (26.5)
\$65,000 to \$79,999	25 (12.5)
\$80,000 to \$129,999	23 (11.5)
\$130,000 or more	13 (6.5)
Gambled in the past 12 months	138 (69.0)
PGSI categories	
Non-problem	181 (90.5)
Low-risk	13 (6.5)
Moderate-risk	3 (1.5)
Problem	3 (1.5)
Participation in gambling activities (past 12 months)^b	
EGMs	42 (21.0)
Horse or greyhound races	46 (23.0)
Instant scratch tickets	34 (17.0)
Lottery	106 (53.0)
Keno	11 (5.5)
Casino table games	13 (6.5)
Bingo	8 (4.0)
Sports or other event betting	17 (8.5)
Informal private games	6 (3.0)

^a Based on sample size of 179 due to missing data.

^b Note the percentage does not equate to 100 as participants could indicate as having gambled on multiple gambling activities.

Importance of responsible gambling limits

Participants in the expert and public opinion surveys were asked to indicate how important responsible gambling guidelines are in preventing gambling-related harm (Table 36). The findings indicate that the majority of the expert (93.0%) and public (89.5%) group rated the importance of responsible gambling guidelines in preventing gambling-related harm as very or somewhat important. There were no significant differences between the three expert groups or the three public groups.

Table 36. Importance of responsible gambling guidelines

Importance n (%)	Expert total (n=100)	Researchers (n=48)	Clinicians (n=28)	Government (n=20)	Public total (n=200)	Non- gamblers (n=62)	Non- problem gamblers (n=119)	Any-risk gamblers (n=19)
Very important	59 (59.0)	26 (54.2)	17 (60.7)	14 (70.0)	142 (71.0)	48 (77.4)	81 (68.1)	13 (68.4)
Somewhat important	34 (34.0)	18 (37.5)	10 (35.7)	5 (25.0)	37 (18.5)	11 (17.7)	23 (19.3)	3 (15.8)
Mildly important	4 (4.0)	2 (4.2)	1 (3.6)	0 (0.0)	12 (6.0)	1 (1.6)	8 (6.7)	3 (15.8)
Not all important	3 (3.0)	2 (4.2)	0 (0.0)	1 (5.0)	9 (4.5)	2 (3.2)	7 (5.9)	0 (0.0)

Scope of responsible gambling guidelines

Participants in the expert and public opinion surveys were asked to indicate their opinion on the scope of the responsible gambling guidelines (Table 37). Overall, the majority of the expert group agreed or strongly agreed that: responsible gambling guidelines should target all gamblers regardless of risk level (85.0%); safe levels of gambling are possible (79.0%); responsible gambling guidelines should be available for each type of gambling (77.0%); lottery play should be included in the development of responsible gambling guidelines (68.0%). In contrast, less than half (45.0%) agreed or strongly agreed that low-risk gambling can have benefits for some people compared to no gambling, and only 23.0% agreed or strongly agreed that that responsible gambling guidelines should primarily target high risk gamblers and that separate responsible gambling guidelines should be available for men and women.

In contrast, the majority of the public group agreed or strongly agreed that: responsible gambling guidelines should target all gamblers regardless of risk level (81.5%); responsible gambling guidelines should primarily target high risk gamblers (75.5%); responsible gambling guidelines should be available for each type of gambling (73.0%); and lottery play should be included in the development of responsible gambling guidelines (66.5%). Only 32.5% agreed or strongly agreed that separate responsible gambling guidelines should be available for men and women.

Across the expert groups, a greater proportion of clinicians than researchers and government workers agreed that separate responsible gambling guidelines should be available for men and women ($p < 0.01$). When comparing across the public groups, a greater proportion of non-gamblers than participants in the other risk categories agreed that responsible gambling guidelines should target all gamblers regardless of risk level ($p < 0.05$).

Table 37. Scope of responsible gambling guidelines

	Expert total (n=100)	Researchers (n=48)	Clinicians (n=28)	Government (n=20)	Public total (n=200)	Non- gamblers (n=62)	Non- problem gamblers (n=119)	Any-risk gamblers (n=19)
Responsible gambling guidelines should primarily target high risk gamblers								
Strongly agree or agree	23 (23.0)	9 (18.8)	8 (28.6)	4 (20.0)	151 (75.5)	42 (67.7)	96 (80.7)	13 (68.4)
Neutral	15 (15.0)	11 (22.9)	2 (7.1)	0 (0.0)	19 (9.5)	10 (16.1)	7 (5.9)	2 (10.5)
Strongly disagree or disagree	62 (62.0)	28 (58.3)	18 (64.3)	16 (80.0)	30 (15.0)	10 (16.2)	16 (13.5)	4 (21.0)
Responsible gambling guidelines should target all gamblers regardless of risk level								
Strongly agree or agree	85 (85.0)	40 (83.3)	23 (82.1)	19 (95.0)	163 (81.5)	57 (91.9)	92 (77.3)	14 (73.7)
Neutral	9 (9.0)	5 (10.4)	2 (7.1)	1 (5.0)	20 (10.0)	3 (4.8)	14 (11.8)	3 (15.8)
Strongly disagree or disagree	6 (6.0)	3 (6.3)	3 (10.7)	0 (0.0)	17 (8.0)	2 (3.2)	13 (10.9)	2 (10.6)
Lottery play should be included in the development of responsible gambling guidelines								
Strongly agree or agree	68 (68.0)	31 (64.6)	23 (82.1)	10 (50.0)	134 (67.0)	46 (74.2)	77 (64.5)	11 (57.9)
Neutral	19 (19.0)	12 (25.0)	3 (10.7)	4 (20.0)	35 (17.5)	10 (16.1)	23 (19.3)	2 (10.5)
Strongly disagree or disagree	13 (13.0)	5 (10.4)	2 (7.1)	6 (30.0)	31 (15.5)	6 (9.7)	19 (16.0)	6 (31.6)
The responsible gambling guidelines should be available for each type of gambling (i.e. Separate limits for EGMs, lottery, bingo, casino games, sports betting etc.)								
Strongly agree or agree	77 (77.0)	35 (73.0)	24 (85.7)	15 (75.0)	146 (73.0)	48 (77.4)	86 (72.3)	12 (63.2)
Neutral	11 (11.0)	7 (14.6)	3 (10.7)	1 (5.0)	26 (13.0)	7 (11.3)	13 (10.9)	6 (31.6)
Strongly disagree or disagree	12 (12.0)	6 (12.5)	1 (3.6)	4 (20.0)	28 (14.0)	7 (11.3)	20 (16.8)	1 (5.3)
Separate responsible gambling guidelines should be available for men and women								
Strongly agree or agree	23 (23.0)	6 (12.5)	14 (50.0)	3 (15.0)	65 (32.5)	19 (30.6)	42 (35.3)	4 (21.1)
Neutral	27 (27.0)	16 (33.3)	7 (25.0)	4 (20.0)	22 (11.0)	7 (11.3)	15 (12.6)	0 (0.0)

Strongly disagree or disagree	50 (50.0)	26 (54.1)	7 (25.0)	13 (60.0)	113 (56.5)	36 (58.1)	62 (52.1)	15 (78.9)
Safe levels of gambling are possible								
Strongly agree or agree	79 (79.0)	39 (81.3)	20 (71.4)	17 (85.0)	NA	NA	NA	NA
Neutral	8 (8.0)	5 (10.4)	2 (7.1)	1 (5.0)	NA	NA	NA	NA
Strongly disagree or disagree	13 (13.0)	4 (8.4)	6 (21.4)	2 (10.0)	NA	NA	NA	NA
Low-risk gambling can have benefits for some people compared to non-gambling								
Strongly agree or agree	45 (45.0)	23 (47.9)	8 (28.6)	10 (50.0)	NA	NA	NA	NA
Neutral	33 (33.0)	17 (35.4)	15 (53.6)	1 (5.0)	NA	NA	NA	NA
Strongly disagree or disagree	22 (22.0)	8 (16.7)	5 (17.8)	9 (45.0)	NA	NA	NA	NA

Labelling responsible gambling guidelines

Participants were asked to rate their level of comfort with various labels that could be used to describe the term responsible gambling guidelines (Table 38). In the expert group, the mean rating for the term 'responsible gambling guidelines' ($M=6.00$) was significantly higher than all other labels ($p \leq 0.001$). Similarly, in the public group, the mean rating for the term 'responsible gambling guidelines' ($M=7.30$) was significantly higher than all other labels ($p < 0.001$), with the exception of 'responsible gambling limits' ($M=7.25$).

Although the parametric tests revealed a significant difference between the three expert groups on the label responsible gambling guidelines ($p = 0.041$), with clinicians ($M=7.04$, $SD=2.27$) reporting greater comfort with this label than researchers ($M=5.40$, $SD=2.86$), the results of the non-parametric equivalent indicated that the differences in mean ranks were only approaching significance ($p = 0.054$). No significant differences were identified between the three public groups (non-gamblers; non-problem gamblers; any-risk gamblers) on any of the labels for responsible gambling guidelines.

Table 38. Level of comfort with responsible gambling guidelines labels

Label M (SD)	Expert total (n=100)	Researchers (n=48)	Clinicians (n=28)	Government (n=20)	Public total (n=200)	Non-gamblers (n=62)	Non-problem gamblers (n=119)	Any-risk gamblers (n=19)
Low-risk gambling limits	4.67 (2.47)	4.71 (2.52)	4.25 (2.24)	4.90 (2.22)	6.05 (2.81)	6.66 (2.69)	5.67 (2.89)	6.37 (2.39)
Safe gambling limits	4.54 (3.06)	4.35 (3.04)	3.71 (2.72)	5.65 (3.07)	6.36 (3.03)	6.27 (2.99)	6.53 (3.01)	5.58 (3.29)
Responsible gambling limits	5.14 (2.85)	5.10 (2.90)	5.29 (2.54)	4.40 (3.05)	7.25 (2.61)	6.82 (2.80)	7.45 (2.51)	7.37 (2.52)
Responsible gambling guidelines	6.00 (2.90)	5.40 (2.86)	7.04 (2.27)	5.45 (3.35)	7.30 (2.53)	7.42 (2.15)	7.36 (2.65)	6.53 (2.86)
Moderate gambling limits	3.40 (1.96)	3.40 (2.09)	3.68 (1.95)	2.95 (1.67)	5.51 (2.71)	5.74 (2.90)	5.42 (2.64)	5.32 (2.56)
Low-risk/moderate gambling limits	3.44 (2.15)	3.48 (2.28)	3.71 (1.94)	2.80 (1.88)	5.11 (2.82)	5.60 (3.01)	5.03 (2.70)	4.00 (2.69)

Face validity of responsible gambling limits

As presented in previous chapters, responsible gambling limits were developed based on: (1) endorsement of \geq two PGSI negative consequence items; and (2) alternative gambling-related harm items. Participants were asked to rate their opinion on the face validity of both sets of responsible gambling limits (Table 39).

Overall, the expert ratings of the validity of the PGSI-based responsible gambling guidelines were close to the midpoint (i.e., just right), ranging from a mean of 4.17 for number of gambling activities to a mean of 6.16 for frequency. In contrast, the expert ratings of the validity of the responsible gambling guidelines derived from the alternative gambling-related harm items ranged from the midpoint towards the liberal points of the scale, ranging from a mean of 5.78 for number of gambling activities to a mean of 7.77 for expenditure as a proportion of gross personal income.

Similarly, the public ratings of the validity of the PGSI-based responsible gambling guidelines were close to the midpoint (i.e., just right), ranging from a mean of 4.35 for number of gambling activities to a mean of 6.28 for expenditure and expenditure as a proportion of gross personal income. In contrast, the public ratings of the validity of the responsible gambling guidelines derived from the alternative gambling-related harm items ranged from the midpoint towards the liberal points of the scale, ranging from a mean of 4.94 for number of gambling activities to a mean of 7.64 for expenditure as a proportion of gross personal income.

There were no significant differences between the three expert groups on the ratings for any of the responsible gambling limits. In contrast, there was a significant difference between the three public groups on the alternative gambling-related harm-based frequency limit ($p = 0.019$), the alternative gambling-related harm-based expenditure limit ($p = 0.019$), the PGSI-based number of gambling activities limit ($p = 0.002$), and the alternative gambling-related harm-based number of gambling activities limit ($p = 0.009$). Post-hoc comparisons revealed that non-gamblers ($M=8.16$) reported a higher mean score for the gambling-related harm based frequency limit compared to non-problem gamblers ($M=6.93$); non-gamblers ($M=8.00$) reported a higher mean score for the alternative gambling-related harm based expenditure limit than any-risk gamblers ($M=5.95$); non-gamblers ($M=5.35$) reported a higher mean score for the PGSI-based number of gambling activities limit than non-problem gamblers ($M=3.82$), and non-gamblers reported a higher mean score ($M=5.82$) for the alternative gambling-related harm-based number of gambling activities limit than non-problem gamblers ($M=4.54$). These results suggest that non-gamblers rated these limits as more liberal than the other public groups.

Table 39. Face validity of responsible gambling limits

Responsible gambling limit dimension M (SD)	Expert total (n=100)	Researchers (n=48)	Clinicians (n=28)	Government (n=20)	Public total (n=200)	Non-gamblers (n=62)	Non-problem gamblers (n=119)	Any-risk gamblers (n=19)
PGSI-based limits								
Frequency	6.16 (2.06)	6.19 (1.71)	6.43 (2.22)	6.45 (2.21)	5.96 (2.91)	6.66 (2.93)	5.66 (2.84)	5.58 (3.01)
Expenditure	5.46 (2.10)	5.21 (2.06)	5.64 (2.09)	6.25 (2.02)	6.28 (2.90)	6.58 (2.93)	6.34 (2.84)	4.89 (2.96)
Expenditure as a proportion of gross personal income	5.80 (1.85)	6.08 (1.98)	5.64 (2.02)	5.70 (1.08)	6.28 (2.85)	6.60 (2.57)	6.23 (2.96)	5.58 (2.95)
Number of gambling activities	4.17 (2.07)	4.35 (1.95)	4.14 (2.40)	4.15 (1.90)	4.35 (2.76)	5.35 (2.99)	3.82 (2.43)	4.37 (3.08)
Alternative gambling-related harm limits								
Frequency	7.26 (2.49)	7.27 (2.31)	7.39 (2.70)	7.70 (2.23)	7.32 (2.87)	8.16 (2.63)	6.93 (2.99)	6.95 (2.27)
Expenditure	7.44 (2.42)	7.46 (2.45)	7.29 (2.39)	8.30 (1.69)	7.61 (2.82)	8.00 (2.87)	7.67 (2.70)	5.95 (2.99)
Expenditure as a proportion of gross personal income	7.77 (2.33)	7.69 (2.56)	7.54 (2.38)	8.80 (1.11)	7.64 (2.87)	8.05 (2.84)	7.50 (2.89)	7.19 (2.85)
Number of gambling activities	5.78 (2.32)	5.90 (2.00)	5.93 (2.71)	5.90 (2.10)	4.94 (2.75)	5.82 (2.89)	4.54 (2.56)	4.53 (2.88)

Gambling activity-specific responsible gambling limits

All participants in the expert opinion survey were asked to indicate their opinion on the face validity of gambling activity-specific responsible gambling limits. Participants in the public opinion survey who indicated that they had gambled on the gambling activity in the previous 12 months were asked about the face validity of the corresponding gambling activity limit (Table 40).

Overall, the expert ratings of the gambling activity-specific responsible gambling limits were close to the midpoint of the scale (i.e., just right), ranging from for the horse or greyhound racing expenditure as a proportion of gross personal income limit (M=4.82) to the horse or greyhound racing frequency limit (M=5.79). The public ratings of the gambling activity-specific responsible gambling limits were generally lower, ranging from the keno expenditure limit (M=3.09) to the sports/other event betting expenditure as a proportion of gross personal income limit (M=5.18).

There were no differences between the three gambling expert groups on any of the gambling activity-specific responsible gambling limits. Due to small sample sizes, comparisons between the two public groups (non-problem gamblers, any-risk gamblers) were not conducted.

Table 40. Face validity of gambling activity-specific responsible gambling limits

Responsible gambling limit dimension M (SD)	Expert total (n=100)	Researchers (n=48)	Clinicians (n=28)	Government (n=20)	Public total	Non-gamblers	Non-problem gamblers	Any-risk gamblers
EGMs					n=42		n=32	n=10
Frequency	5.09 (2.07)	5.13 (1.89)	5.32 (2.02)	5.15 (2.59)	4.48 (2.96)	NA	4.69 (3.01)	3.80 (2.82)
Expenditure	5.30 (2.11)	5.06 (1.96)	5.46 (2.20)	6.15 (2.08)	3.98 (2.93)	NA	4.28 (3.09)	3.00 (2.21)
Expenditure as a proportion of gross personal income	5.42 (1.93)	5.54 (1.85)	5.29 (2.21)	5.70 (1.72)	4.81 (3.23)	NA	4.94 (3.29)	4.40 (3.17)
Session expenditure	5.69 (1.89)	5.56 (1.73)	6.04 (2.03)	6.05 (1.64)	4.86 (2.71)	NA	5.06 (2.97)	4.20 (1.55)
Horse or greyhound racing					n=46		n=39	n=7
Frequency	5.79 (1.89)	5.79 (1.76)	6.11 (1.99)	5.85 (1.79)	4.37 (2.59)	NA	4.51 (2.67)	3.57 (1.99)
Expenditure	5.20 (1.88)	5.13 (1.71)	5.54 (2.01)	5.40 (1.93)	4.74 (2.55)	NA	4.77 (2.50)	4.57 (3.05)
Expenditure as a proportion of gross personal income	4.82 (1.81)	4.83 (1.78)	5.25 (1.82)	4.65 (1.66)	4.78 (2.68)	NA	4.77 (2.74)	4.86 (2.55)
Keno					n=11		n=8	n=3
Frequency	5.05 (1.93)	4.92 (1.60)	5.39 (2.04)	5.35 (2.28)	3.73 (3.04)	NA	3.88 (3.44)	3.33 (2.08)
Expenditure	5.08 (1.96)	4.77 (1.85)	5.54 (1.99)	5.65 (1.87)	3.09 (2.88)	NA	3.38 (3.16)	2.33 (2.31)
Expenditure as a proportion of gross personal income	4.95 (1.86)	4.75 (1.67)	5.18 (2.06)	5.65 (1.66)	3.45 (2.42)	NA	3.25 (2.49)	4.00 (2.65)
Sports/other event betting					n=17		n=11	n=6
Frequency	5.40 (2.35)	5.25 (2.12)	5.86 (2.45)	5.75 (2.55)	4.88 (3.31)	NA	5.18 (3.49)	4.33 (3.20)
Expenditure	5.60 (2.16)	5.48 (1.94)	6.00 (2.31)	6.00 (2.10)	4.88 (3.10)	NA	5.18 (3.13)	4.33 (3.27)
Expenditure as a proportion of gross personal income	5.12 (2.00)	5.02 (1.66)	5.46 (2.22)	5.45 (2.21)	5.18 (2.72)	NA	5.27 (2.97)	5.00 (2.45)
Casino table games					n=13		n=8	n=5
Expenditure as a proportion of gross personal income	5.26 (1.88)	5.29 (1.92)	5.64 (1.77)	5.20 (1.67)	4.38 (2.22)	NA	5.38 (2.20)	2.80 (1.10)

Importance of responsible gambling limits

Participants in the expert opinion survey were asked to rate the importance of the four gambling limit indices (Table 41). Expenditure was rated most important by experts ($M=6.86$). This was significantly higher than the ratings for frequency ($p=0.001$) and number of gambling activities ($p<0.001$), but not expenditure as a proportion of gross personal income ($p=0.482$). There were no significant differences across the three expert groups on the importance of any of the gambling limit indices.

Table 41. Importance of responsible gambling limit indices

Responsible gambling limit dimension M (SD)	Expert total (n=100)	Researchers (n=48)	Clinicians (n=28)	Government (n=20)
Frequency	6.20 (2.73)	6.27 (2.66)	6.14 (2.52)	6.75 (3.01)
Expenditure	6.86 (2.58)	7.00 (2.59)	6.93 (2.36)	7.20 (2.46)
Expenditure as a proportion of gross personal income	6.69 (2.55)	6.63 (2.60)	6.86 (2.22)	7.15 (2.78)
Number of gambling activities	5.24 (2.89)	5.19 (2.80)	4.82 (2.71)	6.50 (3.05)

Importance of behavioural responsible gambling guidelines

Participants in the expert opinion survey were also asked to indicate the importance of the behavioural guidelines for responsible gambling that are currently promoted by the Victorian Responsible Gambling Foundation (Table 42). Of the ten behavioural responsible gambling guidelines, the most important guidelines were never chase your losses ($M=8.65$), followed closely by set a money limit in advance ($M=8.61$) and don't think of gambling as a way to make money ($M=8.54$). There were no significant differences across the three expert groups on any of the importance of behavioural responsible gambling guidelines. Interestingly, all the behavioural responsible gambling guidelines were rated as more important than the quantitative responsible gambling limits.

