SOCIAL INFLUENCES ON GAMBLERS BY RISK GROUP: AN EGOCENTRIC SOCIAL NETWORK ANALYSIS

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RESEARCH REPORT

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Social influences on gamblers by risk group: An egocentric social network analysis

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Acronyms

Term	Description
ATGS	Attitude Towards Gambling Scale
ATSI	Aboriginal and Torres Strait Islander
ANOVA	Analysis Of Variance
ECR	Early Career Research
EGM	Electronic Gaming Machine
LOTE	Language Other than English
LR	Low Risk (PGSI category)
MR	Moderate Risk Gambler (PGSI category)
NG	Non-Gambler (in the last 12 months)
NP	Non-Problem Gambler (PGSI category)
PG	Problem Gambler (PGSI category)
PGSI	Problem Gambling Severity Index
SD	Standard Deviation
SNA	Social Network Analysis
SPSS	Statistical Package for the Social Sciences
VRGF	Victorian Responsible Gambling Foundation

Executive summary

Research aims and objectives

The specific aims of the project are to use egocentric social network analysis (described in Chapter 2) in order to:

1. Capture and map the nature of the social networks (i.e., social context) for low risk and moderate risk gamblers, in terms of the gambling and other potentially risky behaviours (e.g. alcohol consumption) of the most influential people around them;

2. Determine whether the social networks around low risk and moderate risk gamblers differ to those around non-gamblers, non-problem gamblers and problem gamblers, and how they differ;

3. Consider the potential role of social networks on the normalisation of gambling behaviour.

Methodology

A total of 784 respondents (18+ from Victoria) were recruited through an online market research panel, with approximately equal numbers of non-gamblers, non-problem gamblers, low risk gamblers, moderate risk gamblers and problem gamblers.

Each respondent (ego) completed questions about their own demographics and gambling, smoking and drinking behaviours, including whether they had experienced harm from their gambling. They then identified the 20 most influential people in their lives (alters), and completed questions about them. The questions about the alters included their demographics, the nature and strength of their relationship with the ego, their gambling, drinking and smoking behaviours, and whether they had experienced harms from their gambling. Finally, each ego reported which of their alters knew each other.

The methodology was based on egocentric social network analysis. Social network analysis in general, and the specifics of egocentric social network analysis, are discussed in Chapter 2, while details about the methodology and specific methods are discussed in Chapter 3.

Results and discussion

The key results from this study are summarised below. Full results are presented in Chapter 4.

Egos

- The results for each group in terms of the egos' demographics and behaviours were consistent with previous literature. Those in higher risk gambling groups tended to be younger, were more likely to

be male, tended to be more engaged gamblers, and to engage in other comorbid behaviours (smoking and drinking) more frequently.

- They were also significantly more likely to experience more harm from their gambling. In particular, the low risk and moderate risk gamblers (the key groups of interest for the present study) were between non-problem gamblers and problem gamblers for most of these measures, as would be expected.
- These results indicated robustness in the sampling procedure.
- Comorbid behaviours (alcohol and smoking) were significantly more likely to be linked to gambling behaviour for those in higher risk groups.

Alters

- Egos in higher risk groups, particularly moderate risk and problem gamblers, were significantly more likely to have alters who were closer in age to them than those for lower risk and non-gamblers.
- No differences between the groups were found for similarity in gender.
- Those in higher risk groups were surrounded by significantly more gamblers. For non-gamblers, 3.7 of the 20 alters were gamblers. For non-problem gamblers, 7.3 of the 20 alters were gamblers. For low risk, 9.4 gamblers, for moderate risk, 9.9 gamblers and for problem gamblers, 13 of the 20 alters (on average) were gamblers.
- This indicates a role of either normalisation of behaviour through social influence, or social selection, whereby people associate with others who share their interests, or a combination of normalisation and social selection.
- These social influences appear to come from family, friends and colleagues, with no significant difference between influences from these different groups of alters, although this is likely to differ for individual respondents.
- As noted above, comorbid behaviours (smoking and drinking) were significantly more likely to be linked to gambling behaviour for egos in higher risk groups. The same was true for their alters, with egos in higher gambling risk groups surrounded by more smokers and drinkers.

Ego-alter relationships

- No significant differences were found between the groups in terms of the proportion of their 20 alters who were family, friends or colleagues.
- Low risk and problem gamblers were significantly closer to their alters than non-problem gamblers. Previous studies have found social isolation as a risk factor for problem gambling, but the present

results suggest that this may not be the case in general. Given that the networks of higher risk gamblers include more alters who share similar interests, it is perhaps not surprising that they feel closer to their alters than do non-problem gamblers. We do not discount social isolation as an important risk factor for developing problem gambling, as isolation may have resulted in these gamblers seeking to socialise with people who share their influences (social selection).