Table 42. Importance of behavioural responsible gambling guidelines

Behavioural responsible gambling guideline M (SD)	Expert total (n=100)	Researchers (n=48)	Clinicians (n=28)	Government (n=20)
Don't think of gambling as a way to make money	8.54 (1.90)	8.44 (1.89)	8.75 (1.67)	8.20 (2.33)
Only gamble with money you can afford to lose	8.08 (2.34)	8.21 (2.11)	7.96 (2.47)	7.60 (2.82)
Set a money limit in advance	8.61 (1.83)	8.81 (1.70)	8.75 (1.62)	8.05 (2.26)
Set a time limit in advance	7.25 (2.55)	7.02 (2.50)	7.93 (2.37)	7.10 (2.43)
Never chase your losses	8.65 (2.09)	8.29 (2.26)	9.11 (1.69)	8.60 (2.23)
Don't gamble when you're depressed or upset	8.15 (2.35)	8.02 (2.40)	8.93 (1.49)	7.80 (2.44)
Balance gambling with other activities	7.98 (2.33)	7.73 (2.46)	8.32 (2.16)	8.00 (2.22)
Don't take your ATM card with you	7.52 (2.56)	7.54 (2.58)	8.00 (2.48)	7.00 (2.25)
Take frequent breaks	7.46 (2.47)	7.25 (2.51)	7.75 (2.38)	7.70 (2.20)
Don't drink or use drugs when gambling	7.81 (2.40)	7.60 (2.39)	8.46 (1.99)	7.60 (2.50)

Promotion of responsible gambling limits

Presentation of likelihood of gambling-related harm risk

In the expert opinion survey, participants were asked to rate their level of agreement on how responsible gambling limits should be presented (Table 43). Approximately half of participants agreed or strongly agreed that the 'promotion of responsible gambling guidelines should generally indicate that not everyone who exceeds the limit are experiencing gambling-related harm' (43.0%) or that the 'promotion of responsible gambling guidelines should specifically indicate that approximately 1 in 10 people in the general population who exceed the limits are experiencing gambling-related harm' (46.0%). In contrast, the majority of experts (89.0%) agreed or strongly agreed that the 'promotion of responsible gambling guidelines should indicate that you are up to seven times more likely to experience gambling-related harm if you exceed the limits'. There were no significant differences between the three gambling expert groups on any of presentation of responsible gambling limit items.

Table 43. Promotion of responsible gambling limits

	Expert total (n=100)	Researchers (n=48)	Clinicians (n=28)	Government (n=20)
Promotion of responsible gambling guidelines should generally indicate that not everyone who exceeds the limit are experiencing gambling-related harm				
Strongly agree or agree	44 (44.0)	23 (47.9)	9 (32.1)	8 (40.0)
Neutral	23 (23.0)	9 (18.8)	11 (39.3)	3 (15.0)
Strongly disagree or disagree	33 (33.0)	16 (33.3)	8 (28.6)	9 (45.0)
Promotion of responsible gambling guidelines should specifically indicate that approximately 1 in 10 people in the general population who exceed the limits are experiencing gambling-related harm				
Strongly agree or agree	46 (46.0)	21 (43.8)	12 (42.9)	11 (55.0)
Neutral	20 (20.0)	10 (20.8)	9 (32.1)	1 (5.0)
Strongly disagree or disagree	34 (34.0)	17 (35.4)	7 (25.0)	8 (40.0)
Promotion of responsible gambling guidelines should indicate that you are up to seven times more likely to experience gambling-related harm if you exceed the limits				
Strongly agree or agree	89 (89.0)	44 (89.0)	27 (96.5)	17 (85.0)
Neutral	8 (8.0)	3 (6.3)	1 (3.6)	3 (15.0)
Strongly disagree or disagree	3 (3.0)	1 (2.1)	0 (0.0)	0 (0.0)

The target population for the promotion of responsible gambling limits

Participants in the expert and public opinion surveys were asked to indicate their opinion on to whom responsible gambling limits should be promoted (Table 44). The majority of participants in the expert and public groups agreed or strongly agreed that responsible gambling limits should be promoted to: the general population (expert: 89.0%; public: 85.5%); gamblers (expert: 94.0%; public: 88.5%); gamblers experiencing mild gambling problems (expert: 93.0%; public: 90.5%); gamblers experiencing moderate gambling problems (expert: 93.0%; public: 89.0%); gamblers experiencing severe gambling problems (expert: 87.0%; public: 93.5%). In addition, the majority of participants in the expert group agreed or strongly agreed that responsible gambling limits should be promoted to: the family and friends of gamblers (92.0%); the family and friends of gamblers experiencing gambling problems (91.0%); clinicians involved in the counselling of gamblers (89.0%); and clinicians involved in the counselling of the family members and friends (89.0%).

No significant differences were identified across the expert groups on any of the promotion items. In contrast, a significantly smaller proportion of any-risk gamblers than non-gamblers and non-problem gamblers agreeing to the items: relating to promotion of guidelines to 'gamblers experiencing moderate gambling problems' ($p < 0.001$) and 'gamblers experiencing severe gambling problems' ($p = 0.011$).

Table 44. Target populations for the promotion of responsible gambling limits

Who	Expert total (n=100)	Researchers (n=48)	Clinicians (n=28)	Government (n=20)	Public total (n=200)	Non-gamblers (n=62)	Non-problem gamblers (n=119)	Any-risk gamblers (n=19)
The general population								
Strongly agree or agree	89 (89.0)	42 (87.5)	26 (93.5)	18 (90.0)	171 (85.5)	57 (92.0)	100 (84.0)	14 (73.7)
Neutral	9 (9.0)	6 (12.5)	2 (7.1)	0 (0.0)	20 (10.0)	5 (8.1)	12 (10.1)	3 (15.8)
Strongly disagree or disagree	2 (2.0)	0 (0.0)	0 (0.0)	2 (10.0)	9 (4.5)	0 (0.0)	7 (5.9)	2 (10.5)
Gamblers								
Strongly agree or agree	94 (94.0)	45 (93.8)	27 (96.4)	19 (95.0)	177 (88.5)	57 (92.0)	106 (89.0)	14 (73.7)
Neutral	5 (5.0)	3 (6.3)	1 (3.6)	0 (0.0)	14 (7.0)	5 (8.1)	6 (5.0)	3 (15.8)
Strongly disagree or disagree	1 (1.0)	0 (0.0)	0 (0.0)	1 (5.0)	9 (4.5)	0 (0.0)	7 (5.9)	2 (10.6)
Gamblers experiencing mild gambling problems								
Strongly agree or agree	93 (93.0)	44 (91.7)	27 (96.5)	19 (95.0)	181 (90.5)	59 (95.1)	107 (89.9)	15 (79.0)
Neutral	7 (7.0)	4 (8.3)	1 (3.6)	1 (5.0)	15 (7.5)	3 (4.8)	9 (7.6)	3 (15.8)
Strongly disagree or disagree	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (2.0)	0 (0.0)	3 (2.5)	1 (5.3)
Gamblers experiencing moderate gambling problems								
Strongly agree or agree	93 (93.0)	45 (93.8)	27 (96.4)	18 (90.0)	178 (89.0)	59 (95.2)	107 (89.9)	12 (63.2)
Neutral	6 (6.0)	3 (6.3)	1 (3.6)	2 (10.0)	15 (7.5)	3 (4.8)	7 (5.9)	5 (26.3)
Strongly disagree or disagree	1 (1.0)	0 (0.0)	0 (0.0)	0 (0.0)	7 (3.5)	0 (0.0)	5 (4.2)	2 (10.5)
Gamblers experiencing severe gambling problems								
Strongly agree or agree	87 (87.0)	44 (91.7)	24 (85.7)	16 (80.0)	187 (93.5)	61 (98.4)	111 (93.3)	15 (79.0)
Neutral	7 (7.0)	2 (4.2)	1 (3.6)	3 (15.0)	4 (2.0)	0 (0.0)	3 (2.5)	1 (5.3)

Strongly disagree or disagree	6 (6.0)	2 (4.2)	3 (10.7)	1 (5.0)	9 (4.5)	1 (1.6)	5 (4.2)	3 (15.8)
The family and friends of gamblers								
Strongly agree or agree	92 (92.0)	43 (89.6)	27 (96.5)	19 (95.0)	NA	NA	NA	NA
Neutral	7 (7.0)	5 (10.4)	1 (3.6)	0 (0.0)	NA	NA	NA	NA
Strongly disagree or disagree	1 (1.0)	0 (0.0)	0 (0.0)	1 (5.0)	NA	NA	NA	NA
The family and friends of gamblers experiencing gambling problems								
Strongly agree or agree	91 (91.0)	43 (89.6)	27 (96.4)	18 (90.0)	NA	NA	NA	NA
Neutral	9 (9.0)	5 (10.4)	1 (3.6)	2 (10.0)	NA	NA	NA	NA
Strongly disagree or disagree	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	NA	NA	NA	NA
Clinicians involved in the counselling of gamblers								
Strongly agree or agree	89 (89.0)	44 (91.7)	24 (85.7)	18 (90.0)	NA	NA	NA	NA
Neutral	11 (11.0)	4 (8.3)	4 (14.3)	2 (10.0)	NA	NA	NA	NA
Strongly disagree or disagree	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	NA	NA	NA	NA
Clinicians involved in the counselling of the family members and friends								
Strongly agree or agree	89 (89.0)	46 (95.9)	24 (85.7)	16 (80.0)	NA	NA	NA	NA
Neutral	11 (11.0)	2 (4.2)	4 (14.3)	4 (20.0)	NA	NA	NA	NA
Strongly disagree or disagree	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	NA	NA	NA	NA

Location of responsible gambling limit promotion

Participants in the expert and public opinion surveys were asked to indicate their opinion on how responsible gambling limits should be promoted (Table 45). Overall, the majority of participants in the expert and public groups agreed or strongly agreed that responsible gambling limits should be promoted through: gambling related websites (expert: 95.0%; public: 92.5%); gambling venues (expert: 94.0%; public: 93.5%); gambling counselling services (expert: 94.0%; public: 92.0%); broad media and education campaigns (expert: 91.0%; public: 88.0%); other community clinics (expert: 90.0%; public: 84.5%); social media (expert: 83.0%; public: 78.5%); GP clinics (expert: 87.0%; public: 68.5%); general websites (expert: 66.0%; public: 71.0%); schools and universities (expert: NA; public: 71.0%); on digital screens (expert: 62.0%, public: 64.0%); and at promotional events (expert: 53.0%, public: 61.5%).

No significant differences were identified across the expert groups on any of the items relating to how and where responsible gambling guidelines should be promoted. In contrast, a significantly smaller proportion of any-risk gamblers agreed that responsible gambling limits should be promoted at promotional events than non-gamblers and non-problem gamblers ($p = 0.039$).

Table 45. Location of responsible gambling limit promotion

	Expert total (n=100)	Researchers (n=48)	Clinicians (n=28)	Government (n=20)	Public total (n=200)	Non- gamblers (n=62)	Non- problem gamblers (n=119)	Any-risk gamblers (n=19)
Broad media and education campaigns								
Strongly agree or agree	91 (91.0)	44 (91.7)	25 (89.3)	18 (90.0)	176 (88.0)	57 (91.9)	103 (86.6)	16 (84.2)
Neutral	7 (7.0)	4 (8.3)	2 (7.1)	1 (5.0)	14 (7.0)	2 (3.2)	10 (8.4)	2 (10.5)
Strongly disagree or disagree	2 (2.0)	0 (0.0)	1 (3.6)	1 (5.0)	10 (5.0)	3 (4.8)	6 (5.1)	1 (5.3)
General websites (i.e. non gambling-related websites)								
Strongly agree or agree	66 (66.0)	27 (56.3)	22 (78.6)	15 (75.0)	142 (71.0)	47 (75.8)	84 (70.6)	11 (57.9)
Neutral	29 (29.0)	17 (35.4)	6 (21.4)	5 (25.0)	38 (19.0)	11 (17.7)	22 (18.5)	5 (26.3)
Strongly disagree or disagree	5 (5.0)	4 (8.3)	0 (0.0)	0 (0.0)	20 (10.0)	4 (6.4)	13 (10.9)	3 (15.8)
Social media (e.g. facebook, twitter)								
Strongly agree or agree	83 (83.0)	39 (78.6)	23 (82.1)	19 (95.0)	157 (78.5)	50 (80.7)	93 (78.2)	14 (73.7)
Neutral	13 (13.0)	6 (12.5)	5 (17.9)	1 (5.0)	31 (15.5)	9 (14.5)	20 (16.8)	2 (10.5)
Strongly disagree or disagree	4 (4.0)	3 (6.3)	0 (0.0)	0 (0.0)	12 (6.0)	3 (4.7)	6 (5.0)	3 (15.8)
At promotional events (e.g. music festivals)								
Strongly agree or agree	53 (53.0)	23 (47.9)	17 (60.7)	12 (60.0)	123 (61.5)	43 (69.4)	73 (61.3)	7 (36.8)
Neutral	36 (36.0)	20 (41.7)	9 (32.1)	5 (25.0)	36 (18.0)	11 (17.7)	20 (16.8)	5 (26.3)
Strongly disagree or disagree	11 (11.0)	5 (10.4)	2 (7.1)	3 (15.0)	41 (20.5)	8 (13.0)	26 (21.8)	7 (36.8)
Digital screens (e.g. at petrol stations)								
Strongly agree or agree	62 (62.0)	27 (56.2)	19 (67.9)	14 (70.0)	128 (64.0)	46 (74.2)	73 (61.4)	9 (47.3)
Neutral	27 (27.0)	16 (33.3)	8 (28.6)	2 (10.0)	32 (16.0)	9 (14.5)	21 (17.6)	2 (10.5)
Strongly disagree or disagree	11 (11.0)	5 (10.4)	1 (3.6)	4 (20.0)	40 (20.0)	7 (11.3)	25 (21.0)	8 (42.1)
In GP clinics								
Strongly agree or agree	57 (57.0)	41 (85.4)	25 (89.3)	17 (85.0)	137 (68.5)	41 (66.1)	83 (69.7)	13 (68.5)
Neutral	13 (13.0)	7 (14.6)	3 (10.7)	3 (15.0)	31 (15.5)	12 (19.4)	18 (15.1)	1 (5.3)
Strongly disagree or disagree	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	32 (16.0)	9 (14.6)	18 (15.1)	5 (26.3)

In other community clinics (e.g. mental health or alcohol or other drug)								
Strongly agree or agree	90 (90.0)	43 (89.6)	24 (85.7)	19 (95.0)	169 (84.5)	52 (83.9)	98 (82.3)	19 (100.0)
Neutral	9 (9.0)	5 (10.4)	3 (10.7)	1 (5.0)	14 (7.0)	6 (9.7)	8 (6.7)	0 (0.0)
Strongly disagree or disagree	1 (1.0)	0 (0.0)	1 (3.6)	0 (0.0)	17 (8.0)	4 (6.4)	13 (10.9)	0 (0.0)
In gambling counselling services								
Strongly agree or agree	94 (94.0)	43 (89.6)	23 (82.2)	18 (90.0)	184 (92.0)	57 (92.0)	109 (91.6)	18 (94.8)
Neutral	4 (4.0)	4 (8.3)	5 (17.9)	1 (5.0)	8 (4.0)	3 (4.8)	4 (3.4)	1 (5.3)
Strongly disagree or disagree	2 (2.0)	1 (2.1)	0 (0.0)	1 (5.0)	8 (4.0)	2 (3.2)	6 (5.0)	0 (0.0)
In gambling venues								
Strongly agree or agree	94 (94.0)	45 (93.8)	26 (92.8)	20 (100.0)	187 (93.5)	58 (93.5)	112 (94.1)	17 (89.5)
Neutral	4 (4.0)	2 (4.2)	2 (7.1)	0 (0.0)	6 (3.0)	1 (1.6)	4 (3.4)	1 (5.3)
Strongly disagree or disagree	2 (2.0)	1 (2.1)	0 (0.0)	0 (0.0)	7 (3.5)	3 (4.8)	3 (2.5)	1 (5.3)
On gambling related websites								
Strongly agree or agree	95 (95.0)	45 (93.8)	26 (92.9)	20 (100.0)	185 (92.5)	58 (93.5)	109 (91.6)	18 (94.8)
Strongly disagree or disagree	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	9 (4.0)	3 (4.8)	5 (4.2)	1 (5.3)
Schools and universities ^a								
Strongly agree or agree	NA	NA	NA	NA	142 (71.0)	46 (74.2)	83 (69.8)	13 (68.4)
Neutral	NA	NA	NA	NA	28 (14.0)	10 (16.1)	17 (14.3)	1 (5.3)
Strongly disagree or disagree	NA	NA	NA	NA	26 (13.0)	6 (9.7)	15 (12.6)	5 (26.3)

^aBased on n=196

Selection of a responsible gambling limit for promotion and timeframes preferences

Several responsible gambling limits across multiple dimensions of gambling behaviour have been presented throughout this report. It may not, however, be practical or possible to promote all of these dimensions. As such, the expert and public opinion surveys included an item in which participants ranked in order of importance each gambling limit (Table 46). In regards to the first preference for the limit type, the proportion of responses in the expert group were as follows: expenditure (35.0%), expenditure as a proportion of income (32.0%); frequency (27.0%); and number of gambling activities (6.0%). In contrast, the proportion of responses in the public group were as follows: expenditure as a proportion of income (40.5%); expenditure (26.0%), frequency (26.0%); and number of gambling activities (7.5%). No significant differences were identified within the expert or public groups.

Throughout this report, the responsible gambling limits have been presented in a yearly timeframe. However, the frequency and expenditure limits could also be presented in a monthly or weekly timeframe. As such, participants were asked to indicate their preferred timeframe for the presentation and dissemination of the frequency and expenditure limits. In relation to the frequency limit, the proportion of responses in the expert group were as follows: weekly (50.0%); monthly (45.0%); and yearly (5.0%). The proportion of responses in the public group were as follows: weekly (44.0%); monthly (38.5%); and yearly (17.5%). No significant differences were identified within each of the expert or public groups. In relation to the expenditure limit, the proportion of responses in the expert group were as follows: monthly (48.0%); weekly (39.0%); and yearly (13.0%). In contrast, the proportion of responses in the public group were as follows: weekly (52.5%); yearly (27.0%); and monthly (20.5%). No significant differences were identified within each of the expert or public groups.

Table 46. Gambling limit dimensions and timeframe preferences

	Expert total (n=100)	Researchers (n=48)	Clinicians (n=28)	Government (n=20)	Public total (n=200)	Non- gamblers (n=62)	Non- problem gamblers (n=119)	Any-risk gamblers (n=19)
First preference of gambling limit dimension, n (%)								
Frequency	27 (27.0)	16 (33.3)	5 (17.9)	6 (30.0)	52 (26.0)	18 (29.0)	32 (26.9)	2 (10.5)
Expenditure	35 (35.0)	21 (43.8)	8 (28.6)	5 (25.0)	52 (26.0)	12 (19.4)	31 (26.1)	9 (47.4)
Expenditure as a proportion of income	32 (32.0)	8 (16.7)	14 (50.0)	7 (35.0)	81 (40.5)	27 (43.5)	48 (40.3)	6 (31.6)
Number of activities	6 (6.0)	3 (6.3)	1 (3.6)	2 (10.0)	15 (7.5)	5 (8.1)	8 (6.7)	2 (10.5)
First preference for frequency limit timeframe, n (%)								
Yearly	5 (5.0)	2 (4.2)	2 (7.1)	0 (0.0)	35 (17.5)	13 (21.0)	20 (16.8)	2 (10.5)
Monthly	45 (45.0)	25 (52.1)	11 (39.3)	7 (35.0)	77 (38.5)	25 (40.3)	47 (39.5)	5 (26.3)
Weekly	50 (50.0)	21 (43.8)	15 (53.6)	13 (65.0)	88 (44.0)	24 (38.7)	52 (43.7)	12 (63.2)
First preference for expenditure limit timeframe, n (%)								
Yearly	13 (13.0)	8 (16.7)	3 (10.7)	0 (0.0)	54 (27.0)	18 (29.0)	30 (25.2)	6 (31.6)
Monthly	48 (48.0)	24 (50.0)	11 (39.3)	12 (60.0)	41 (20.5)	8 (12.9)	27 (22.7)	6 (31.6)
Weekly	39 (39.0)	16 (33.3)	14 (50.0)	8 (40.0)	105 (52.5)	36 (58.1)	62 (52.1)	7 (36.8)

Open-ended items

Expert

Participants in the expert opinion survey were asked several open-ended items. The majority of participants (75%) provided comments to at least one of the open-ended questions: (1) 'Do you have any suggestions for the way these responsible gambling limits should be promoted in the general population?' (2) 'Do you have concerns about promoting responsible gambling limits?' (3) 'Do you have suggestions for addressing these concerns?' and (4) 'Do you have any other comments regarding responsible gambling limits?' The responses across these items were combined for the purpose of this analysis as there was substantial overlap across items.

Suggestions for promoting responsible gambling limits

In relation to suggestions for promoting responsible gambling limits key themes that emerged were:

Population-level approach to the promotion of responsible gambling limits (16% of comments).

Promotion to the general population, through a broad and consistent message was thought to be the most effective way of promoting responsible gambling limits.

...I think it needs to be generalised, in context of overall populations and demographics - a way that everyone will get the same message regardless of income, time available, social number of activities... (Clinician, Female)

Although I like the breakdown of limits by gambling preference I think this is hard to disseminate to the public...' (Government, Male)

I think there needs to be a focus on the general population... (Industry, Male)

I think that sticking to one limit across the board will be easier and clearer for people to understand... (Researcher, Male)

Targeted promotion of responsible gambling limits. In contrast, several participants (6% of comments) indicated that the promotion of responsible gambling limits should be targeted to at-risk populations, specifically, young people (i.e., university students and school children) and problem gamblers.

Emphasis needs to be on gamblers in terms of who you are targeting, as a general message may have wrong effect... (Government, Male)

I do really like the idea of quant guidelines, and applaud the effort. But also think that blanket limits for everyone won't necessarily work because people have different circumstances. (Researcher, Male)

How to promote. Several participants further expressed their opinions on how responsible gambling guidelines should be promoted. The most frequent promotion strategy was through advertising on TV and radio (13%), followed by awareness and education campaigns (11%), on public transport (5%), in venues (e.g. TAB slips, EGMs; 5%), gambling advertisements (3%), and social media (3%). Additionally, several participants suggested that responsible gambling limits should be promoted in a similar way to responsible drinking and healthy eating guidelines to assist with understanding the message (3%).

The guidelines should look similar to responsible eating and drinking health promotion information so the general public are not overwhelmed with details but broad meaningful and simple guidelines. (Researcher, Female)

Broad media campaigns (TV/Radio/Bus/Billboard advertisements) seem to be an effective way of getting such a message across to the community en masse - which seems appropriate for these types of guidelines. (Researcher, Female)

Expenditure as proportion of income as preferred limit. Interestingly, several participants (8% of comments) reiterated that expenditure as a proportion of income was their preferred limit type, as it takes into account individual difference in income.

These are very subjective and what seems like 'a lot' to one person may seem not much to someone else. This is why % of income is the most appropriate way to do this. (Government, Male)

'...Percentage of income' limits are much better than dollar amounts... (Clinician, Male)

Weekly limits as preferred timeframe. Participants (8%) also reiterated their preferred timeframe for the responsible gambling limits. Of these, the majority indicated (5%) indicate that the weekly timeframe was best for promoting to the public as it was immediate, easy to calculate and less abstract than a monthly or yearly timeframe. However, one participant expressed their concern with a weekly timeframe, stating that it implies that weekly gambling is the norm.

Using week by week guidelines is appropriate for a clinical context and when working or targeting young people. Guidelines per year are not as tangible or as easy to keep track of from a self monitoring point of view. (Researcher, Female)

More immediate time frames are easier to conceptualise, and would make it easier for people to understand in relation to them. (Researcher, Female)

I think a yearly figure of visits of money or sessions is too abstract. People can remember if they've already "gambled twice this week" - but a year long, or even a month is too long to remember across. (Researcher, Male)

Concerns for promoting responsible gambling limits

Several participants also noted concerns with the promotion of responsible gambling limits. The most common concerns included:

Labels used indicate safe levels of gambling that may promote gambling behaviour (25% of comments). Participants expressed concern that terms, such as, 'responsible gambling limits' and 'safe gambling limits' are indicative that safe levels of gambling are possible. Moreover, participants were concerned that the implication of 'safe levels' may increase gambling behaviour for some individuals.

Only that when promoting limits that gamblers, especially those in the risky category, will consider credible you may be promoting limits that are actually prompting other gamblers and non-gamblers to think these are limits they should gamble up to, ie have unintended consequence of upping the gambling norm. Difficult to get around but need to be mindful of. (Government, Male)

'Quantitative responsible gambling limits' might give a wrong and un-intended message to the public that people gambling within the limits are 'absolutely' safe, or people who never gambles should not worry anything and should start trying within the limits. (Clinician, Male)

Yes, if too high, then these can become like a speed-limit: people will spend up to the limit because it has been considered 'safe', even when they can't afford it. (Researcher, Male)

The public will ignore the responsible gambling limit (16% of comments): Participants raised concerns relating to the impact of the responsible gambling limits on the public. They noted that the public may dismiss them as they are conservative. Several participants also expressed concerns that these responsible gambling limits will have no impact on those at-risk of, or currently experiencing gambling problems, as these individuals do not always acknowledge having problems and are able to dissociate.

Given that the PGSI limits are relatively conservative, I think many problem gamblers may dismiss them as too low. (Researcher, Female)

People at risk can't recognise they are at risk and so often seem immune to me to any warnings. (Clinician, Male)

Caveats required when promoting responsible gambling limits (15% of comments). A common theme identified throughout the responses was that the wording used to promote these limits had to be carefully considered, ensuring a clear message so the public does not misinterpret the limits. Several participants indicated that caveats were required, such as, 'not everyone who exceeds these limits will experience harm', 'increased risk of harm', and that statements, such as, 'don't gamble more than...' should be avoided. Some participants also indicated that the responsible gambling limits should be promoted in conjunction with the behavioural guidelines.

I think it is all about the message of the risk spectrum. Some behaviours are more risky than others. But just because you gamble more than the upper limits does not mean you have a problem, but you are likely to be at great risk of developing one! (Government, Male)

Any promotion around these guidelines needs to make it abundantly clear that you are more likely to experience gambling-related harm if you go over these limits, and it is also important to explain what is meant by harm. (Researcher, Female)

One final thought relates to ensuring the consequences of exceeding the limits are concrete and easily understood eg you are 7 times more likely to experience gambling related-harm helps to quantify the extent of potential personal impact or harm. (Researcher, Female)

Responsible gambling puts onus on individual (8% of comments). Participants also conveyed concern with the term 'responsible gambling' as it perpetuates the notion that gambling responsibly is the responsibility of the individual gambler, without attributing any, or enough, of the responsibility to the industry or government.

The responsibility of responsible gambling should never be only on the gambler's shoulder, it also be the responsibility of all gaming industries (Clinician, Male)

No this is a very difficult area and there are shifts between a regulatory model putting the onus on the gambling operator and between putting some onus on the person participating in the activity. (Government, Female)

We need to get the balance right re personal responsibility and the reality that games are designed to be addictive. Need to make sure these messages don't create a situation where individual idleness gamblers feel like a failure without understanding what is going on structurally. (Government, Female)

The responsible gambling limits reinforce the neo-liberalism aspects in responsible gambling, emphasising on individual's effort. Governments and industry should take the responsibility

themselves in providing a responsible gambling environment for the community. (Government, Female)

For people with a problem, often there isn't a safe limit. I worry about "responsible" too - are you irresponsible if you don't stick to the limits - it puts it all on the person without acknowledging the addictive nature of gambling products. (Researcher, Male)

'This process continues the individuation of gambling as a personal responsibility.'
(Researcher, Male)

Gender-specific limits should not be used. Concerns were raised (7% of comments) about the gender-specific limits, indicating that they would be too confusing for the public and that they should not be promoted.

I am worried about separating out male and female gambling limits - I don't really understand why they should be different, to be frank. I also think in communicating different thresholds for males and females it will muddy the water when promoting this. (Researcher, Male)

In relation to gender differences, I think it would be confusing to the public to promote different limits for male or female. (Researcher, Male)

Gambling activity-specific limits should be promoted. Around 7% of comments indicated that separate gambling-activity specific limits should be promoted. These participants indicated that responsible gambling limits cannot be generalised across all forms of gambling.

I think they should be specific to each gambling form if possible. (Industry, Female)

Generic limits that are supposed to cover all forms of gambling is problematic (e.g. gambling on lotto once a week unlikely to be problem; even sports betting once a week may not be an issue if you bet on specific, planned games with limits). (Researcher, Male)

I think separating types of gambling is critical for communicating useful clear messages. How often you visit and how much you spend makes sense for pokies but much less sense for online sports betting. (Government, Female)

Difficulty with expenditure as proportion of income limit (8% of comments). Several participants expressed concern with the expenditure as a proportion of income limit being too difficult to understand and calculate, indicating that most people do not think in these terms.

I believe that promoting information to the community needs to be done in a realistic way (common sense) e.g. more than three coffees per week spent at the pokies is too many, rather than % of income as most "clients" don't think in terms of the percentage of their income. (Clinician, Female)

Many people do not think in annual or percentage of income terms. (Government, Male)

While % income is a reasonable guideline for people to work out their gambling spend, not everyone would want to work this out. (Researcher, Female)

Individual differences are not taken in to account (13% of comments). A recurring theme in this data was that the responsible gambling limits do not take into account individual differences. Most participants stated that finances and income need to be taken in to consideration when promoting

responsible gambling limits. For example, expenditure may have different consequences depending on an individual's income.

Quantitative measures do not take into consideration the complexity of problem gambling behaviours. (Clinician, Female)

These are very subjective and what seems like 'a lot' to one person may seem not much to someone else. (Government, Male)

'Overall I think the inherent problem with putting specific figures like 'betting no more than 600 per year' is that for some people this is a very large figure and for others its quite small. Using a measure like this may lead someone in a low income bracket who loses 600 dollars to believe they don't have a problem. But the level of harm they experience will be much higher than someone with a higher level of disposable income who loses the same amount.' (Government, Female)

Suggestions for dealing with concerns raised about responsible gambling limits

Suggestions for dealing with the concern relating to individual differences varied. Some participants indicated that the expenditure limits should be framed in terms of losses, that different limits should be posed for different incomes, or that limits should be calculated based on disposable income. Interestingly, several participants also noted that intensity of a gambling session (i.e., expenditure within a session) is an important limit that could be helpful in identifying gambling-related harm.

Perhaps an equation that one can input one's own individual stats and so set a personal limit within context of this is the amount I can afford to lose in my entertainment. (Clinician, Female)

Setting \$ limit is flawed as every case is different. We don't know how much any individual person can afford to spend on gambling. The limit needs to be a % of nett available income after all living expenses, financial commitments and repayment of debt has been met. (Industry, Female)

As you know, people differ in the amount of money they can lose before they experience problems. A caveat is needed to state that individual circumstances will change these limits. (Researcher, Female)

I mention this as its an important point in that part of an education program about safe gambling should be gambling intensity not just money or frequency of sessions, in fact this may be the most important factor in setting safe guidelines. (Government, Male)

Other suggestions for addressing some of the aforementioned concerns raised by participants included:

Proper testing of message prior and after release (5% of comments). It was suggested that testing of the marketing strategy and messaging is required prior to and after public dissemination, especially with individuals in high-risk demographic categories.

Messaging needs to be thoroughly tested, both before being promoted and after being promoted. (Clinician, Male)

Conduct a consultative process with representatives from high risk age groups and demographics. (Researcher, Female)

Market research to see how they are received and interpreted by the target audience and research to assess their impact on the behaviour of at risk and problem gamblers.

(Researcher, Male)

Shared 'responsibility' on individual, industry and government. When asked to provide suggestions for concerns proposed, several participants indicated that more needs to be done to balance the responsibility of 'responsible gambling' between the individual, industry and government (11% of comments).

Shift the focus to what industry and governments can do instead of individuals. (Government, Female)

Finally, when asked if participants had any other comments in relation to responsible gambling limits, one common theme emerged:

Benefits of responsible gambling limits. Approximately, 16% of comments expressed positive thoughts and benefits relating to the responsible gambling limits developed. Some indicated that these limits were a good starting point and that they could be helpful in reducing gambling-related harm.

They are very helpful because they provide a concrete indicator to gamblers and their family and friends. (Researcher, Female)

I think the guidelines can be an effective way to reduce gambling harm. (Researcher, Female)

It's a good extension to the conversation and adds another element to harm reduction. (Clinician, Female)

They provide a means for individuals to better measure and regulate their gambling. (Researcher, Male)

Conclusions

The primary aim of this program of research was to identify a set of empirically based responsible gambling limits that can be used to inform the development of responsible gambling guidelines for promotion to the Australian public. Secondary aims of this research were to: (1) Identify and evaluate responsible gambling limits for specific sub-groups of the population (i.e., gender- and age-specific responsible gambling limits); (2) Identify and evaluate responsible gambling limits for specific gambling activities; (3) Identify responsible gambling limits for the population using alternative measures of gambling-related harm, such as alternative gambling-related harm items, quality of life, mental health, and substance use; and (4) Canvas expert and public opinion about the promotion of responsible gambling limits. In the following section, we provide: a summary of the main findings in the context of the available literature relating to the identification of responsible gambling limits; the implications of the findings; the limitations of the study; and the final concluding comments from the project.

Responsible gambling limits for the population using the PGSI definitions of gambling-related harm

Risk (dose-response) curves

Although the majority of experts (79%) agreed that safe levels of gambling are possible, less than half (45%) agreed that low-risk gambling can have benefits for some people compared to non-gamblers. The dose-response relationships for the Tasmania and ACT data across multiple gambling indices and multiple definitions of harm using the PGSI were generally J-shaped when employing the Currie et al. (2017; 2006; 2008) methodology, indicating that the chances of experiencing gambling-related harm remained constant at low levels of each of the gambling indices then increased sharply when a certain threshold of gambling behaviour was reached, but were generally r-shaped when employing the Markham et al. (2016) methodology, indicating that there is a level of risk associated with even low levels on the gambling indices.

In a number of ways, the Markham et al. (2016) methodology has greater strengths than the Currie and colleagues (2006; 2008) approach. In particular, whilst Currie and colleagues (2017; 2006; 2008) utilised relatively arbitrary ordinal categories of gambling behaviour, Markham et al. (2016) utilised all available information about the level of gambling behaviour by using a continuous measure. This approach also allowed visualisation using a locally weighted regression coupled with bootstrapping that reduces the influences of outlying observations. Moreover, as noted by Markham et al. (2016), the J-shaped curves in the Currie approach may be an artefact of there being unequal spacing between earlier ordinal points on the x-axis (i.e., more categories devoted to low levels of gambling behaviour) than later ordinal points on the x-axis (higher levels of gambling behaviour are collapsed into bigger categories). This can give the illusion of a J-curve, but may not be J-shaped when the x-axis is equidistance between points of measurement. Given the statistical robustness of the Markham et al. (2016) approach, our data suggest that even low levels of gambling behaviour is associated with harm; and that this harm increases rapidly with even small increases in gambling consumption.

While risk curves provide an interesting representation of the dose-response relationship between gambling behaviour and gambling-related harm, they themselves are not employed to identify optimal cut-offs of gambling behaviour involving increased risk of harm. They may, however, imply that responsible gambling limits may be made on the basis of the amount of absolute risk that can be tolerated (Markham et al., 2016).

Proposed responsible gambling limits for the population

Responsible gambling limits for the Tasmania and ACT data identified by exploring the optimal cut-offs in ROC analyses were generally robust to variations in definitions of harm and were generally consistent across both datasets (with the exception of the definition of harm based on the PGSI problem gambling cut-off). It is interesting to note that this definition of harm is the equivalent of an absolute risk of 1 in 100 gamblers, which was the threshold of harm set for the alcohol low-risk limits. It is evident from the findings of this study that the limits become considerably less conservative based on this level of absolute risk: a gambling frequency of 25-48 times per year, a gambling expenditure of \$816 to \$1204 per year, a gambling expenditure comprising 2.31 to 4.22% of an individual's gross personal income, and 2 to 3 gambling activities. Despite good classification accuracy indices, it is desirable for responsible gambling limits to be targeted at a larger segment of the population than problem gamblers (Currie et al., 2006; Currie et al., 2009). Excluding this definition, the responsible gambling limits across the various definitions of harm ranged from a gambling frequency of 17 to 38 times per year, a gambling expenditure of \$275 to \$745 per year, a gambling expenditure comprising 0.61 to 1.96% of an individual's gross personal income, and 2 to 3 gambling activities.

The definition of harm based on two or more of the seven negative consequence PGSI items was selected as the definition of harm to be employed in this study as it produced superior ROC parameters (sensitivity, specificity, and AUCs). This definition of gambling-related harm has also displayed superiority over other harm definitions in previous research (Currie et al., 2006; Currie et al., 2009). This finding suggests that individuals endorsing gambling-related problems in two different areas can be reasonably viewed as experiencing gambling-related harm (Currie et al., 2006). In the current study, this definition also captured a relatively high proportion of individuals (1.9-2.3%) and gamblers (3.5-3.7%) in the general population, although these prevalence estimates are lower than those identified in North American general-population samples (4.2 to 6% of general population: (Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008). Using this definition, the proposed responsible gambling limits for the Australian population are estimated to be a gambling frequency of 20 to 30 times per year, a gambling expenditure of \$380 to \$615 per year, a gambling expenditure comprising 0.83% to 1.68% of an individual's gross personal income, and 2 gambling activities (Table 47). The proposed responsible gambling limits using this definition (Table 47) are generally at the lower end of the range identified in the previous Canadian studies (Currie et al., 2017; Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008; Currie et al., 2009). Experts and the public in the current study thought these proposed limits were just right (i.e., neither too liberal nor too conservative). In this study, similar responsible gambling limits were identified across both the Tasmanian and ACT databases, although the ACT limits were consistently slightly more conservative than the Tasmanian limits. Given the differences between the ACT and Tasmania, particularly in relation to their socio-demographic profiles, the similar pattern of results found across independently conducted state/territory surveys enhance the generalisability of the identified responsible gambling limits to other states of Australia, such as Victoria.

Table 47. Summary of proposed responsible gambling limits

RESPONSIBLE GAMBLING LIMITS FOR THE POPULATION	
<ul style="list-style-type: none"> • a gambling frequency of 20 to 30 times per year • a gambling expenditure of \$380 to \$615 per year • a gambling expenditure comprising 0.83% to 1.68% of gross personal income • 2 gambling activities 	
RESPONSIBLE GAMBLING LIMITS FOR EGM GAMBLING	RESPONSIBLE GAMBLING LIMITS FOR HORSE/DOG RACE GAMBLING
<ul style="list-style-type: none"> • an EGM gambling frequency of 10 times per year • an EGM gambling expenditure of \$300 per year • an EGM gambling expenditure comprising 0.63% to 1.04% of gross personal income • an EGM session gambling expenditure of \$35 • an EGM session duration of 40 minutes 	<ul style="list-style-type: none"> • a horse/dog race gambling expenditure comprising 0.55% of gross personal income
RESPONSIBLE GAMBLING LIMITS FOR INSTANT SCRATCH TICKET GAMBLING	RESPONSIBLE GAMBLING LIMITS FOR LOTTERY GAMBLING
<ul style="list-style-type: none"> • an instant scratch ticket gambling expenditure of \$45 per year 	<ul style="list-style-type: none"> • a lottery gambling expenditure comprising 0.45% of an individual's gross personal income
RESPONSIBLE GAMBLING LIMITS FOR KENO GAMBLING	RESPONSIBLE GAMBLING LIMITS FOR CASINO TABLE GAMBLING
<ul style="list-style-type: none"> • a keno gambling frequency of 4 to 13 times per year • a keno gambling expenditure of \$45 to \$160 per year 	<ul style="list-style-type: none"> • a casino table game gambling expenditure of \$345 per year • a casino table game gambling expenditure comprising 0.36% to 0.76% of an individual's gross personal income
RESPONSIBLE GAMBLING LIMITS FOR BINGO GAMBLING	RESPONSIBLE GAMBLING LIMITS FOR SPORT/OTHER EVENT GAMBLING
<ul style="list-style-type: none"> • a bingo gambling expenditure of \$150 per year • bingo gambling expenditure comprising 0.49% of an individual's gross personal income • a bingo session duration of 90 minutes • bingo session expenditure of \$17 	<ul style="list-style-type: none"> • a sports/other event betting gambling frequency of 14 times per year • a sports/other event betting gambling expenditure of \$400 per year • a sports/other event gambling expenditure comprising 0.55% to 0.86% of gross personal income

Cross-sectional and longitudinal evaluation of the proposed responsible gambling limits

The validity of the proposed responsible gambling limits is also confirmed by findings that exceeding all of the proposed responsible gambling limits cross-sectionally predicted gambling-related harm across both datasets and all were independent cross-sectional predictors of gambling-related harm after controlling for the other proposed responsible gambling limits in at least one dataset, with the exception of gambling frequency. These findings replicate those identified in previous research (Brosowski et al., 2015; Currie et al., 2011; Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008). Moreover, the number of responsible gambling limits exceeded significantly cross-sectionally predicted gambling-related harm. The limits were, however, less predictive of subsequent gambling-related harm in longitudinal analyses. The limits relating to gambling frequency and gambling expenditure (gambling expenditure and gambling expenditure as a proportion of gross personal income) significantly longitudinally predicted gambling-related harm in at least one wave. However, only exceeding the gambling expenditure limit (from wave 1 to wave 2 only) and the gambling frequency limit (from wave 1 to wave 3 only) independently predicted subsequent gambling-related harm after controlling for the other proposed responsible gambling. None of the other proposed responsible gambling limits were significant longitudinal independent predictors of gambling-related harm. The number of responsible gambling limits exceeded in wave 1, however, significantly predicted subsequent gambling-related harm in both waves 2 and 3 of the longitudinal gambling study. These findings suggest that the limits identified in this study were less able to predict the *future* development of gambling-related harm.

Excluding lottery only gamblers

Although lottery gambling is generally viewed as a safe activity because of the small gambling expenditures and delay between bet placement and outcome (Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008), over two-thirds of experts and the public (67-68%) agreed that lottery play should be included in the development of responsible gambling guidelines. ROC analyses excluding people who *only* played lottery derived consistently less acceptable optimal responsible gambling limits compared to those that included lottery only gamblers. This is in contrast to the study conducted by Currie, Hodgins, Wang, El-Guebaly, Wynne, et al. (2008), who found that excluding lottery only gamblers increased the highest accuracy of prediction for gambling frequency. The limits excluding lottery only gamblers are only slightly higher (1.0 to 1.5 times higher) than those derived from analyses including all gamblers, presumably because they exclude lottery only gamblers who likely engage in relatively low levels of gambling behaviour. Previous research has also found that excluding lottery only gamblers results in very similar responsible gambling limits (Currie et al., 2006). These findings suggest that the inclusion of gamblers who only gamble on the lottery in the analyses does not skew the responsible gambling cut-offs. These findings, in combination with the stakeholder opinions, imply that lottery play should be included in the development of responsible gambling limits; and that the development of responsible gambling limits for each type of gambling activity may be more helpful.

The relative and absolute risk associated with exceeding the proposed responsible gambling limits

The relative risk calculations indicated that exceeding the proposed responsible gambling limits confers a high degree of risk for gambling-related harm. The risk ratio calculations revealed that gamblers who exceeded the proposed responsible gambling limits were 3.4 to 20.2 times more likely than gamblers who stayed within the limits to experience gambling-related harm. Gamblers can use this information to determine their level of risk of experiencing gambling-related harm based on their gambling frequency, expenditure, expenditure as a proportion of income, and number of gambling

activities. For example, a gambler who estimates gambling losses of approximately \$3000 per year is 11 times more likely to experience gambling-related harm than people who gamble less than \$3000 per year. This information can therefore be used in the promotion of the limits to gamblers so that they can estimate their individual level of risk of experiencing gambling-related harm. Interestingly, the relative risk ratio data presented in this study suggests that gambling behaviour lower than the proposed responsible gambling limits identified in this study also confer a considerable degree of risk. Consistent with the risk curves identified using the Markham et al. (2016) methodology, these findings again raise questions regarding to the degree to which there is any level of gambling behaviour that is not associated with harm.

Another important consideration when considering the utility of the proposed responsible gambling limits is the absolute risk associated with exceeding the limits (i.e., the number of people experiencing an event in relation to the population at risk). The replication of the linear and r-shaped curves using the Markham et al. (2016) approach suggests that limits may be adopted on the basis of tolerable levels of absolute risk (Markham et al., 2016). Across the two datasets, the absolute risk calculations revealed that, gamblers who exceeded the proposed responsible gambling limits had a 4.7-17.1% risk of experiencing gambling-related harm. Moreover, the degree of absolute risk incrementally increased as each responsible gambling limit increased. The estimates provided in this report allow for the selection of responsible gambling limits depending on the level of absolute risk that can be tolerated.

Consideration of the base prevalence rate of gambling-related harm

Another way for gamblers to estimate their individual level of risk of experiencing gambling-related harm is to promote the guidelines with caveats relating to the positive predictive value associated with the limit (i.e., the proportion of people exceeding the proposed responsible gambling limits who are actually experiencing gambling-related harm). Not all gamblers exceeding the proposed responsible gambling limits experience gambling-related harm. Based on the prevalence of two or more negative gambling consequences in the population, between 7% and 12% of gamblers in the population will actually be experiencing gambling-related harm; and approximately 99% of gamblers who stay within the limits will not be experiencing gambling-related harm. These low positive predictive values, which are not unique to gambling, may be explained by the fact that there are many measurable and unmeasurable factors that could lead to gamblers experiencing harm independent of consumption level, such as psychiatric comorbidity, recent job loss, premorbid relationship discord, and predisposition to stress. Alternatively, the PGSI, which is a very brief measure, is not intended as a measure of gambling harm and likely does not capture all possible gambling-related harms. The use of a comprehensive measure of gambling-related harms, such as the harms checklist developed by Browne et al. (2016) may therefore be warranted in future research attempting to identify responsible gambling limits in population-representative studies.

Although these findings suggest that gamblers who stay within the limits are very likely to not be at risk for gambling-related harm, caution is advised in promoting the limits to gamblers within the general population as only a small proportion of them will actually be experiencing gambling-related harm. For example, 11.5% of Tasmanian gamblers who exceeded the gambling expenditure responsible gambling limit of \$615 per year will actually be experiencing two or more negative gambling consequences. An appropriate strategy for promoting the proposed responsible gambling limits may therefore to pose the question to these gamblers: “Approximately 1 in 10 gamblers who spend more than \$615 in a year will experience gambling-related harm. Is this you?”. This strategy would reduce defensiveness in gamblers who exceed the limits and allow them to reflect on the extent to which their gambling behaviour impacts on their lives.

These limits can, however, identify a higher proportion of people exceeding the responsible gambling limits who are actually experiencing gambling-related harm in higher prevalence populations and

settings, such as EGM venue employees (23-34%), mental health services (53-66%), online support services (98-99%), and online self-directed programs (100%). Settings in which there is likely a high proportion of people experiencing gambling-related harm, such as gambling venues, mental health services, general practitioner (GP) offices, and gambling counselling services are therefore appropriate settings in which to promote responsible gambling limits.

Maximising specificity and sensitivity

ROC analyses, which attempt to identify a threshold of gambling behaviour at which harm is most likely to occur, necessarily involve a trade-off between sensitivity and specificity. In the absence of a conceptual rationale for maximising sensitivity or specificity, previous research and the current study employed an approach that attempts to balance sensitivity and specificity. In the current study, this was achieved using the Youden index. The application of the Youden index in the general population, however, produced a very high proportion of false positives (i.e., only 7-12% of gamblers who exceeded the proposed responsible gambling limits actually experienced gambling-related harm). Although screening tests generally favour high sensitivity, Currie et al. (2009) has expressed concerns that a high false positive rate may diminish the credibility of responsible gambling limits in the eyes of the public. These high rates of false positives have recently also been identified in the most recent study by Currie et al. (2017), in their attempted identification of low-risk gambling limits from longitudinal datasets. The identification of high rates of false positives in these studies may provide a rationalisation for prioritising specificity in future research attempting to identify optimal responsible gambling limits.

We therefore repeated the ROC analyses with specificity maximised by reducing the sensitivity to 0.50. This analysis resulted in responsible gambling limits that were approximately two to four times the proposed responsible gambling limits identified using the Youden index. Higher limits were also identified by Currie et al. (2017) who also gave more weight to specificity (specificity was held at 0.70 or higher) to reduce the unacceptably high number of false positives. Although Currie et al. (2017) identify a range of reasons for the higher limits from their longitudinal datasets, this modification to the statistical criteria for establishing the optimal cut-off is likely primarily responsible for these increased limits. In our study, the limits after maximising specificity were estimated to be: a gambling frequency of 49 to 65 times per year; a gambling expenditure of \$1,380 to \$2,306 per year; a gambling expenditure comprising 3.03% to 6.19% of an individual's gross personal income; and 2 to 3 gambling activities. These estimates provide an indication of the *most extreme* upper estimates for each of the responsible gambling limits. Compared to the proposed responsible gambling limits balancing sensitivity and specificity, these limits result in a higher proportion of gamblers who exceed the limits actually experiencing gambling-related harm (7-21%). The proportion of gamblers who remain within the limits who do not experience gambling-related harm identified using these responsible gambling limits was similar. These findings suggest that increasing the responsible gambling limits to those identified after increasing specificity would identify a larger proportion of gamblers exceeding the limits who are actually experiencing gambling-related harm; without considerably impacting on the identification of gamblers who stay within the limits and do not experience gambling-related harm. These most extreme upper limit estimates may therefore be selected, depending on the target population, the setting in which the responsible gambling limits are employed, the purpose of applying the proposed responsible gambling limits, and the amount of tolerable risk (Markham et al., 2016; Weinstock et al., 2007).

Due to participant burden, the public and expert opinion surveys were limited to certain key items relating to the promotion of responsible gambling limits. Consequently, the face validity of the responsible gambling limits derived from maximising specificity was not explored. However, both experts and public both rated the validity of similarly high responsible gambling limits derived from the

Tasmanian set of alternative gambling-related harm items. Interestingly, both stakeholder groups rated the validity of these responsible gambling limits towards the liberal (i.e., too high) end of the scale.

We also analysed the effect of maximising sensitivity by reducing specificity to a minimum of 0.50 to provide an indication of the most extreme lower estimates for each of the responsible gambling limits. This analysis resulted in responsible gambling limits that were approximately one-third to one-half of the proposed responsible gambling limits identified using the Youden index. Compared to the proposed responsible gambling limits balancing sensitivity and specificity, these limits result in an even lower proportion of gamblers who exceed the limits actually experiencing gambling-related harm (6-7%). The proportion of gamblers who remain within the limits who do not experience gambling-related harm identified using these responsible gambling limits was similar. The findings suggest that decreasing the responsible gambling limits to those identified after maximising sensitivity would identify a smaller proportion of gamblers exceeding the limits who are actually experiencing gambling-related harm; without considerably impacting on the identification of gamblers who stay within the limits and do not experience gambling-related harm.

Responsible gambling limits for population subgroups using the PGSI definitions of gambling-related harm

There were no significant interaction effects of either gender or age with the responsible gambling limits to predict gambling-related harm. These findings suggest that each limit predicts gambling-related harm equally for men and women and across age categories. This is consistent with previous literature that suggests that the dose-response relationship between gambling behaviour and gambling-related harm is similar for men and women (Currie et al., 2017; Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008). Moreover, few experts (23%) and members of the public (33%) agreed that separate responsible gambling guidelines should be available for men and women. Taken together, these findings indicate that the calculation of gender- and age-specific limits appears unwarranted.

Gambling activity-specific responsible gambling limits using the PGSI definition of gambling-related harm

It has been argued that responsible gambling limits for each type of gambling activity may be helpful, but that this may reduce their practical value (Currie et al., 2006). In the current study, three-quarters of experts and the public (73-77%) agreed that responsible gambling guidelines should be available for each type of gambling. Using the selected definition of harm, only a selection of the responsible gambling limits were acceptable across gambling activities (see Table 24). These analyses are limited by the absence of game-specific PGSI questions and the reduced sample sizes for analysing each game separately. Interestingly, however, experts within the general public generally rated the gambling activity-specific responsible gambling limits as just right (i.e., not too liberal nor too conservative). There was, however, a tendency for gamblers on a particular gambling activity to rate particular gambling activity-specific responsible gambling limits as more conservative than experts. Between 24 and 36% of EGM gamblers, 36% of horse/dog race gamblers, 37% of instant scratch tickets gamblers, 29% of lottery gamblers, 23 to 43% of keno gamblers, 22 to 33% of casino table gamblers, 20 to 56% of bingo gamblers, and 14 to 33% of sports/other event bettors exceeded these limits.

Exceeding the proposed gambling activity-specific responsible gambling limits were generally good predictors of gambling-related harm. Exceeding each of the proposed EGM, instant scratch ticket,

lottery, casino table games, keno, and sports/other event-betting-specific responsible gambling limits significantly predicted gambling-related harm; while exceeding the proposed horse/dog racing and bingo-specific responsible gambling limits failed to predict gambling-related harm. There was little consistency in exceeding the proposed gambling activity-specific responsible gambling limits as independent predictors of gambling-related harm after controlling for the other proposed responsible gambling limits and socio-demographic characteristics.

An attempt was made to identify which of the proposed responsible gambling limits relating to specific gambling activities contributed most to gambling-related harm. Before and after controlling for the other proposed gambling activity-specific responsible gambling limits, the proposed EGM-specific limits were generally the strongest and most consistent predictors of gambling-related harm. Exceeding the proposed limits for casino table gambling and sports/other event betting were also strong significant predictors of gambling-related harm across limit types. These analyses confirmed that exceeding the proposed EGM responsible gambling limits contributed most to gambling-related harm (Dowling et al., 2005).

Responsible gambling limits for the population using alternative measures of gambling-related harm

Previous research has relied exclusively on measures of problem gambling severity, such as the PGSI and the SOGS, to derive responsible gambling limits. This is a limitation in comparison to the alcohol literature, which has employed a range of harms to the drinker, including chronic disease from volume of drinking over time, injury from specific drinking occasions, and total mortality, hazardous behaviours, and delinquent behaviours (National Health and Medical Research Council, 2009; Rehm et al., 2008; Room & Rehm, 2012). We therefore attempted to extend the previous gambling research by expanding the definition of gambling-related harm from just these measures to other measures of harm, including an alternative set of gambling-related harm items and measures that do not attribute functioning to gambling, such as quality of life, mental health, and substance use measures.

The alternative set of gambling-related harm items produced relatively consistent and less conservative responsible gambling limits across the four gambling indices. Extreme caution, however, is required in their interpretation. These items did not produce consistently acceptable responsible gambling limits, possibly due to the smaller samples employed in these analyses or the use of a dichotomous response options for each item. These items also captured fewer respondents in the population experiencing harm than the selected definition of harm using the PGSI, suggesting that these items are measuring more severe or extreme harms. Moreover, the items were different across the Tasmanian and ACT datasets and do not comprise validated instruments with interpretable scoring procedures. Finally, experts and the public rated the validity of these responsible gambling limits towards the liberal (i.e., too high) end of the scale. Taken together, these findings suggest that it likely premature to base responsible gambling guidelines on these limits. They highlight the need to subject validated measures of harms attributable to gambling other than the PGSI or the SOGS to ROC analyses to derive responsible gambling limits. Despite the call for the change of focus for population studies to also evaluate the degree of harm, rather than just problems, measures that specifically measure gambling-related harm are under-developed; although Browne, Goodwin, and Rockloff (2017) has recently developed and validated a new brief instrument, the Short Gambling Harms Scale, for use as a population-level measure of past year gambling-related harm. This scale was developed from a much more comprehensive harms checklist (Browne et al., 2016). Similarly, Bagby, Quilty, and Watson (2012) developed the CPGI-Population Harm, a 10-item scale from a pool of CPGI items to assess the impact of gambling problems at the population level (e.g., family, community, and other environmental levels such as work).

An attempt was also made to identify responsible gambling limits by exploring the optimal cut-offs in ROC analyses using multiple definitions of harm based on measures of quality of life (physical health, psychological health, social relationships and environment), mental health (depression, generalised anxiety, panic symptoms, post-traumatic stress disorder, generalised social anxiety, attention-deficit hyperactivity disorder, and psychological distress), and substance use (hazardous drinking, smoking, illicit drug use, and prescription drug misuse). These analyses failed to produce any acceptable responsible gambling limits. These findings suggest that instruments assessing harms that are not directly attributed to gambling behaviour fail to produce acceptable responsible gambling limits. It is likely that these measures of harm are not sufficiently sensitive or associated with gambling harms to produce any useable results. It is therefore recommended that future research attempting to identify responsible gambling limits from measures other than the PGSI and SOGS focus on specific measures of harm that can be attributed to excessive gambling behaviour, such as the Short Gambling Harms Scale (Browne et al., 2017), gambling harms checklist (Browne et al., 2016), or the CPGI-Population Harm (Bagby et al., 2012).

The promotion of responsible gambling limits

Although it is beyond the scope of this project to translate the proposed responsible gambling limits to responsible gambling guidelines that can be promoted to the Australian public, we have attempted to inform this translation, primarily through studies canvassing expert and public opinion about the promotion of responsible gambling limits.

Importance of responsible gambling limits

Almost all stakeholders (90-93%) indicated that responsible gambling guidelines are important in preventing gambling-related harm. Interestingly, however, behavioural responsible gambling guidelines were rated as more important than each of the proposed responsible gambling limits identified in this study. Of the ten behavioural responsible gambling guidelines listed on the Victorian Responsible Gambling Foundation's website, the most important were never chasing your losses, setting a money limit in advance, and not thinking of gambling as a way to make money. The higher ratings by the public and expert groups for the behavioural responsible gambling guidelines are not unexpected, given their likely greater familiarity with these types of guidelines via their promotion in public health messaging. Moreover, these guidelines are largely based on common sense; for example, it is hard not to agree with a message to not chase gambling losses. In contrast, the proposed quantitative limits are likely a newer concept to stakeholders, who may not yet be certain about their possible impact on consumer behaviour. These findings suggest that stakeholders will need to be informed about the purpose of responsible gambling limits and the ways in which they can be employed to prevent harm.

Labelling responsible gambling guidelines

Responsible gambling guidelines was the term preferred by both experts and the public, followed by *responsible gambling limits*. *Low-risk gambling limits* and *safe gambling limits* were the next most preferred terms. These are interesting findings given the current level of debate about the term responsible gambling in perpetuating the notion of individual responsibility, without attributing responsibility to the industry or government. In the alcohol field, there has been a shift in terminology from responsible drinking guidelines to low-risk drinking guidelines due to the influence of the public health model and an increased focus on the epidemiological study of risks (Room & Rehm, 2012). Moreover, the term limits should be employed in preference to the term guidelines given that scientific evidence relating to the identification of the level of gambling behaviour at which low-risk behaviour is distinguished from high-risk behaviour is in its early stages.

The target population and audience for the promotion of responsible gambling limits

Between 26 and 60% of gamblers exceeded the proposed responsible gambling limits; these prevalence estimates are considerably higher than those identified in North American samples (11-32%). This group of people comprise the target audience for the promotion of the proposed responsible gambling limits in order to identify gamblers who are at risk for meeting the selected definition of harm. The profiles of gamblers who exceeded each of the limits were generally consistent and encompassed a broad range of characteristics, such as older age, male gender, participation on most gambling activities, classification within any of the PGSI risk categories, hazardous drinking, and smoking; higher levels of education and higher gross personal incomes appear to be somewhat protective for exceeding the proposed responsible gambling limits. Smoking, however, generally failed to remain a significant predictor of exceeding the limits after accounting for other characteristics. This group of gamblers will ultimately be the recipients of the promotion of the proposed responsible gambling limits.

It is, however, the characteristics of the 3.5 to 3.7% of gamblers experiencing gambling-related harm that are important when targeting the promotion of responsible gambling guidelines. These gamblers were most likely to be moderate risk gamblers, with smaller proportions of problem gamblers and low risk gamblers. These findings suggest that the target population of gamblers experiencing harm related to their gambling are not restricted to the highest end of the problem gambling severity continuum. Moreover, the profiles of gamblers experiencing gambling-related harm suggest that the target population for the promotion of the proposed responsible gambling guidelines are EGM and sports/other event betting gamblers. There were also some other characteristics, such as lower age, participation in some gambling activities (horse/dog races, instant scratch tickets, keno, and casino table games), and some psychological characteristics (hazardous drinking, smoking, psychological distress and general health) that were significantly associated with gambling-related harm, but their associations were attenuated after accounting for other characteristics.

It is evident that a much broader range of variables significantly predict exceeding each of the proposed responsible gambling limits than those that significantly predict experiencing gambling-related harm. This is, of course, to be expected given the much higher proportion of the gambling population who exceed each of the limits relative to those who report gambling-related harm. While there was little consistency in the demographic variables predicting both gambling-related harm and exceeding each of the proposed limits, the two groups have EGM and sports/other event gambling participation and low risk to problem gambling classification in common.

The majority of stakeholders (82-85%) agreed that responsible gambling guidelines should target all gamblers regardless of risk level, with higher rates of endorsement for non-gamblers than non-problem and at-risk gamblers. Fewer experts (23%) than members of the public (76%) agreed that responsible gambling guidelines should primarily target high risk gamblers. The majority of experts and the public agreed that responsible gambling limits should be promoted to the general population and gamblers across the continuum of problem gambling severity. In addition, the majority of experts agreed that responsible gambling limits should be promoted to the family and friends of gamblers, the family and friends of gamblers experiencing gambling problems, clinicians involved in the counselling of gamblers, and clinicians involved in the counselling of the family members and friends. It is therefore evident that most stakeholders think that responsible gambling guidelines should be promoted to the general population and a range of at-risk populations.

The selection of a responsible gambling limit for promotion

This study identified and evaluated responsible gambling guidelines across multiple dimensions of gambling behaviour. Given it is likely impractical to promote multiple gambling guidelines, information about the evaluation of each of the responsible gambling limits has been provided to inform the selection of one or more of the limits. A summary of the evaluation of each of the proposed responsible gambling limits is provided in Table 48.

Over one-third (35-39%) of gamblers exceeded the gambling frequency limit. Of those gamblers who exceeded this limit, 62 to 76% also exceeded the gambling expenditure limit, 66 to 72% also exceeded the gambling expenditure as a proportion of gross personal income limit, and 71 to 76% also exceeded the number of gambling activities limit. Of those gamblers who exceeded the gambling frequency limit, 9 to 12% exceeded only that limit, with the remainder exceeding one other limit (19-27%), two other limits (24-26%), or all four limits (25-35%). The cross-sectional evaluation of this limit revealed that exceeding this limit was significantly associated with gambling-related harm in both datasets; but failed to independently predict gambling-related harm in either dataset after controlling for the other proposed responsible gambling limits. The longitudinal evaluation of this limit revealed that exceeding this limit significantly predicted gambling-related harm in both waves; and significantly predicted gambling-related harm from wave 1 to wave 3 after controlling for the other proposed responsible gambling limits. Gamblers who exceeded this limit were 3 to 6 times more likely than gamblers who did not exceed this limit to experience gambling-related harm; and had a 5-12% risk of experiencing gambling-related harm. Approximately 8% of gamblers who exceeded this limit actually experienced gambling-related harm; and 98 to 99% of gamblers who stayed within this limit did not experience gambling-related harm. It was rated as the third most important responsible gambling limit by experts; and rated as the most important limit by over one-quarter of experts (27%) and the public (26%).

Approximately one-quarter (26-28%) of gamblers exceeded the gambling expenditure limit. Of those gamblers who exceeded this limit, 62 to 76% also exceeded the gambling frequency limit, 82 to 85% also exceeded the gambling expenditure as a proportion of gross personal income limit, and 81% also exceeded the number of gambling activities limit. Of those gamblers who exceeded the gambling expenditure limit, only 1% exceeded only that limit, with the remainder exceeding one other limit (9%), two other limits (30-34%), or all four limits (57-60%). The cross-sectional evaluation of this limit revealed that exceeding this limit was significantly associated with gambling-related harm in both datasets; and independently associated with gambling-related harm after controlling for the other proposed responsible gambling limits in both datasets. The longitudinal evaluation of this limit revealed that exceeding this limit significantly predicted gambling-related harm from wave 1 to wave 2; and that it significantly independently predicted gambling-related harm after controlling for the other proposed responsible gambling limits, but only in wave 2. Gamblers who exceeded this limit were 7 to 11 times more likely than gamblers who did not exceed this limit to experience gambling-related harm; and had a 7-15% risk of experiencing gambling-related harm. Between 10 and 12% of gamblers who exceeded this limit actually experienced gambling-related harm; and 99% of gamblers who stayed within this limit did not experience gambling-related harm. It was rated as the most important responsible gambling limit by experts; and rated as the most important limit by one-third of experts (35%) and one-quarter of the public (26%).

Approximately one-quarter (27-28%) of gamblers exceeded the gambling expenditure as a proportion of gross personal income limit. Of those gamblers who exceeded this limit, 66 to 72% also exceeded the gambling frequency limit, 82 to 85% also exceeded the gambling expenditure limit, and 75 to 82% also exceeded the number of gambling activities limit. Of those gamblers who exceeded the gambling as a proportion of gross personal income limit, only 2 to 4% exceeded only that limit, with the remainder exceeding one other limit (6-15%), two other limits (22-26%), or all four limits (56-71%). The

cross-sectional evaluation of this limit revealed that exceeding this limit was significantly associated with gambling-related harm in both datasets, while the longitudinal evaluation revealed that exceeding this limit significantly predicted gambling-related harm in both subsequent waves. Due to its multicollinearity with the gambling expenditure limit, this limit was not evaluated as an independent cross-sectional or longitudinal predictor of gambling-related harm after controlling for the other proposed responsible gambling limits. Gamblers who exceeded this limit were 8 to 20 times more likely than gamblers who did not exceed this limit to experience gambling-related harm; and had a 7 to 17% risk of experiencing gambling-related harm. Ten to eleven percent of gamblers who exceeded this limit actually experienced gambling-related harm; and 99% of gamblers who stayed within this limit did not experience gambling-related harm. It was rated as the second most important responsible gambling limit by experts; and rated as the most important by one-third of experts (32%) and over one-third of the public (41%).

Over one-half (50-60%) of gamblers exceeded the number of gambling activities limit. Of those gamblers who exceeded the number of gambling activities limit, 71 to 76% also exceeded the gambling frequency limit, 81% also exceeded the gambling expenditure limit, and 75 to 82% also exceeded the gambling expenditure as a proportion of gross personal income limit. Of those gamblers who exceeded the number of gambling activities limit, a significant proportion exceeded only that limit (25-40%), with the remainder exceeding one other limit (16-18%), two other limits (15-16%), or all four limits (27-43%). The cross-sectional evaluation of this limit revealed that exceeding this limit was significantly associated with gambling-related harm in both datasets; and significantly independently associated with gambling-related harm after controlling for the other proposed responsible gambling limits, but only in the Tasmania database. The longitudinal evaluation of this limit revealed that exceeding this limit failed to longitudinally predict gambling-related harm in either wave; before or after controlling for the other proposed responsible gambling limits. Gamblers who exceeded this limit were 4 to 5 times more likely than gamblers who did not exceed this limit to experience gambling-related harm; and had a 5 to 11% risk of experiencing gambling-related harm. Seven percent of gamblers who exceeded this limit actually experienced gambling-related harm; and 98 to 99% of gamblers who stayed within this limit did not experience gambling-related harm. It was rated as the least important responsible gambling limit by experts; and rated as the most important by only 6% of experts and 8% of the public.

Taken together, these findings indicate the limits related to gambling expenditure (gambling expenditure and gambling expenditure as a proportion of income limits) were consistently the best-performing limits. These limits were most likely to be acceptable across analyses and were exceeded by the smallest proportion of the population to access the group of gamblers experiencing gambling-related harm. Few gamblers exceeded only these limits; and the promotion of these limits will also identify the most people who also exceed the other limits. Exceeding these limits were consistently the strongest cross-sectional predictors of gambling-related harm. In fact, exceeding the proposed gambling expenditure limit was the only significant independent predictor of gambling-related harm after controlling for the other proposed responsible gambling limits across both datasets. Exceeding these limits were also among the most consistent and strongest longitudinal predictors of subsequent gambling-related harm. Gamblers who exceeded the limits relating to gambling expenditure also had the highest relative risk of experiencing gambling-related harm and the highest positive predictive values (i.e., identified the highest proportion of gamblers in the population who exceed the responsible gambling limits who are actually experiencing gambling-related harm). Finally, both experts and the public ranked these limits as the most important responsible gambling limits for promotion. Because gambling expenditure is confounded by annual income, it has been suggested that gambling expenditure as a proportion of income may be most relevant limit in assessing the risk of harm as it reduces the influence of income and provides a standardised index across the gambling population (Currie et al., 2017; Shaffer, LaBrie, LaPlante, Nelson, & Stanton, 2004; Volberg, 1994; Weinstock et al., 2007).

These findings suggest that the gambling limits related to gambling expenditure (gambling expenditure and gambling expenditure as a proportion of incomes) are most suitable for promotion. However, because a considerable proportion of gamblers who exceed a particular proposed responsible gambling limit also exceeded other proposed limits, the promotion of one of the proposed responsible gambling limits will also likely identify individuals who exceed other proposed responsible gambling limits.

Table 48. Summary comparison of the proposed responsible gambling limits

	Gambling frequency	Gambling expenditure	Gambling expenditure as proportion of gross personal income	Number of gambling activities
General population exceeding this limit (%)	19-24	15-16	14-16	27-37
Gamblers exceeding this limit (%)	35-39	26-28	27-28	50-60
Gamblers exceeding this limit who only exceeded this limit (%)	9-12	1	2-4	25-40
Gamblers exceeding this limit who exceeded all four limits (%)	25-35	57-60	56-71	27-43
Cross-sectional association with gambling-related harm ^a	Yes	Yes	Yes	Yes
Independent cross-sectional association with gambling-related harm ^b	No	Yes	N/A	Yes (Tas only)
Longitudinal association with gambling-related harm ^a	Yes	Yes (wave 2 only)	Yes	No
Independent longitudinal association with gambling-related harm ^b	Yes (wave 3 only)	Yes (wave 2 only)	N/A	No
Relative risk	3-6	7-11	8-20	4-5
Absolute risk (%)	5-12	7-15	7-17	5-11
Gamblers exceeding this limit who actually experience gambling-related harm (%)	8	10-12	10-11	7
Gamblers staying within this limit who actually do not experience gambling-related harm (%)	98-99	99	99	98-99
Ranking by experts	3	1	2	4
First preference for promotion by experts (%)	27	35	32	6
First preference for promotion by the public (%)	26	26	41	8

^a after controlling for socio-demographic characteristics^b after controlling for other proposed responsible gambling limits and socio-demographic characteristics

Timeframe preferences

The gambling frequency and expenditure limits can be presented in a yearly, monthly or weekly timeframe. Both experts and the public indicated that their preferred timeframe for the promotion of the frequency limit was weekly (44-50%), followed closely by monthly (39%-45%). While the experts preferred monthly (48%) then weekly (39%) for the gambling expenditure limit, the public preferred weekly (53%) then yearly (27%). The public were more likely than experts to indicate a yearly timeframe as their first preference for both of these limits, suggesting that the public feel more confident than experts in their ability to calculate their level of risk based on yearly expenditure limits. The timeframe selected for the frequency and expenditure limits may be dependent on the target population, setting, and purpose. For example, it may be more difficult for regular or problem gamblers to interpret longer timeframes; while infrequent gamblers may find it difficult to relate to very short timeframes. Shorter timeframes may, however, be more helpful in promoting and maintaining behaviour change.

Presentation of likelihood of gambling-related harm risk

Just under half of experts agreed that the promotion of responsible gambling guidelines should generally indicate that not everyone who exceeds the limit are experiencing gambling-related harm (43%). Almost all experts agreed that the promotion of responsible gambling guidelines should indicate that you are up to seven times more likely to experience gambling-related harm if you exceed the limits (89%), but only just under half (46%) agreed that promotion of responsible gambling guidelines should specifically indicate that approximately 1 in 10 people in the general population who exceed the limits are experiencing gambling-related harm. These findings suggest that experts agree that caveats regarding the likelihood of risk should be employed when promoting responsible gambling and that their preference was to express this risk via risk ratios rather than absolute risk via positive predictive values (i.e., the proportion of people exceeding the responsible gambling limits who are actually experiencing gambling-related harm).

Location of responsible gambling limit promotion

The majority of experts and the public agreed that responsible gambling limits should be promoted through gambling related websites, gambling venues, gambling counselling services, broad media and education campaigns, other community clinics, such as mental health or alcohol or other drug use services, and social media. Lower proportions of experts and the public agreed with the promotion of the limits via GP clinics, general websites, schools and universities, digital screens, and promotional events. These findings suggest that stakeholders agree with the promotion of responsible gambling to the broader population (e.g., via media and education campaigns and social media), gambling populations (e.g., gambling-related websites, gambling venues, and gambling counselling services), and other vulnerable populations in which there is a high rate of gambling problems (e.g., other community clinics, such as mental health or alcohol or other drug use services).

Concerns about the promotion of responsible gambling limits

Experts in the stakeholder consultations identified several concerns with the promotion of responsible gambling limits in response to the open-ended items. Some experts expressed concerns that some of the labels, such as responsible gambling limits and safe gambling limits, may imply permission to gamble up to the suggested level. There was also some concern that the term responsible gambling perpetuates the notion of individual responsibility, without attributing responsibility to the industry or government. These concerns reflect those put forward in relation to the development of low-risk drinking guidelines (Casswell, 2012; Hawks, 1994; Latino-Martel et al., 2011; Room & Rehm, 2012). Some experts also raised concerns that the public may dismiss the limits because they are

conservative or that at-risk gamblers may dismiss them due to low problem recognition. A common theme was that the wording used to promote the limits had to be carefully considered to avoid misinterpretations of the limits; for example, several experts suggested that caveats were required when the responsible gambling limits were promoted to avoid their misinterpretation by the general public, such as “*not everyone who exceeds these limits will experience harm*” and “*increased risk of harm*”, rather than statements such as “*don’t gamble more than...*”. Other concerns related to the confusion that may be created by gender-specific responsible gambling limits; that responsible gambling limits cannot be generalised across all forms of gambling; that gambling expenditure as a proportion of income may be difficult to calculate for some people; and that responsible gambling limits do not take individual differences into account. Although some experts indicated that the responsible gambling limits were another avenue with the potential to reduce gambling-related harm, they recommended proper testing of the marketing strategy and messaging prior to and after promotion of the responsible gambling limits to the public, especially with individuals in high-risk demographic categories.

Strengths and limitations

This is the first program of research to attempt to identify and evaluate responsible gambling limits using population-representative samples recruited outside of Canada. It replicated previous research in the area, effectively allowing direct comparisons to be made between the Australian and Canadian data, but also extended this work in several ways. This is the first study to: 1) extend the examination of risk curves using the Markham methodology to gambling indices other than gambling expenditure; 2) identify the relative risk associated with exceeding the proposed responsible gambling limits; 3) provide an indication of responsible gambling limits based on absolute risk; 4) conduct an extensive exploration of positive and negative predictive values in settings with different base prevalence rates of gambling-related harm; 5) profile the target audience for the promotion of the proposed responsible gambling limits; 6) identify and evaluate responsible gambling limits for specific gambling activities in large population-representative samples; 7) identify the extreme upper and lower responsible gambling limits by maximising specificity and sensitivity; 8) expand the definition of gambling-related harm from problem gambling instruments to other measures of harm, such as alternative gambling-related harm items, quality of life, mental health, and substance use; and 9) canvas public opinion about the promotion of responsible gambling limits.

The program of research allowed for a triangulation of findings from multiple datasets conducted by independent research teams with similar, but slightly different, methodologies. Given differences in demographic and gambling patterns in Tasmania and the ACT, the similar pattern of results found across these surveys provides strong evidence of robust and generalizable responsible gambling limits to other Australian states and territories, such as Victoria. The use of the same measures in multiple Tasmanian surveys over time allowed the datasets to be combined, which enhanced the sample size available for each analysis.

The Tasmanian and ACT surveys are among the few population-representative surveys in Australia to obtain detailed expenditure data on specific gambling activities. Moreover, the Tasmanian Longitudinal Gambling Study is the only longitudinal, representative general population survey in Australia that includes detailed expenditure data on specific gambling activities across multiple waves of data collection. The wording of the expenditure items, the collection of precise continuous frequency and expenditure data across all gambling activities, and the data cleaning procedures (e.g., converting wins to zero) are likely to produce the best match with diary data and actual jurisdictional gambling revenue (Williams, Volberg, Stevens, Williams, & Arthur, 2016). This avoids difficulties encountered by previous population-based research attempting to identify responsible gambling limits, which may underestimate actual gambling frequency as it has had to derive composite indices based on the most

frequent gambling activity (e.g., an individual who plays the lottery once per week and EGMs every day was classified as a daily gambler) (Brosowski et al., 2015; Currie et al., 2017; Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008; Currie et al., 2009). It also avoids the difficulties of previous research that has had to estimate gambling expenditure using the mid-points of set expenditure response categories (Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008; Currie et al., 2009). There is empirical evidence that collecting precise estimates of gambling expenditure for individual gambling activities has the best validity (Wood & Williams, 2007) and that the most accurate responsible gambling limits are derived from studies collecting dollar estimates for each type of gambling activity (Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008). This method of data collection also allowed for the derivation of responsible gambling limits for each gambling activity. Finally, in contrast to some of the other available studies (Currie et al., 2006), the Tasmanian and ACT surveys administered the PGSI to all past-year year gamblers.

Using the Tasmanian and ACT studies as the basis for the data analyses offer several other significant advantages. Given that the increase in mobile telephone-only households may be a source of bias for traditional landline gambling prevalence surveys (Dowling et al., 2016; Jackson et al., 2014), the dual-frame methodology employed in the 2013 Tasmania SEIS enhanced the capture of the sub-sample of the population that is most likely to display the greatest rate of gambling-related harm. The surveys also include a range of other gambling-related harm, such as quality of life, mental health and substance use problems. Studies from both states/territories also employed rigorous weighting procedures, had generally good response rates, and were ethically approved by university ethics committees.

Overall, this program of research represents a significant contribution to gambling research and has considerable potential utility in the prevention of gambling-related harm. However, there several scientific limitations associated with this program of research that require consideration in the promotion of the proposed responsible gambling limits. First, self-reported measures of gambling involvement are prone to error. There has been much concern that self-reported expenditures collected from population surveys are underestimates of actual expenditures when compared to revenues reported by the industry. In particular, gambling expenditure as a proportion of income is likely subject to the most error given it is the ratio of gambling expenditures and household income, which are both prone to error (Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008). Interestingly, however, both in previous research and the current study, this responsible gambling limit appears to be regarded by both empirical research and experts as the most useful and accurate parameter to consider when assessing risk of harm (Currie et al., 2017; Currie, Hodgins, Wang, El-Guebaly, & Wynne, 2008; Currie et al., 2009; Shaffer et al., 2004; Volberg, 1994; Weinstock et al., 2007; Weinstock et al., 2008).

A strong argument can be made for basing responsible gambling limits on self-reported expenditure data because it best reflects the amount gamblers perceive they spend when considering the relevance of the responsible gambling limits to their behaviour (Currie, Hodgins, Wang, El-Guebaly, & Wynne, 2008; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008). It is also important to note that this phenomenon is not unique to gambling. Self-reported alcohol consumption data collected in epidemiological surveys do not correspond to the consumption estimates derived from alcohol sales data (Greenfield & Kerr, 2008). This has not prevented the development, acceptance and promotion of responsible drinking guidelines worldwide. Moreover, this phenomenon is likely not to be unique to gambling expenditure. It is likely that other indices of gambling involvement, such as gambling participation, frequency and duration are also subject to self-report biases. However, the focus has not been on these indices because industry data on these indices are not available. The most serious consequence of under-reporting is that the responsible gambling limits derived from this research could be somewhat conservative (Currie, Hodgins, Wang, El-Guebaly, & Wynne, 2008; Currie et al., 2006). However, conservative limits are preferred if the intent is to provide the general public with

guidance about safe gambling levels (Currie et al., 2006). This tendency to under-report may support the use of a range or the upper threshold of a range as a quantitative responsible gambling limit rather than precise figures (Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008).

Measures of gambling-related harm employed in both the current study and previous research were also based on self-report. This is in contrast to the NHMRC drinking guidelines, which are based on relatively objective indicators, such as injury from specific drinking occasions and total mortality (National Health and Medical Research Council, 2009; Rehm et al., 2008; Room & Rehm, 2012). Moreover, in order to allow comparisons to findings reported by previous population-based research (Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008; Currie et al., 2009), we employed the definitions of harm based on a subset of seven items that Currie, Hodgins, Wang, El-Guebaly, Wynne, et al. (2008) and Currie et al. (2009) argue represent negative consequences; this classification of items into negative consequences and behavioural symptoms is not consistent with the development classification (Ferris & Wynne, 2001). Relatedly, the harms measured by the PGSI and the alternative gambling-related harm items employed in this study substantially consider harm to others or pressures from others concerning the gambling. This is in contrast to the alcohol guidelines, which are framed in terms of risks to the drinker and do not include any consideration of risks to others (National Health and Medical Research Council, 2009; Rehm et al., 2008; Room & Rehm, 2012). The gambling and alcohol fields therefore have quite different criteria against which they are measuring their risk curves. Taken together, these findings suggest that research is required to explore the validity of self-report measures of gambling-related harm.

Compared to some of the available previous research, the large sample sizes allowed us to divide the samples into gambling activity subgroups. However, because ROC analyses increase in accuracy with sample size (Fluss, Faraggi, & Reiser, 2005; Quilty et al., 2014; Weinstock et al., 2007), ROC estimates were generally inferior for these subgroups of the population ($AUC < 0.70$) relative to those for the entire sample. Moreover, the cross-sectional evaluation of gambling activity-specific limits must be interpreted with caution because smaller cell sizes can lead to large confidence intervals around some estimates. These limitations highlight the need to conduct replications of gambling activity-specific limits using very large samples. Moreover, because the PGSI is not asked for every gambling activity, the identification of gambling activity-specific responsible gambling limits in the previous sections are fundamentally limited by the inability to link gambling-related harms to specific gambling activities. The identification of reliable gambling activity-specific responsible gambling limits will require a dedicated project involving very large representative samples of gamblers and the measurement of harms specific to each gambling activity.

Although the Tasmanian and ACT surveys generally had very low rates of missing data, there were higher amounts of missing data for annual personal income (12-15%). This is consistent with all of the previous research employed to derive population-based responsible gambling limits (Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008; Currie et al., 2009). Moreover, the Tasmanian and ACT surveys employed categorical measures of gross personal income, with bandwidth intervals of \$10,000 to \$50,000, from which we employed the midpoint for the creation of the gambling expenditure as a proportion of personal income. This lack of precision may have precluded an accurate calculation of gambling expenditure as a proportion of personal income. There is a need for more precise assays of this construct, although this may further reduce the missingness of the variable. It should also be noted that the proposed gambling expenditure as a proportion of income limits derived in this study are not directly comparable to previous studies as they employed household income, rather than personal income.

Other limitations of this study include the recording (Tasmania) or recoding (ACT) of self-reported wins (expenditure) as zero, the use of the same data to estimate the gambling limits and to demonstrate cross-sectional validity, and the low response rate to the public survey.

Implications

Consistent with a public health perspective towards gambling, efforts targeted at the prevention of gambling-related harm, rather than problem gambling, may be more effective as they potentially impact a much larger segment of the population (Currie et al., 2006; Currie et al., 2009). The proposed responsible gambling limits identified in the current program of research can be used to inform the development of quantitative responsible gambling guidelines that can be promoted to the Australian public. Currie, Hodgins, Wang, El-Guebaly, and Wynne (2008) argue that the preventative goal of responsible gambling guidelines is to prevent gambling-related harm, in contrast to objective of the alcohol low-risk limits which is to prevent acute alcohol intoxication. The use of limits may be an easy and cost-effective method to screen for people at high risk for gambling-related harm (Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008; Weinstock et al., 2007; Weinstock et al., 2008). It has been argued that because the comparison of self-reported behaviour with the responsible gambling limits may generate inferences about the presence of problems, screening based on gambling consumption may reduce the subjective bias inherent when gamblers respond to problem-focused screening questions (Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008; Rockloff, 2012; Weinstock et al., 2007; Weinstock et al., 2008). Such normative data can serve as reference points to inform gamblers of the relative risk if allows gamblers to compare their current behaviour with the guideline and serve as reference points of the relative risk if they exceed them (Currie et al., 2017; Currie et al., 2006). The limits can assist gamblers in reducing their gambling consumption by increasing awareness of what defines risk behaviour, highlighting potential negative consequences of exceeding the limits, and enhancing motivation to employ self-directed change strategies or seek help (Currie et al., 2006; Weinstock et al., 2008). Such guidelines are therefore helpful in the identification of people who may be unaware that they are currently experiencing gambling-related harm, as well as those who will experience gambling-related harm in the future. These guidelines could usefully augment the currently available behavioural responsible guidelines (Currie, Hodgins, Wang, El-Guebaly, & Wynne, 2008; Currie et al., 2006). Responsible gambling limits can also be employed in population-level surveillance research to monitor the prevalence of gambling-related harm and to identify potential risk and protective factors for high-risk gambling (Currie et al., 2011; Currie et al., 2009; Weinstock et al., 2008). These limits can also be used to investigate the efficacy of secondary intervention efforts by evaluating the proportion of gamblers who gamble less than the responsible gambling limits following the delivery of the intervention (Weinstock et al., 2008). This has been piloted in the US, where the national guidelines for low-risk drinking were used as criteria for inclusion in a pilot study examining the feasibility and acceptability of a computer tailored secondary intervention program (Mauriello, Gkbayrak, Van Marter, Paiva, & Prochaska, 2011). Finally, the proposed responsible gambling limits may be applied in clinical settings for gamblers selecting a moderation goal (Currie et al., 2006; Quilty et al., 2014; Weinstock et al., 2007). Such moderation limits would ultimately provide guidance to clinicians and gamblers seeking to reduce their gambling behaviour about what constitutes low-risk gambling following treatment.

Final concluding comments

An argument could be made that the less conservative limits from the larger Tasmanian dataset comprise the proposed responsible gambling limits from this program of research: a gambling frequency of 30 times per year (2.5 times per month); a gambling expenditure of \$615 per year (\$51 per month); a gambling expenditure comprising 1.7% of gross personal income; and 2 gambling activities. These limits are consistent with those identified in population-representative studies conducted in Canada (Currie et al., 2017; Currie et al., 2006; Currie, Hodgins, Wang, El-Guebaly, Wynne, et al., 2008; Currie et al., 2009) and elsewhere (Brosowski et al., 2015). The utility of the proposed responsible gambling limits is also supported by findings that experts and the public thought the proposed guidelines were just right (i.e., neither too liberal nor too conservative); and that the

higher limits identified using alternative gambling-related harm items were too high. Moreover, exceeding all of the proposed responsible gambling limits cross-sectionally predicted gambling-related harm across both datasets and all but the gambling frequency limit were independent cross-sectional predictors of gambling-related harm after controlling for the other proposed limits. All limits except the number of gambling activities limit were longitudinal predictors of subsequent gambling-related harm. In addition, the relative risk ratio estimates only slightly increased when using gambling behaviour cut-offs that were above the proposed limits, suggesting that raising the cut-offs does not substantially alter the relative risk for harm. This is likely because when the cut-off is raised, a proportion of gamblers who are under limit are still experiencing harm, and thus the risk of harm when meeting the limit remains stable when relative to the group who does not meet the harm. The limits related to gambling expenditure (gambling expenditure and gambling expenditure as a proportion of income limits) were consistently the best-performing limits.

The current study employed an approach that attempts to balance sensitivity and specificity. This approach, however, produced a very high proportion of false positives, which may diminish the credibility of responsible gambling limits in the eyes of the public. An argument can therefore be made to set higher consumption thresholds by giving more weight to specificity than sensitivity. Limits with specificity maximised resulted in a higher proportion of gamblers exceeding the limits who actually experienced gambling-related harm (7-21%); and resulted in limits that were generally two to four times higher the proposed responsible gambling limits. In Tasmania, these limits were: a gambling frequency of 65 times per year (5.4 times per month); a gambling expenditure of \$2,306 per year (\$192 per month); a gambling expenditure comprising 6.2% of an individual's gross personal income; and 3 gambling activities. These estimates provide an indication of the *most extreme* upper estimates for each of the responsible gambling limits. Increasing the limits to these consumption levels would identify a larger proportion of gamblers exceeding the limits who actually experience gambling-related harm; without considerably impacting on the identification of gamblers who remain within the limits and do not experience harm. It is important to note, however, that both the public and consumers believed that limits of this magnitude were too liberal. Further, at least from a relative risk perspective, there is little utility in increasing the limits because there is little change in the risk relative to the group who do not meet the limit with increasing gambling behaviour.

Moreover, there were some findings in this study suggesting that gambling at any level appears to carry some level of risk. Markham et al. (2016) r-shaped curves were generally replicated across multiple gambling indices, which is suggestive that there is a level of risk associated with even low levels of gambling consumption. Moreover, the relative risk ratio data presented in this study suggests that gambling behaviour lower than the proposed responsible gambling limits identified in this study also confers a considerable degree of risk. These findings therefore provide some support for the argument that even low levels of gambling consumption is associated with harm; and that this harm increases rapidly with even small increases in gambling consumption (Currie et al., 2006; Markham et al., 2016). Markham et al. (2016) argue that the absence of J-curves implies that previously identified responsible gambling limits should be disregarded and limits based on tolerable levels of risk. The analyses of absolute risk, including the positive predictive values, provided in this report may serve as the basis for the identification of limits based on the level of tolerable risk for any given purpose. The evidence-based limits identified in this study using ROC analyses and the Youden Index, however, remain valid indicators of levels of gambling consumption that reliably differentiate gamblers who are at lower and higher risk of gambling-related harm. The absence of a "low-risk" region of the curves may, however, explain the relatively conservative nature of the proposed responsible gambling limits.

The cut-offs selected may be dependent on the target population, the setting in which the responsible gambling limits are employed, the purpose of applying the proposed responsible gambling limits, and the amount of tolerable risk (Markham et al., 2016; Weinstock et al., 2007). We hope these two sets of limits serve as working guidelines for the consideration of researchers, clinicians and policy makers.

The responsible gambling limits proposed in this research require rigorous empirical investigation prior to their application to the prevention and treatment of gambling-related harm. However, offering guidelines based on empirically derived limits provide the opportunity for consumers to enhance informed choices about personal risk, or at the very least, generate public discussion about gambling norms. We have attempted to inform the translation of the proposed responsible gambling limits to responsible gambling guidelines that can be promoted to the Australian public, primarily through studies canvassing expert and public opinion about the promotion of responsible gambling limits. It is, however, beyond the scope of this program of research to translate the proposed limits or to recommend how they should be promoted. Comprehensive evaluation of marketing strategies and messaging is required before the proposed responsible gambling guidelines are promoted to the Australian public.

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Appendices

Appendix 1. Secondary analysis of existing datasets: Descriptive statistics

Table 49. Descriptive statistics for the existing datasets employed in this study

	Tasmanian SEIS Surveys (%)	Survey on Gambling, Health and Wellbeing in the ACT (%)	Tasmanian Longitudinal Gambling Study		
			Wave 1 (%)	Wave 2 (%)	Wave 3 (%)
Gender (male)	56.4	47.0	63.1	63.1	63.1
Age					
18-34	10.7	13.7	7.5	6.3	6.3
35-49	21.6	22.4	21.2	17.9	15.9
50-64	34.7	28.4	38.3	35.2	34.8
65+	32.0	32.2	32.3	40.7	43.1
PGSI category					
Non-gambling	35.9	46.6	24.4	31.6	29.3
Non-problem gambling	57.2	44.5	58.5	59.2	60.5
Low risk gambling	4.2	5.7	10.3	6.7	5.6
Moderate risk gambling	1.8	2.1	4.9	2.1	3.5
Problem gambling	0.5	1.1	1.6	0.4	0.7

Appendix 2. Secondary analysis of existing datasets: Description of measures

Quality of life. The WHO-QOL-BREF consists of items measuring quality of life across four domains: Physical Health (7 items), Psychological Health (6 items), Social Relationships (3 items), and Environment (8 items). Respondents indicated how often each item applied to them in the last four weeks on five-point scales that vary slightly across items. Scores are derived by averaging the sum of the items multiplied by four. The WHO-QOL-BREF shows good internal consistency with Cronbach's alpha values for each of the four domain scores ranging from 0.66 to 0.84, and good discriminant validity (World Health Organization (WHO), 1998). It demonstrates the contribution of all four domains to quality of life. For the purpose of the ROC analyses, this quality of life variable was quartiled; the lowest quartile was considered to represent harm, while the remaining three quartiles were coded to represent no harm.

Depression: The Patient Health Questionnaire-2 (PHQ-2) was employed to screen for depression (Kroenke et al., 2003). This brief screener comprises the first two items of the Physical Health Questionnaire, and represents the core DSM-IV items for major depressive disorder. Scores range from 0 to 6 and a score of three or greater indicates a positive screen for major depressive disorder (Kroenke et al., 2003). The predictive accuracy of the PHQ-2 was compared to the structured clinical interview for DSM-III-R (SCID) and was found to have good sensitivity (.83) and specificity (.90) for classifying major depression. For the purpose of the ROC analyses, a score of three or more was utilised to represent harm.

Generalised anxiety symptoms: The Generalised Anxiety Disorder-2 (GAD-2) (Kroenke et al., 2007) was employed to measure generalised anxiety. This brief screen comprises the first two items of the Generalised Anxiety Disorder (GAD) questionnaire, and represents the core DSM-IV items for generalised anxiety disorder. Scores range from 0 to 6 and a score of three or greater indicates a positive screen for generalised anxiety disorder (Kroenke et al., 2007). The predictive accuracy of the GAD-2 was compared to the GAD sections of the Structured Clinical Interview for DSM-IV (SCID). Validity results indicated that with a cut-off score of 3 the GAD-2 has good sensitivity (.76-.93) and specificity (.80 to .85). For the purpose of the ROC analyses, a score of three or more was utilised to indicate harm.

Panic symptoms: The two question version of the Autonomic Nervous System Questionnaire (ANS) (Stein et al., 1999) was used to screen for panic symptoms. These two questions relate to the previous six months, with a positive endorsement of either item indicating a positive screen for a panic disorder. In the development of this questionnaire, the ANS had excellent sensitivity (range of .94–1.00 across the three clinic sites) and negative predictive value (.94 –1.00) but low specificity (.25–.59) and positive predictive value (range.18–.40) (Stein et al., 1999). For the purpose of the ROC analyses, a positive endorsement of either item was utilised to indicate harm.

Post-traumatic stress disorder symptoms: The Primary Care Posttraumatic Stress Disorder (PC-PTSD)(Prins et al., 2004) was used to screen for post-traumatic stress disorder (PTSD). This questionnaire contains four items relating to the past month, where a positive endorsement on three or more items indicates a positive screen for PTSD. This instrument has yielded a sensitivity of .78 and specificity of .87 (Prins et al., 2004). The PC-PTSD was used at screening and a one-month follow-up and these administrations demonstrated good test-retest reliability with a correlation coefficient of .83. For the purpose of the ROC analyses, a positive endorsement of three or more items was utilised to indicate harm.

Generalised social anxiety symptoms: The Social Phobia Inventory (Mini SPIN) (Connor et al., 2001) was employed to screen for generalised social anxiety disorder. The Mini SPIN consists of three questions and respondents reply on a 5 point scale from (0) not at all to (4) extremely. Scores range from 0 to 18 and a score of six or greater indicates a positive screen for generalised social

anxiety disorder. The measure shows sensitivity of 88.7%, specificity of 90.0%, positive predictive value of 52.5%, and negative predictive value of 98.5% (Connor et al., 2001). For the purpose of the ROC analyses, a score of six or more was utilised to indicate harm.

Attention-deficit hyperactivity disorder. The ADHD Self-Report Scale (ASRS) (Kessler et al., 2005) was used to screen for attention-deficit hyperactivity disorder (ADHD). The 6 item ASRS asks respondents to describe how often they have conducted themselves in certain ways over the previous six months. Responses include never, rarely, sometimes, often or very often, with scoring differing for each item. A response of sometimes, often or very often on the first three items is given a score of 1. All other responses on those items are given a score of 0. A response of often or very often on the final three items is given a score of 1, with all other responses on those items given a score of 0. Scores range from 0 to 6 and a score of four or greater indicates a positive screen for ADHD. The ASRS has demonstrated a sensitivity of 68.7%, specificity of 99.5% and total classification accuracy of 97.9% (Kessler et al., 2005). For the purpose of the ROC analyses, a score of four or more was utilised to indicate harm.

Psychological distress: Psychological distress was measured using the Kessler 6 Psychological Distress Scale (K6) (Kessler et al., 2002). The K6 measures current and nonspecific psychological distress in the past four weeks and comprises of six items relating to the experience of specific symptoms of psychological distress, such as nervousness, agitation, psychological fatigue, and depression. Using the scoring based on Australian norms, the response options for each item range from 1 (none of the time) to 5 (all of the time). Item scores are summed to obtain a total score between 6 and 30 and respondents can be classified as being at low (score of 6-13), moderate (score of 14-18), high (score of 19-24), or very high risk (score of 25-30). This measure has demonstrated high internal consistency and reliability ($\alpha = .89$) across major sociodemographic subsamples (Kessler et al., 2002). For the purpose of the ROC analyses, a score of 14 or more was utilised to indicate harm.

Hazardous drinking. In the 2011 Tasmanian survey, the Alcohol Use Disorder Identification Test-3 (AUDIT-3; (Gordon et al., 2001) which consists of the third question of the AUDIT (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001): 'How often do you have 6 or more standard drinks on one occasion?' was employed to measure hazardous drinking. A response of not at all or less than monthly indicates non-hazardous drinking, while a response of monthly, weekly, or daily/almost daily, indicates probably hazardous drinking. This cut-off produced a sensitivity of 1.00 and a specificity of .51 in identifying hazardous drinkers when compared with a positive endorsement of hazardous drinking on the full AUDIT (Babor et al., 2001). In the 2013 Tasmanian survey, a modified version of the AUDIT-C was employed. This version tailors the consumption items to Australian alcohol use, as recommended in the AUDIT manual (Babor, De La Fuente, Saunders, & Grant, 1992). This version has been employed in the Longitudinal Study of Australian Children (LSAC) conducted by the Australian Institute of Family Studies (Edwards & Baxter, 2013). For the purpose of the ROC analysis, harm based on hazardous drinking was defined as a response of monthly, weekly, or daily/almost daily for the AUDIT-3 (2011), and a score of 4 or more for men, and a score 3 or more for women, on the AUDIT-C (2013). In the ACT survey, respondents were asked the first two items of the AUDIT-C (frequency and quantity). These items were combined to estimate typical weekly alcohol consumption. For the purpose of the ROC analysis, harm was defined as 14 or more standard drinks per week for women and 28 or more standard drinks per week for men.

Smoking. Single items were employed to measure the use of tobacco products in the Tasmanian and ACT surveys. In the Tasmanian surveys, respondents were asked: 'How often do you use tobacco products?' Response options in the 2013 survey were: every day; 4-6 times a week; 2-3 times a week; once a week; 2-3 times a month; monthly or less; not in the last year; never. Response options in the 2011 survey were: daily or almost daily; weekly; monthly; less than monthly; not at all in

the last 3 months. In the ACT survey, respondents were asked: 'How often do you currently smoke cigarettes?' Response options were: Do not smoke at all, less than once a day; at least once a day. For the purpose of the ROC analyses, response options were dichotomised, with harm defined as the presence of any smoking.

Illicit drug use and prescription drug misuse. Single items were employed to measure the use of illicit drugs and misuse of prescription medication in the previous 12 months in the Tasmanian surveys. These items were: 'How often do you use cannabis or other non-prescription substances, such as cocaine, amphetamine type stimulants, inhalants like petrol or glue, hallucinogens, or heroin?' (illicit drug use); and 'How often do you use prescription medications NOT as directed by your doctor, such as sleeping pills, pain medications, or diet pills?' (prescription drug misuse). These items were based on a single-item screening test for drug use in primary care (Smith et al., 2010). This single item has demonstrated excellent sensitivity (.86-.96) and specificity (.89-.96) in detecting past year drug use, when compared to the Composite International Diagnostic Interview Substance Abuse Model (Smith et al., 2010). In the 2011 survey, response options were (1) daily or almost daily; (2) weekly; (3) monthly; (4) less than monthly; and (5) not at all in the last 3 months. In the 2013 Tasmanian survey, response categories were (1) everyday; (2) 4-6 times a week; (3) 2-3 times a week; (4) weekly; (5) 2-3 times a month; (6) monthly or less and; (7) not in the last 12 months. For the purpose of the ROC analyses, binary variables of any illicit drug use and any prescription drug misuse represented harm.

Appendix 3. Risk (dose-response) curves: Sample sizes**Table 50. Sample sizes for each category employed in risk curves employed in the Currie and colleagues (2017; 2006; 2008) methodology**

	Tasmania	ACT		Tasmania	ACT		Tasmania	ACT
Frequency			Expenditure			Proportion of income		
1-10	2,026	447	\$1-\$50	1,222	300	0%-0.25%	1,517	401
11-25	1,019	182	\$51-\$100	603	108	0.26%-0.50%	611	107
26-50	453	72	\$101-\$250	955	164	0.51%-1.00%	685	230
51-100	1,555	283	\$251-\$500	870	131	1.01%-3.00%	1,066	179
101-200	526	161	\$501-\$1000	782	115	3.01%-5.00%	377	72
>200	197	73	>\$1001	1,089	347	>5.00%	720	142

Appendix 4. ROC analyses according to each PGSI definition of harm

Table 51. ROC analyses for the Tasmanian data according to each definition of harm based on the PGSI^{a,b}

Responsible gambling limit		Endorsement of ≥ 1 PGSI item	Endorsement of ≥ 1 PGSI negative consequence items	Endorsement of ≥ 2 PGSI items	Endorsement of ≥ 2 PGSI negative consequence items	Low-risk gambling (PGSI score ≥ 1) ^c	Moderate-risk gambling (PGSI score ≥ 3)	Modified moderate-risk gambling (PGSI score ≥ 5)	Problem gambling (PGSI score ≥ 8)
Proportion of population exceeding each definition of harm		6.92% (95% CI 6.10, 7.83)	6.14% (95% CI 5.36, 7.04)	2.84% (95% CI 2.31, 3.48)	2.30% (95% CI 1.81, 2.91)	6.92% (95% CI 6.10, 7.83)	2.36% (95% CI 1.92, 2.91)	1.16% (95% CI 0.88, 1.55)	0.63% (95% CI 0.42, 0.93)
Proportion of gamblers exceeding each definition of harm		11.00% (95% CI 9.74, 12.41)	9.82% (95% CI 8.59, 11.20)	4.52% (95% CI 3.69, 5.52)	3.68% (95% CI 2.90, 4.64)	11.00% (95% CI 9.74, 12.41)	3.76% (95% CI 3.05, 4.62)	1.85% (95% CI 1.39, 2.46)	1.00% (95% CI 0.67, 1.49)
Gambling frequency per year	Cut off	25	25	28	30	25	31	38	48
	AUC (95% CI)	0.70 (0.66, 0.74)	0.69 (0.65, 0.74)	0.76 (0.71, 0.81)	0.76 (0.70, 0.81)	0.70 (0.66, 0.74)	0.71 (0.66, 0.77)	0.79 (0.74, 0.85)	0.86 (0.79, 0.93)
	sens, spec	0.64, 0.65	0.64, 0.64	0.72, 0.66	0.71, 0.67	0.64, 0.65	0.63, 0.68	0.71, 0.73	0.78, 0.77
	N	5753	5754	5753	5754	5753	5753	5753	5753
Gambling expenditure per year	Cut off	418	432	584	615	418	577	745	1204
	AUC (95% CI)	0.75 (0.71, 0.79)	0.75 (0.70, 0.79)	0.85 (0.82, 0.89)	0.86 (0.82, 0.90)	0.75 (0.71, 0.79)	0.80 (0.76, 0.85)	0.88 (0.83, 0.93)	0.95 (0.91, 0.99)
	sens, spec	0.65, 0.72	0.65, 0.72	0.78, 0.76	0.78, 0.77	0.65, 0.72	0.70, 0.76	0.80, 0.79	0.90, 0.86
	N	5501	5498	5501	5498	5501	5501	5501	5501
Gambling expenditure as proportion of gross personal income	Cut off	1.08	1.10	1.54	1.68	1.08	1.54	1.96	4.22
	AUC (95% CI)	0.76 (0.72, 0.79)	0.76 (0.72, 0.80)	0.83 (0.78, 0.88)	0.84 (0.79, 0.89)	0.76 (0.72, 0.79)	0.78 (0.73, 0.84)	0.87 (0.80, 0.93)	0.96 (0.94, 0.98)
	sens, spec	0.70, 0.68	0.71, 0.68	0.77, 0.73	0.78, 0.74	0.70, 0.68	0.70, 0.72	0.81, 0.76	0.95, 0.87
	N	4958	4954	4958	4954	4958	4958	4958	4958
Number of gambling activities	Cut off	2	2	2	2	2	2	3	3
	AUC (95% CI)	0.71 (0.67, 0.74)	0.72 (0.67, 0.76)	0.77 (0.72, 0.81)	0.78 (0.73, 0.83)	0.71 (0.67, 0.74)	0.72 (0.67, 0.77)	0.79 (0.73, 0.86)	0.83 (0.75, 0.91)
	sens, spec	0.69, 0.60	0.71, 0.60	0.80, 0.58	0.82, 0.58	0.69, 0.60	0.73, 0.58	0.59, 0.82	0.67, 0.82
	N	5833	5860	5833	5860	5833	5833	5833	5833

^a Bold typeface indicates AUC ≥ 0.70^b Endorsement of 2 or more PGSI negative consequence items selected as definition of harm for derivation of responsible gambling limits^c Endorsement of ≥ 1 PGSI item and low-risk gambling (PGSI score ≥ 1) derive the same responsible gambling limits as they are based on the same sample

Table 52. ROC analyses for the ACT data according to each definition of harm based on the PGSI^{a,b}

Responsible gambling limit		Endorsement of ≥ 1 PGSI item	Endorsement of ≥ 1 PGSI negative consequence items	Endorsement of ≥ 2 PGSI items	Endorsement of ≥ 2 PGSI negative consequence items	Low-risk gambling (PGSI score ≥ 1) ^c	Moderate-risk gambling (PGSI score ≥ 3)	Modified moderate-risk gambling (PGSI score ≥ 5)	Problem gambling (PGSI score ≥ 8)
Proportion of population exceeding each definition of harm		5.74% (95% CI 4.47, 7.33)	4.26% (95% CI 3.33, 5.44)	2.59% (95% CI 1.92, 3.49)	1.92% (95% CI 1.39, 2.65)	5.74% (95% CI 4.47, 7.33)	1.60% (95% CI 1.12, 2.27)	0.64% (95% CI 0.40, 1.03)	0.41% (95% CI 0.22, 0.75)
Proportion of gamblers exceeding each definition of harm		10.57% (95% CI 8.26, 13.43)	7.85% (95% CI 6.13, 10.00)	4.77% (95% CI 3.53, 6.43)	3.54% (95% CI 2.56, 4.88)	10.57% (95% CI 8.26, 13.43)	2.94% (95% CI 2.06, 4.19)	1.18% (95% CI 0.73, 1.89)	0.75% (95% CI 0.41, 1.38)
Gambling frequency per year	Cut off	17	19	22	20	17	20	26	25
	AUC (95% CI)	0.74 (0.67, 0.81)	0.78 (0.70, 0.85)	0.82 (0.75, 0.88)	0.79 (0.72, 0.86)	0.74 (0.67, 0.81)	0.79 (0.71, 0.87)	0.84 (0.74, 0.94)	0.85 (0.77, 0.93)
	sens, spec	0.68, 0.67	0.72, 0.69	0.76, 0.72	0.75, 0.69	0.68, 0.67	0.74, 0.68	0.78, 0.74	0.82, 0.73
	N	1215	1215	1215	1215	1215	1215	1215	1215
Gambling expenditure per year	Cut off	275	317	380	380	275	414	728	816
	AUC (95% CI)	0.79 (0.73, 0.85)	0.79 (0.72, 0.87)	0.85 (0.80, 0.91)	0.84 (0.78, 0.91)	0.79 (0.73, 0.85)	0.86 (0.80, 0.93)	0.94 (0.88, 0.99)	0.95 (0.91, 0.99)
	sens, spec	0.72, 0.72	0.71, 0.73	0.79, 0.75	0.78, 0.74	0.72, 0.72	0.80, 0.76	0.89, 0.84	0.91, 0.85
	N	1157	1157	1157	1157	1157	1157	1157	1157
Gambling expenditure as proportion of gross personal income	Cut off	0.61	0.70	0.87	0.83	0.61	0.97	1.93	2.31
	AUC (95% CI)	0.81 (0.76, 0.87)	0.82 (0.76, 0.88)	0.86 (0.79, 0.92)	0.85 (0.77, 0.92)	0.81 (0.76, 0.87)	0.89 (0.85, 0.93)	0.96 (0.92, 0.99)	0.97 (0.93, 1.01)
	sens, spec	0.73, 0.74	0.73, 0.75	0.77, 0.78	0.77, 0.76	0.73, 0.74	0.84, 0.78	0.91, 0.87	0.92, 0.89
	N	1014	1014	1014	1014	1014	1014	1014	1014
Number of gambling activities	Cut off	2	2	2	2	2	2	2	2
	AUC (95% CI)	0.73 (0.65, 0.81)	0.73 (0.65, 0.80)	0.77 (0.70, 0.84)	0.73 (0.65, 0.82)	0.73 (0.65, 0.81)	0.79 (0.71, 0.88)	0.79 (0.68, 0.89)	0.77 (0.65, 0.88)
	sens, spec	0.66, 0.68	0.66, 0.66	0.74, 0.66	0.69, 0.65	0.66, 0.68	0.78, 0.65	0.78, 0.64	0.76, 0.64
	N	1208	1208	1208	1208	1208	1208	1208	1208

^a Bold typeface indicates AUC ≥ 0.70^b Endorsement of 2 or more PGSI negative consequence items selected as definition of harm for derivation of responsible gambling limits^c Endorsement of ≥ 1 PGSI item and low-risk gambling (PGSI score ≥ 1) derive the same responsible gambling limits as they are based on the same sample

Appendix 5. Tasmanian Longitudinal Gambling Study: Descriptive statistics**Table 53. Descriptive statistics for each wave of the Tasmanian Longitudinal Gambling Study**

	Mean	Median	% missing
Wave 1			
Gambling frequency	67.6	49.0	1.4
Gambling expenditure	1743	378	7.8
Number of gambling activities	2.5	2.0	0.4
PGSI score	0.6	0.0	0.2
Wave 2			
Gambling frequency	58.4	46.5	8.0
Gambling expenditure	1374	420	12.3
Number of gambling activities	2.4	2.0	0.0
PGSI score	0.3	0.0	0.0
Wave 3			
Gambling frequency	50.9	43.0	5.1
Gambling expenditure	1374	420	8.9
Number of gambling activities	2.4	2.0	0.0
PGSI score	0.4	0.0	0.6

Appendix 6. ROC analyses excluding lottery only gamblers according to each PGSI definition of harm

Table 54. ROC analyses excluding lottery only gamblers for the Tasmanian data according to each definition of harm based on the PGSI^{a,b}

Responsible gambling limit		Endorsement of ≥ 1 PGSI items	Endorsement of ≥ 1 PGSI negative consequence items	Endorsement of ≥ 2 PGSI items	Endorsement of ≥ 2 PGSI negative consequence items	Low-risk gambling (PGSI score ≥ 1) ^c	Moderate-risk gambling (PGSI score ≥ 3)	Modified moderate-risk gambling (PGSI score ≥ 5)	Problem gambling (PGSI score ≥ 8)
Proportion of population exceeding each definition of harm		6.92% (95% CI 6.10, 7.83)	6.14% (95% CI 5.36, 7.04)	2.84% (95% CI 2.31, 3.48)	2.30% (95% CI 1.81, 2.91)	6.92% (95% CI 6.10, 7.83)	2.36% (95% CI 1.92, 2.91)	1.16% (95% CI 0.88, 1.55)	0.63% (95% CI 0.42, 0.93)
Proportion of gamblers exceeding each definition of harm		13.57% (95% CI 11.96, 15.37)	12.17% (95% CI 10.61, 13.94)	5.67% (95% CI 4.61, 6.96)	4.68% (95% CI 3.69, 5.93)	13.57% (95% CI 11.96, 15.37)	4.72% (95% CI 3.81, 5.84)	2.38% (95% CI 1.78, 3.18)	1.30% (95% CI 0.87, 1.93)
Gambling frequency per year	Cut off	27	26	30	32	27	33	40	52
	AUC (95% CI)	0.69 (0.65, 0.73)	0.69 (0.64, 0.73)	0.75 (0.69, 0.80)	0.74 (0.69, 0.80)	0.69 (0.65, 0.73)	0.71 (0.65, 0.77)	0.79 (0.73, 0.85)	0.84 (0.77, 0.92)
	sens, spec	0.63, 0.64	0.64, 0.63	0.71, 0.65	0.70, 0.66	0.63, 0.64	0.64, 0.67	0.72, 0.71	0.76, 0.76
	N	4182	4176	4182	4176	4182	4182	4182	4182
Gambling expenditure per year	Cut off	440	455	620	649	440	610	804	1288
	AUC (95% CI)	0.74 (0.70, 0.79)	0.74 (0.69, 0.79)	0.84 (0.81, 0.88)	0.84 (0.80, 0.89)	0.74 (0.70, 0.79)	0.81 (0.76, 0.85)	0.87 (0.82, 0.92)	0.94 (0.90, 0.98)
	sens, spec	0.66, 0.70	0.66, 0.70	0.78, 0.74	0.78, 0.75	0.66, 0.70	0.72, 0.73	0.81, 0.77	0.89, 0.84
	N	3966	3956	3966	3956	3966	3966	3966	3966
Gambling expenditure as proportion of gross personal income	Cut off	1.15	1.17	1.64	1.8	1.15	1.66	2.11	4.35
	AUC (95% CI)	0.75 (0.72, 0.79)	0.76 (0.72, 0.80)	0.82 (0.77, 0.87)	0.83 (0.77, 0.88)	0.75 (0.72, 0.79)	0.79 (0.73, 0.84)	0.86 (0.79, 0.92)	0.95 (0.93, 0.97)
	sens, spec	0.71, 0.67	0.72, 0.66	0.77, 0.71	0.77, 0.72	0.71, 0.67	0.72, 0.71	0.81, 0.75	0.94, 0.85
	N	3587	3576	3587	3576	3587	3587	3587	3587
Number of gambling activities	Cut off	3	3	3	3	3	3	3	3
	AUC (95% CI)	0.65 (0.61, 0.70)	0.66 (0.62, 0.71)	0.71 (0.66, 0.76)	0.72 (0.67, 0.78)	0.65 (0.61, 0.70)	0.67 (0.61, 0.73)	0.74 (0.67, 0.82)	0.79 (0.70, 0.88)
	sens, spec	0.45, 0.76	0.46, 0.76	0.54, 0.75	0.57, 0.75	0.45, 0.76	0.50, 0.74	0.62, 0.74	0.69, 0.74
	N	4252	4272	4252	4272	4252	4252	4252	4252

^a Bold typeface indicates AUC ≥ 0.70^b Endorsement of 2 or more PGSI negative consequence items selected as definition of harm for derivation of responsible gambling limits^c Endorsement of ≥ 1 PGSI item and low-risk gambling (PGSI score ≥ 1) derive the same responsible gambling limits as they are based on the same sample

Table 55. ROC analyses excluding lottery only gamblers for the ACT data according to each definition of harm based on the PGSIa,b

Responsible gambling limit		Endorsement of ≥ 1 PGSI items	Endorsement of ≥ 1 PGSI negative consequence items	Endorsement of ≥ 2 PGSI items	Endorsement of ≥ 2 PGSI negative consequence items	Low-risk gambling (PGSI score ≥ 1) ^c	Moderate-risk gambling (PGSI score ≥ 3)	Modified moderate-risk gambling (PGSI score ≥ 5)	Problem gambling (PGSI score ≥ 8)
Proportion of population exceeding each definition of harm		5.74% (95% CI 4.47, 7.33)	4.26% (95% CI 3.33, 5.44)	2.59% (95% CI 1.92, 3.49)	1.92% (95% CI 1.39, 2.65)	5.74% (95% CI 4.47, 7.33)	1.60% (95% CI 1.12, 2.27)	0.64% (95% CI 0.40, 1.03)	0.41% (95% CI 0.22, 0.75)
Proportion of gamblers exceeding each definition of harm		13.29% (95% CI 10.30, 16.98)	9.71% (95% CI 7.49, 12.50)	6.19% (95% CI 4.55, 8.36)	4.58% (95% CI 3.29, 6.33)	13.29% (95% CI 10.30, 16.98)	3.80% (95% CI 2.64, 5.44)	1.48% (95% CI 0.91, 2.41)	0.99% (95% CI 0.53, 1.82)
Gambling frequency per year	Cut off	16	19	21	19	16	20	28	25
	AUC (95% CI)	0.74 (0.67, 0.81)	0.78 (0.70, 0.85)	0.82 (0.75, 0.88)	0.79 (0.72, 0.87)	0.74 (0.67, 0.81)	0.79 (0.71, 0.87)	0.87 (0.81, 0.93)	0.84 (0.76, 0.92)
	sens, spec	0.70, 0.65	0.73, 0.69	0.79, 0.70	0.78, 0.66	0.70, 0.65	0.77, 0.67	0.85, 0.74	0.82, 0.71
	N	942	942	942	942	942	942	942	942
Gambling expenditure per year	Cut off	275	320	386	389	275	430	920	840
	AUC (95% CI)	0.78 (0.72, 0.85)	0.78 (0.71, 0.86)	0.85 (0.79, 0.91)	0.84 (0.77, 0.91)	0.78 (0.72, 0.85)	0.86 (0.79, 0.93)	0.95 (0.91, 0.98)	0.94 (0.89, 0.98)
	sens, spec	0.72, 0.70	0.71, 0.71	0.80, 0.74	0.79, 0.73	0.72, 0.70	0.81, 0.74	0.92, 0.85	0.91, 0.83
	N	896	896	896	896	896	896	896	896
Gambling expenditure as proportion of gross personal income	Cut off	0.65	0.74	0.93	0.87	0.65	1.01	2.06	2.50
	AUC (95% CI)	0.80 (0.74, 0.85)	0.80 (0.73, 0.86)	0.84 (0.77, 0.91)	0.83 (0.75, 0.91)	0.80 (0.74, 0.85)	0.88 (0.83, 0.92)	0.95 (0.91, 0.99)	0.96 (0.91, 1.00)
	sens, spec	0.72, 0.72	0.72, 0.73	0.76, 0.76	0.77, 0.73	0.72, 0.72	0.84, 0.76	0.90, 0.85	0.91, 0.88
	N	794	794	794	794	794	794	794	794
Number of gambling activities	Cut off	2	2	2	2	2	2	3	2
	AUC (95% CI)	0.68 (0.59, 0.77)	0.69 (0.60, 0.78)	0.71 (0.63, 0.79)	0.67 (0.58, 0.77)	0.68 (0.59, 0.77)	0.74 (0.65, 0.84)	0.76 (0.65, 0.86)	0.70 (0.58, 0.82)
	sens, spec	0.69, 0.56	0.71, 0.55	0.76, 0.54	0.70, 0.54	0.69, 0.56	0.80, 0.54	0.57, 0.79	0.76, 0.53
	N	935	935	935	935	935	935	935	935

^a Bold typeface indicates AUC ≥ 0.70^b Endorsement of 2 or more PGSI negative consequence items selected as definition of harm for derivation of responsible gambling limits^c Endorsement of ≥ 1 PGSI item and low-risk gambling (PGSI score ≥ 1) derive the same responsible gambling limits as they are based on the same sample

Appendix 7. Effect of maximising specificity in ROC analyses on responsible gambling limits

Table 56. ROC maximising specificity (sensitivity >0.50) analyses for the Tasmania data according to each definition of harm based on the PGSI^{a,b}

Responsible gambling limit		Endorsement of ≥ 1 PGSI items	Endorsement of ≥ 1 PGSI negative consequence items	Endorsement of ≥ 2 PGSI items	Endorsement of ≥ 2 PGSI negative consequence items	Low-risk gambling (PGSI score ≥ 1) ^c	Moderate-risk gambling (PGSI score ≥ 3)	Modified moderate-risk gambling (PGSI score ≥ 5)	Problem gambling (PGSI score ≥ 8)
Proportion of population exceeding each definition of harm		6.92% (95% CI 6.10, 7.83)	6.14% (95% CI 5.36, 7.04)	2.84% (95% CI 2.31, 3.48)	2.30% (95% CI 1.81, 2.91)	6.92% (95% CI 6.10, 7.83)	2.36% (95% CI 1.92, 2.91)	1.16% (95% CI 0.88, 1.55)	0.63% (95% CI 0.42, 0.93)
Proportion of gamblers exceeding each definition of harm		11.00% (95% CI 9.74, 12.41)	9.82% (95% CI 8.59, 11.20)	4.52% (95% CI 3.69, 5.52)	3.68% (95% CI 2.90, 4.64)	11.00% (95% CI 9.74, 12.41)	3.76% (95% CI 3.05, 4.62)	1.85% (95% CI 1.39, 2.46)	1.00% (95% CI 0.67, 1.49)
Gambling frequency per year	Cut off	42	41	62	65	42	52	90	149
	AUC (95% CI)	0.70 (0.66, 0.74)	0.69 (0.65, 0.74)	0.76 (0.71, 0.81)	0.76 (0.70, 0.81)	0.70 (0.66, 0.74)	0.71 (0.66, 0.77)	0.79 (0.74, 0.85)	0.86 (0.79, 0.93)
	sens, spec	0.50, 0.77	0.51, 0.76	0.50, 0.83	0.50, 0.83	0.50, 0.77	0.50, 0.79	0.50, 0.88	0.50, 0.93
	N	5753	5754	5753	5754	5753	5753	5753	5753
Gambling expenditure per year	Cut off	854	884	2160	2306	854	1612	3240	7344
	AUC (95% CI)	0.75 (0.71, 0.79)	0.75 (0.70, 0.79)	0.85 (0.82, 0.89)	0.86 (0.82, 0.90)	0.75 (0.71, 0.79)	0.80 (0.76, 0.85)	0.88 (0.83, 0.93)	0.95 (0.91, 0.99)
	sens, spec	0.50, 0.84	0.50, 0.84	0.50, 0.93	0.50, 0.93	0.50, 0.84	0.50, 0.9	0.50, 0.95	0.50, 0.98
	N	5501	5498	5501	5498	5501	5501	5501	5501
Gambling expenditure as proportion of gross personal income	Cut off	2.70	2.88	5.44	6.19	2.70	4.19	8.22	18.72
	AUC (95% CI)	0.76 (0.72, 0.79)	0.76 (0.72, 0.80)	0.83 (0.78, 0.88)	0.84 (0.79, 0.89)	0.76 (0.72, 0.79)	0.78 (0.73, 0.84)	0.87 (0.80, 0.93)	0.96 (0.94, 0.98)
	sens, spec	0.50, 0.83	0.50, 0.84	0.50, 0.90	0.50, 0.91	0.50, 0.83	0.50, 0.87	0.50, 0.93	0.50, 0.97
	N	4958	4954	4958	4954	4958	4958	4958	4958
Number of gambling activities	Cut off	2	2	3	3	2	2	3	3
	AUC (95% CI)	0.71 (0.67, 0.74)	0.72 (0.67, 0.76)	0.77 (0.72, 0.81)	0.78 (0.73, 0.83)	0.71 (0.67, 0.74)	0.72 (0.67, 0.77)	0.79 (0.73, 0.86)	0.83 (0.75, 0.91)
	sens, spec	0.69, 0.60	0.71, 0.60	0.52, 0.83	0.54, 0.83	0.69, 0.60	0.73, 0.58	0.59, 0.82	0.67, 0.82
	N	5833	5860	5833	5860	5833	5833	5833	5833

^a Bold typeface indicates AUC ≥ 0.70^b Endorsement of 2 or more PGSI negative consequence items selected as definition of harm for derivation of responsible gambling limits^c Endorsement of ≥ 1 PGSI item and low-risk gambling (PGSI score ≥ 1) derive the same responsible gambling limits as they are based on the same sample

Table 57. ROC maximising specificity (sensitivity >0.50) analyses for the Tasmania and ACT data according to each definition of harm based on the PGSI^{a,b}

Responsible gambling limit		Endorsement of ≥ 1 PGSI items	Endorsement of ≥ 1 PGSI negative consequence items	Endorsement of ≥ 2 PGSI items	Endorsement of ≥ 2 PGSI negative consequence items	Low-risk gambling (PGSI score ≥ 1) ^c	Moderate-risk gambling (PGSI score ≥ 3)	Modified moderate-risk gambling (PGSI score ≥ 5)	Problem gambling (PGSI score ≥ 8)
Proportion of population exceeding each definition of harm		5.74% (95% CI 4.47, 7.33)	4.26% (95% CI 3.33, 5.44)	2.59% (95% CI 1.92, 3.49)	1.92% (95% CI 1.39, 2.65)	5.74% (95% CI 4.47, 7.33)	1.60% (95% CI 1.12, 2.27)	0.64% (95% CI 0.40, 1.03)	0.41% (95% CI 0.22, 0.75)
Proportion of gamblers exceeding each definition of harm		10.57% (95% CI 8.26, 13.43)	7.85% (95% CI 6.13, 10.00)	4.77% (95% CI 3.53, 6.43)	3.54% (95% CI 2.56, 4.88)	10.57% (95% CI 8.26, 13.43)	2.94% (95% CI 2.06, 4.19)	1.18% (95% CI 0.73, 1.89)	0.75% (95% CI 0.41, 1.38)
Gambling frequency per year	Cut off	33	42	56	49	33	49	76	73
	AUC (95% CI)	0.74 (0.67, 0.81)	0.78 (0.70, 0.85)	0.82 (0.75, 0.88)	0.79 (0.72, 0.86)	0.74 (0.67, 0.81)	0.79 (0.71, 0.87)	0.84 (0.74, 0.94)	0.85 (0.77, 0.93)
	sens, spec	0.51, 0.82	0.51, 0.85	0.50, 0.89	0.50, 0.86	0.51, 0.82	0.50, 0.86	0.50, 0.91	0.51, 0.90
	N	1215	1215	1215	1215	1215	1215	1215	1215
Gambling expenditure per year	Cut off	770	874	1440	1380	770	1650	4120	4310
	AUC (95% CI)	0.79 (0.73, 0.85)	0.79 (0.72, 0.87)	0.85 (0.80, 0.91)	0.84 (0.78, 0.91)	0.79 (0.73, 0.85)	0.86 (0.80, 0.93)	0.94 (0.88, 0.99)	0.95 (0.91, 0.99)
	sens, spec	0.50, 0.88	0.50, 0.88	0.50, 0.92	0.51, 0.91	0.50, 0.88	0.50, 0.93	0.50, 0.97	0.50, 0.97
	N	1157	1157	1157	1157	1157	1157	1157	1157
Gambling expenditure as proportion of gross personal income	Cut off	1.79	2.08	3.27	3.03	1.79	4.17	12.74	16.92
	AUC (95% CI)	0.81 (0.76, 0.87)	0.82 (0.76, 0.88)	0.86 (0.79, 0.92)	0.85 (0.77, 0.92)	0.81 (0.76, 0.87)	0.89 (0.85, 0.93)	0.96 (0.92, 0.99)	0.97 (0.93, 1.01)
	sens, spec	0.50, 0.90	0.50, 0.90	0.50, 0.93	0.50, 0.92	0.50, 0.90	0.50, 0.94	0.50, 0.98	0.50, 0.99
	N	1014	1014	1014	1014	1014	1014	1014	1014
Number of gambling activities	Cut off	2	2	2	2	2	3	3	2
	AUC (95% CI)	0.73 (0.65, 0.81)	0.73 (0.65, 0.80)	0.77 (0.70, 0.84)	0.73 (0.65, 0.82)	0.73 (0.65, 0.81)	0.79 (0.71, 0.88)	0.79 (0.68, 0.89)	0.77 (0.65, 0.88)
	sens, spec	0.66, 0.68	0.66, 0.66	0.74, 0.66	0.69, 0.65	0.66, 0.68	0.52, 0.87	0.53, 0.86	0.76, 0.64
	N	1208	1208	1208	1208	1208	1208	1208	1208

^a Bold typeface indicates AUC ≥ 0.70^b Endorsement of 2 or more PGSI negative consequence items selected as definition of harm for derivation of responsible gambling limits^c Endorsement of ≥ 1 PGSI item and low-risk gambling (PGSI score ≥ 1) derive the same responsible gambling limits as they are based on the same sample

Appendix 8. Effect of maximising sensitivity in ROC analyses on responsible gambling limits

The most extreme lower estimates for each of the responsible gambling limits for the Tasmania and ACT data were identified by exploring the optimal cut-offs in ROC analyses across the multiple definitions of harm based on the PGSI after reducing specificity to a minimum of 0.50 (Table 58 and Table 59). The optimal responsible gambling limits were generally robust to variations in definitions of harm ($AUC \geq 0.70$), with most in the moderate accuracy classification range ($AUC = 0.70-0.90$). The various definitions of harm produced very consistent responsible gambling limits across the four gambling indices.

The responsible gambling limits across both datasets ranged from:

- 9 to 16 times per year for gambling frequency
- \$101 to \$177 per year for gambling expenditure
- 0.20 to 0.53% for gambling expenditure as a proportion of gross personal income, and
- 2 gambling activities for number of activities.

The selected definition of harm based on two or more of the seven negative consequence PGSI items produced acceptable responsible gambling limits for all of the four gambling indices across both datasets in these analyses. The limits identified in these analyses were relatively consistent across the two jurisdictions, although the ACT limits were consistently slightly lower than the Tasmanian limits.

Maximising sensitivity, the responsible gambling limits for the Australian population based on the selected definition of harm are estimated to be:

- a gambling frequency of 10 to 16 times per year;
- a gambling expenditure of \$115 to \$169 per year;
- a gambling expenditure comprising 0.24% to 0.51% of an individual's gross personal income; and
- 2 gambling activities.

These responsible gambling limits were generally approximately one-third to one-half the proposed responsible gambling limits identified using the Youden index.

Table 58. ROC analyses maximising sensitivity (specificity >0.50) analyses for the Tasmanian data according to each definition of harm based on the PGSI^{a,b}

		Endorsement of ≥ 1 PGSI items	Endorsement of ≥ 1 PGSI negative consequence items	Endorsement of ≥ 2 PGSI items	Endorsement of ≥ 2 PGSI negative consequence items	Low-risk gambling (PGSI score ≥ 1) ^c	Moderate- risk gambling (PGSI score ≥ 3)	Modified moderate- risk gambling (PGSI score ≥ 5)	Problem gambling (PGSI score ≥ 8)
Proportion of population exceeding each definition of harm		6.92% (95% CI 6.10, 7.83)	6.14% (95% CI 5.36, 7.04)	2.84% (95% CI 2.31, 3.48)	2.30% (95% CI 1.81, 2.91)	6.92% (95% CI 6.10, 7.83)	2.36% (95% CI 1.92, 2.91)	1.16% (95% CI 0.88, 1.55)	0.63% (95% CI 0.42, 0.93)
Proportion of gamblers exceeding each definition of harm		11.00% (95% CI 9.74, 12.41)	9.82% (95% CI 8.59, 11.20)	4.52% (95% CI 3.69, 5.52)	3.68% (95% CI 2.90, 4.64)	11.00% (95% CI 9.74, 12.41)	3.76% (95% CI 3.05, 4.62)	1.85% (95% CI 1.39, 2.46)	1.00% (95% CI 0.67, 1.49)
Gambling frequency per year	Cut off	15	15	16	16	15	16	16	16
	AUC (95% CI)	0.70 (0.66, 0.74)	0.69 (0.65, 0.74)	0.76 (0.71, 0.81)	0.76 (0.70, 0.81)	0.70 (0.66, 0.74)	0.71 (0.66, 0.77)	0.79 (0.74, 0.85)	0.86 (0.79, 0.93)
	sens, spec	0.75, 0.51	0.75, 0.51	0.84, 0.52	0.84, 0.51	0.75, 0.51	0.77, 0.51	0.87, 0.51	0.93, 0.51
	N	5753	5754	5753	5754	5753	5753	5753	5753
Gambling expenditure per year	Cut off	154	158	165	169	154	170	174	177
	AUC (95% CI)	0.75 (0.71, 0.79)	0.75 (0.70, 0.79)	0.85 (0.82, 0.89)	0.86 (0.82, 0.90)	0.75 (0.71, 0.79)	0.80 (0.76, 0.85)	0.88 (0.83, 0.93)	0.95 (0.91, 0.99)
	sens, spec	0.81, 0.50	0.82, 0.50	0.94, 0.50	0.94, 0.50	0.81, 0.50	0.87, 0.50	0.95, 0.50	1.00, 0.50
	N	5501	5498	5501	5498	5501	5501	5501	5501
Gambling expenditure as proportion of gross personal income	Cut off	0.46	0.47	0.50	0.51	0.46	0.51	0.52	0.53
	AUC (95% CI)	0.76 (0.72, 0.79)	0.76 (0.72, 0.80)	0.83 (0.78, 0.88)	0.84 (0.79, 0.89)	0.76 (0.72, 0.79)	0.78 (0.73, 0.84)	0.87 (0.80, 0.93)	0.96 (0.94, 0.98)
	sens, spec	0.84, 0.50	0.85, 0.50	0.92, 0.50	0.93, 0.50	0.84, 0.50	0.86, 0.50	0.95, 0.50	1.00, 0.50
	N	4958	4954	4958	4954	4958	4958	4958	4958
Number of gambling activities	Cut off	2	2	2	2	2	2	2	2
	AUC (95% CI)	0.71 (0.67, 0.74)	0.72 (0.67, 0.76)	0.77 (0.72, 0.81)	0.78 (0.73, 0.83)	0.71 (0.67, 0.74)	0.72 (0.67, 0.77)	0.79 (0.73, 0.86)	0.83 (0.75, 0.91)
	sens, spec	0.69, 0.60	0.71, 0.60	0.80, 0.58	0.82, 0.58	0.69, 0.60	0.73, 0.58	0.83, 0.57	0.89, 0.57
	N	5833	5860	5833	5860	5833	5833	5833	5833

^a Bold typeface indicates AUC ≥ 0.70^b Endorsement of 2 or more PGSI negative consequence items selected as definition of harm for derivation of responsible gambling limits^c Endorsement of ≥ 1 PGSI item and low-risk gambling (PGSI score ≥ 1) derive the same responsible gambling limits as they are based on the same sample

Table 59. ROC analyses maximising sensitivity (specificity >0.50) analyses for the ACT data according to each definition of harm based on the PGSI^{a,b}

		Endorsement of ≥ 1 PGSI items	Endorsement of ≥ 1 PGSI negative consequence items	Endorsement of ≥ 2 PGSI items	Endorsement of ≥ 2 PGSI negative consequence items	Low-risk gambling (PGSI score ≥ 1) ^c	Moderate-risk gambling (PGSI score ≥ 3)	Modified moderate-risk gambling (PGSI score ≥ 5)	Problem gambling (PGSI score ≥ 8)
Proportion of population exceeding each definition of harm		5.74% (95% CI 4.47, 7.33)	4.26% (95% CI 3.33, 5.44)	2.59% (95% CI 1.92, 3.49)	1.92% (95% CI 1.39, 2.65)	5.74% (95% CI 4.47, 7.33)	1.60% (95% CI 1.12, 2.27)	0.64% (95% CI 0.40, 1.03)	0.41% (95% CI 0.22, 0.75)
Proportion of gamblers exceeding each definition of harm		10.57% (95% CI 8.26, 13.43)	7.85% (95% CI 6.13, 10.00)	4.77% (95% CI 3.53, 6.43)	3.54% (95% CI 2.56, 4.88)	10.57% (95% CI 8.26, 13.43)	2.94% (95% CI 2.06, 4.19)	1.18% (95% CI 0.73, 1.89)	0.75% (95% CI 0.41, 1.38)
Gambling frequency per year	Cut off	9	10	10	10	9	10	10	11
	AUC (95% CI)	0.74 (0.67, 0.81)	0.78 (0.70, 0.85)	0.82 (0.75, 0.88)	0.79 (0.72, 0.86)	0.74 (0.67, 0.81)	0.79 (0.71, 0.87)	0.84 (0.74, 0.94)	0.85 (0.77, 0.93)
	sens, spec	0.82, 0.50	0.85, 0.53	0.90, 0.52	0.88, 0.51	0.82, 0.50	0.87, 0.51	0.93, 0.50	0.94, 0.52
	N	1215	1215	1215	1215	1215	1215	1215	1215
Gambling expenditure per year	Cut off	101	106	112	115	101	120	120	122
	AUC (95% CI)	0.79 (0.73, 0.85)	0.79 (0.72, 0.87)	0.85 (0.80, 0.91)	0.84 (0.78, 0.91)	0.79 (0.73, 0.85)	0.86 (0.80, 0.93)	0.94 (0.88, 0.99)	0.95 (0.91, 0.99)
	sens, spec	0.88, 0.50	0.87, 0.50	0.94, 0.50	0.93, 0.50	0.88, 0.50	0.95, 0.51	0.99, 0.50	1.00, 0.50
	N	1157	1157	1157	1157	1157	1157	1157	1157
Gambling expenditure as proportion of gross personal income	Cut off	0.20	0.22	0.23	0.24	0.20	0.24	0.25	0.25
	AUC (95% CI)	0.81 (0.76, 0.87)	0.82 (0.76, 0.88)	0.86 (0.79, 0.92)	0.85 (0.77, 0.92)	0.81 (0.76, 0.87)	0.89 (0.85, 0.93)	0.96 (0.92, 0.99)	0.97 (0.93, 1.01)
	sens, spec	0.89, 0.50	0.89, 0.50	0.93, 0.50	0.93, 0.50	0.89, 0.50	0.97, 0.50	1.00, 0.50	1.00, 0.50
	N	1014	1014	1014	1014	1014	1014	1014	1014
Number of gambling activities	Cut off	2	2	2	2	2	2	2	2
	AUC (95% CI)	0.73 (0.65, 0.81)	0.73 (0.65, 0.80)	0.77 (0.70, 0.84)	0.73 (0.65, 0.82)	0.73 (0.65, 0.81)	0.79 (0.71, 0.88)	0.79 (0.68, 0.89)	0.77 (0.65, 0.88)
	sens, spec	0.66, 0.68	0.66, 0.66	0.74, 0.66	0.69, 0.65	0.66, 0.68	0.78, 0.65	0.78, 0.64	0.76, 0.64
	N	1208	1208	1208	1208	1208	1208	1208	1208

^a Bold typeface indicates AUC ≥ 0.70^b Endorsement of 2 or more PGSI negative consequence items selected as definition of harm for derivation of responsible gambling limits^c Endorsement of ≥ 1 PGSI item and low-risk gambling (PGSI score ≥ 1) derive the same responsible gambling limits as they are based on the same sample

Table 60 displays the positive and negative predictive values based on the prevalence of gambling-related harm in the population (2.30% Tasmania, 1.92% ACT) and gambling (3.68% Tasmania, 3.54% ACT) samples for both the Tasmanian and ACT data after maximising sensitivity. The findings reveal that, in the Tasmanian and ACT general populations, between 3.4% and 4.4% of people who exceed the limits will actually be experiencing gambling-related harm; this is a decrease from the 3.7 to 7.4% of the general population using the Youden Index. Between 99.1% and 99.7% of people who stay within the limits will not be experiencing gambling-related harm; this compares to the 99.0% and 99.4% of the population using the Youden Index. Between 6.2% and 6.9% of Tasmanian and ACT gamblers who exceed the limits will actually be experiencing gambling-related harm; this is a decrease from the 6.8 to 11.5% of gamblers using the Youden Index. Between 98.3% and 99.5% of gamblers who stay within the limits will not be experiencing gambling-related harm; this compares to the 98.3% to 98.9% of gamblers using the Youden Index. Taken together, these findings suggest that decreasing the responsible gambling limits to those identified after maximising sensitivity would identify a smaller proportion of gamblers exceeding the limits who are actually experiencing gambling-related harm; but would not considerably impact on the identification of gamblers who stay within the limits and do not experience gambling-related harm.

Table 60. Positive and negative predictive values based on the prevalence of gambling-related harm in the Tasmanian and ACT population and gambling samples after maximising sensitivity

Responsible gambling limit	Positive and negative predictive values based on the prevalence of gambling-related harm in the population				Positive and negative predictive values based on the prevalence of gambling-related harm in gamblers			
	<i>Tasmanian data</i> (prevalence = 2.30%)		<i>ACT data</i> (prevalence = 1.92%)		<i>Tasmanian data</i> (prevalence = 3.68%)		<i>ACT data</i> (prevalence = 3.54%)	
	Positive predictive value (%)	Negative predictive value (%)	Positive predictive value (%)	Negative predictive value (%)	Positive predictive value (%)	Negative predictive value (%)	Positive predictive value (%)	Negative predictive value (%)
Gambling frequency per year	3.88	99.27	3.40	99.54	6.15	98.82	6.18	99.14
Gambling expenditure per year	4.24	99.72	3.51	99.73	6.70	99.54	6.39	99.49
Gambling expenditure as proportion of gross personal income	4.20	99.67	3.51	99.73	6.63	99.47	6.39	99.49
Number of gambling activities	4.39	99.27	3.72	99.08	6.94	98.83	6.75	98.28

Appendix 9. Contribution of gambling activity-specific responsible gambling limits to gambling-related harm

Although we can make some inferences for some gambling activities, particularly those with higher AUCs such as EGMs, the derivation of gambling activity-specific responsible gambling limits in the previous sections are fundamentally limited by the inability to link gambling-related harms to specific gambling activities. This is because the PGSI was only asked once, rather than for every gambling activity. This is of concern given that some gambling activities, predominantly including EGMs, are thought to contribute more to gambling-related harm than others (Dowling et al., 2005). In order to identify which of the proposed responsible gambling limits relating to specific gambling activities contributed most to gambling-related harm, a series of analyses were conducted for each of the gambling behaviour indices. These analyses are distinct from the previous analyses presented in the gambling activity-specific limits section as they were conducted across the entire gambling samples from both the Tasmanian and ACT data (i.e., they were not restricted to the group of gamblers participating in each specific gambling activity). The purpose of these analyses are to ascertain the contribution of exceeding the limits pertaining to each specific gambling activity.

Separate logistic regression models (adjusted for socio-demographic characteristics) exploring whether the gambling activity-specific responsible gambling limits for each of the gambling behaviour indices across specific gambling activities predicted gambling-related across both datasets are displayed in

Table 61.

The findings suggest that:

- **Gambling frequency limits:** Exceeding all of the proposed gambling activity-specific gambling frequency limits (EGMs, keno, and sports/other event betting) significantly predicted gambling-related harm.
- **Gambling expenditure limits:** Exceeding all of the proposed gambling activity-specific gambling expenditure limits (EGMs, instant scratch tickets, keno, bingo, casino table games, and sports/other event betting) significantly predicted gambling-related harm.
- **Gambling expenditure as a proportion of gross personal income limits:** With the exception of bingo gambling expenditure limit in the Tasmania data, exceeding all of the proposed gambling activity-specific gambling expenditure as a proportion of gross personal income limits (EGMs, horse/dog racing, lottery, casino table games, and sports/other event betting) significantly predicted gambling-related harm.
- **Session expenditure limits:** Exceeding the proposed EGM gambling activity-specific session expenditure limit, but not the bingo session expenditure limit, significantly predicted gambling-related harm.
- **Session duration limits:** Exceeding both of the proposed gambling activity-specific session duration limits (EGMs and bingo) significantly predicted gambling-related harm.

A logistic regression model (adjusted for the other proposed gambling activity-specific responsible gambling limits and socio-demographic characteristics) employed for each gambling behaviour index in order to identify the unique contribution of the limits relating to each gambling activity is also displayed in

Table 61.

The findings revealed that:

- **Gambling frequency limits:** After controlling for the other proposed gambling activity-specific frequency limits, gambling-related harm was significantly independently predicted by exceeding all of the proposed frequency limits (EGMs, keno, sports/other event betting).
- **Gambling expenditure limits:** After controlling for the other proposed gambling activity-specific expenditure limits, gambling-related harm was significantly independently predicted by exceeding the proposed gambling expenditure limits for EGMs, casino table games, and sports/other event betting, but not instant scratch tickets and keno) in the Tasmania data; and for EGMs and keno, but not bingo, in the ACT data.
- **Gambling expenditure as proportion of gross personal income limits:** After controlling for the other proposed gambling activity-specific expenditure as a proportion of gross personal income limits, gambling-related harm was significantly independently predicted by exceeding the proposed gambling expenditure as a proportion of gross personal income limits for EGMs, casino table games, and sports/other event betting, but not horse/dog racing and bingo, in the Tasmania data; and for EGMs and lottery, but not casino table games and sports/other event betting, in the ACT data.
- **Session expenditure limits:** After controlling for the other proposed gambling activity-specific session expenditure limits, gambling-related harm was not significantly independently predicted by either of the proposed session expenditure limits (EGMs or bingo).
- **Session duration limits:** After controlling for the other proposed gambling activity-specific session duration limits, gambling-related harm was significantly independently predicted by exceeding both of the proposed session duration limits (EGMs and bingo) in the ACT data.

These findings indicate that, across the entire gambling sample, exceeding the EGM, keno and sports/other event betting frequency limits independently predict gambling-related harm; exceeding the EGM, keno, casino table games, and sports/other event betting expenditure limits independently predict gambling-related harm; exceeding the EGM, lottery, casino table games, and sports/other event betting expenditure as a proportion of gross personal income limits independently predict gambling-related harm; and exceeding the EGM and bingo session duration limits independently predict gambling-related harm.

Taken together, these findings suggest exceeding the proposed gambling activity-specific responsible gambling limits are generally good predictors of gambling-related harm in the entire Tasmanian and ACT gambling samples. An examination of the results in relation to the contribution of each of the proposed gambling activity-specific responsible gambling limits across both sets of analyses revealed that:

- **EGM-specific limits:** Across both sets of analyses, the proposed EGM-specific limits were generally the strongest predictors of gambling-related harm across all limits. Exceeding the proposed EGM-specific limits significantly predicted gambling-related harm across all limits (gambling frequency, gambling expenditure, gambling expenditure as a proportion of gross personal income, session expenditure, and session duration) in both datasets and were consistently the strongest predictors of gambling-related harm. These limits also independently predicted gambling-related harm across almost all limit types (except session expenditure) after controlling for the other limits; and were the strongest independent predictors of gambling-related harm across all limit types.
- **Casino table games-specific limits:** Exceeding the proposed limits for casino table gambling were also strong significant predictors of gambling-related harm across limit types. Exceeding these limits significantly predicted gambling-related harm across all proposed limits (gambling expenditure and gambling expenditure as a proportion of gross personal income); and independently predicted gambling-related harm for the limits related to gambling expenditure and gambling expenditure as a proportion of gross personal income (Tasmania but not ACT) after controlling for the other limits; but these relationships were not as strong as those for EGMs.

- **Sports/other event betting-specific limits:** Similarly, exceeding the proposed limits for sports/other event betting were also strong significant predictors of gambling-related harm across limit types. Exceeding these limits significantly predicted gambling-related harm across all proposed limits (gambling frequency, gambling expenditure, and gambling expenditure as a proportion of gross personal income); and independently predicted gambling-related harm for these limits after controlling for the other limits, with the exception of gambling expenditure as a proportion of income in the ACT data; but these relationships were not as strong as those for EGMs.
- **Keno-specific limits:** The proposed limits for keno (gambling frequency and gambling expenditure) were significantly associated with gambling-related harm; and independently predicted gambling-related harm for these limit types after also controlling for the other limits (with the exception of gambling expenditure in the ACT data). Moreover, these relationships were not as strong as those for EGMs, casino table games, or sports/other event betting.
- **Horse/dog racing-specific limits:** The only proposed limit for horse/dog racing (gambling expenditure as a proportion of gross personal income) was significantly associated with gambling-related harm, but this relationship was not as strong as the other gambling activities (EGMs, casino table games, sports/other betting, or keno). Moreover, exceeding this limit did not independently predict gambling-related harm after controlling for the other limits.
- **Lottery-specific limits:** Similarly, the only proposed limit for lottery (gambling expenditure as a proportion of gross personal income) was significantly associated with gambling-related harm; and remained significant when controlling for other limits. However, these relationships were not as strong as those for other gambling activities (EGMs, casino table games, sports/other betting, or keno).
- **Instant scratch tickets-specific limits:** The only proposed limit for instant scratch tickets (gambling expenditure) was significantly associated with gambling-related harm, but this relationship was not as strong as the other gambling activities and did not remain significant when controlling for other limits.
- **Bingo-specific limits:** The proposed limits for bingo were the least strongly associated with gambling-related harm across limit types. The bingo-specific gambling expenditure and session duration limits were significantly associated with gambling-related harm; but only the session duration limit remained significant after controlling for the other limits.

Table 61. Cross-sectional prediction of the selected definition of gambling-related harm in Tasmania and the ACT by the proposed responsible gambling limits for each gambling behaviour index ^a

Gambling activity	OR	Robust standard error	z	p	95% CI		OR	Robust standard error	z	p	95% CI	
	Adjusted for socio-demographics ^b						Adjusted for other limits/socio-demographics ^c					
	Gambling frequency per year											
	Tasmanian data											
EGMs	13.78	3.84	9.42	0.000	7.99	23.79	12.23	4.02	7.62	0.000	6.42	23.28
Keno	5.32	1.34	6.66	0.000	3.25	8.70	1.93	0.56	2.26	0.024	1.09	3.43
Sports/other event betting	8.01	3.42	4.88	0.000	3.47	18.47	9.74	4.60	4.82	0.000	3.86	24.58
	ACT data											
EGMs	11.55	5.17	5.47	0.000	4.81	27.77	10.49	4.78	5.15	0.000	4.29	25.64
Keno	8.74	4.90	3.86	0.000	2.91	26.24	4.36	2.49	2.57	0.010	1.42	13.38
	Gambling expenditure per year											
	Tasmanian data											
EGMs	19.33	5.40	10.6	0.000	11.18	33.43	16.8	5.17	9.18	0.000	9.20	30.69
Instant scratch tickets	2.94	0.94	3.37	0.001	1.57	5.50	1.40	0.44	1.08	0.279	0.76	2.58
Keno	4.67	1.22	5.91	0.000	2.80	7.80	1.45	0.41	1.31	0.190	0.83	2.53
Casino table games	16.46	7.89	5.84	0.000	6.43	42.13	3.08	1.50	2.32	0.021	1.19	8.00
Sports/other event betting	13.11	5.35	6.31	0.000	5.90	29.16	16.23	7.67	5.90	0.000	6.43	40.96
	ACT data											
EGMs	13.54	5.32	6.63	0.000	6.27	29.25	11.47	4.55	6.16	0.000	5.28	24.94
Keno	15.46	8.84	4.79	0.000	5.04	47.40	4.53	2.77	2.47	0.014	1.36	15.04
Bingo	3.42	2.11	2.00	0.045	1.03	11.43	1.31	1.17	0.31	0.760	0.23	7.58
	Gambling expenditure as proportion of gross personal income											
	Tasmanian data											
EGMs	12.54	3.72	8.53	0.000	7.02	22.42	11.41	3.00	9.27	0.000	6.82	19.09
Horse/dog racing	3.85	1.10	4.73	0.000	2.20	6.74	1.65	0.57	1.44	0.149	0.84	3.25
Casino table games	9.78	4.98	4.48	0.000	3.61	26.51	3.39	1.61	2.57	0.010	1.33	8.60
Bingo	1.14	0.79	0.19	0.846	0.29	4.45	0.41	0.35	-1.06	0.290	0.08	2.15
Sports/other event betting	7.94	3.35	4.90	0.000	3.47	18.16	5.20	2.66	3.22	0.001	1.91	14.18
	ACT data											
EGMs	19.18	7.91	7.16	0.000	8.55	43.05	14.28	6.35	5.98	0.000	5.97	34.15
Lottery	3.90	1.55	3.44	0.001	1.79	8.48	2.53	1.19	1.98	0.048	1.01	6.36
Casino table games	8.16	5.48	3.13	0.002	2.19	30.42	1.29	1.22	0.27	0.785	0.20	8.23

Sports/other event betting	12.27	6.95	4.43	0.000	4.05	37.21	3.79	3.98	1.27	0.204	0.48	29.68
	Session expenditure											
	Tasmanian data											
EGMs	13.78	3.74	9.67	0.000	8.10	23.44	3.48	5.13	0.85	0.396	0.19	62.33
Bingo	3.67	4.77	1.00	0.316	0.29	46.82	3.39	4.23	0.98	0.328	0.29	39.16
	ACT data											
EGMs	11.09	4.62	5.78	0.000	4.90	25.09	10.82	4.54	5.67	0.000	4.75	24.63
Bingo	4.47	2.28	2.94	0.003	1.65	12.15	2.78	1.44	1.97	0.049	1.01	7.70

^a Analyses conducted across entire gambling samples (i.e., not restricted to the group of gamblers participating in each specific gambling activity)

^b Separate regressions predicting gambling-related harm by each of the proposed responsible gambling limits after controlling for socio-demographic characteristics (age, gender, education, country of birth)

^c Prediction of gambling-related harm by each responsible gambling limit after controlling for the other proposed responsible gambling limits and socio-demographic characteristics (age, gender, education, country of birth)

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