- Not only are egos in higher risk groups surrounded by more gamblers, but they also gamble with a higher proportion of them. Non-problem gamblers gamble with approximately 39% of their alters who are also gamblers. For low risk gamblers, the figure is 50%, while for moderate risk gamblers, the figure is 57%, and for problem gamblers, 80%.

- Egos in higher risk groups are also surrounded by more alters who have experienced harm from their gambling. This does not appear to deter these egos from gambling with them. Non-problem gamblers gamble with about 11% of their harmed alters, compared to 37% for low risk, 45% for moderate risk and 62% for problem gamblers.

- Thus, if we accept that being surrounded by gamblers normalises the behaviour, then being surrounded by, and gambling with, harmed gamblers is also likely to normalise experiencing gambling-related harm.

Structures of social networks

- Density refers to how many of the possible alter-alter relationships actually exist (how many of the alters know each other), with a higher number indicating that more of those relationships exist (see Chapter 3 for details). The social networks of moderate risk gamblers are significantly denser than those of non-problem gamblers, and the networks of problem gamblers are denser than all other gambling and non-gambling groups. For low risk gamblers, their networks are not significantly different to either non-problem or moderate risk gamblers in terms of density, although they are more similar to those of moderate risk gamblers.

- Problem gamblers, in general, do not appear to have distinct social circles. The gamblers in their networks are closely connected to the non-gamblers. They are therefore less able to hide their gambling from certain parts of their network, and therefore also have more social opportunities to gamble with members of their network.

- This also means that it is more difficult for problem gamblers to escape from gambling. Individuals with an isolated group of gamblers can take steps to avoid or spend less time with those people, but for most problem gamblers in particular, this does not appear to be the case.

- Network hierarchy was significantly lower for problem gamblers than all other groups apart from moderate risk gamblers, indicating that problem gambler egos are fairly equally connected to all alters in their networks, rather than just to key individuals. This means that the social influences for problem gamblers cannot simply be managed through changes in the relationship with a small number of key individuals, and that the whole network must be taken into account.

- The implication is that treating a person for gambling-related issues, particularly those in the moderate risk and problem categories, is less likely to be successful if steps to reduce social influences are not also considered. Because of the density of networks for higher risk groups, particularly moderate risk and problem gamblers, these social influences may be hard to alter or avoid. Thus approaches that change norms around gambling may be more influential.

Multivariate models

- Because social networks vary based on factors other than gambling, particularly on age, and because factors such as age are related to gambling-risk group, we also conducted multivariate analyses to determine whether the differences in key variables above are related to being in a higher risk group directly.

- Being a problem gambler (but not a moderate risk gambler) remained a significant predictor for network density when controlling for ego and alter characteristics, as well as ego-alter relationship characteristics.

- When controlling for ego, alter and ego-alter relationship characteristics, being a low risk, moderate risk or problem gambler (compared to non-problem gambler) remained significant predictors for gambling-related harm.

- This indicates that the normalisation of gambling is not due solely to ego, alter, and ego-alter relationship characteristics, but also that a significant proportion of that normalisation is due to risk group.

Limitations of the findings

Key limitations are listed below, but should be read in conjunction with the full discussion provided in Chapter 5.

- The study is cross-sectional, and is therefore unable to observe changes in social networks over time, and as behaviour changes. The sample was recruited online, and therefore may not be representative.

- Respondents were required to provide information on 20 alters, but were also limited to 20 alters, in order to keep the survey to a manageable length. Nevertheless, previous research suggests that this number is likely to be optimal (Meisel et al, 2013).

- The egocentric methodology does not collect information from alters, and thus relies on the ego knowing certain information about their alters. However, since we are interested in the influence of the alters on the ego, it is likely to be the ego's perception of the alter's behaviour that matters, rather than the alter's actual behaviour.

- Egocentric methodology is limited to a small network around the ego; it cannot identify clusters in society as a whole. Sociocentric social network analysis is appropriate for finding clusters, although practical limitations for gambling research make this particularly difficult (see Chapter 2).

- The research was captured using a self-report online survey, and is thus subject to limitations around self-report data, such as exaggeration or social desirability bias.

Strengths of the findings

This study is the first study with a sample size >40 to measure the social networks of gamblers. It is the first to consider and directly compare the social networks of non-gamblers and non-problem, low risk, moderate risk and problem gamblers. It highlights the distinct role of social influence, likely through normalisation and social selection, not just of gambling, but also experiencing gambling-related harms. It also highlights the social influence of other comorbid behaviours, in drinking and smoking.

The measures of network density in particular are the first to highlight key challenges for reducing social influence on gamblers in higher risk groups. It highlights that the networks even of low risk gamblers include a significantly higher number of alters who gamble, and that this is even higher for moderate risk and problem gamblers. The results highlight key challenges for individual approaches to altering these social influences, particularly of those in moderate risk and problem gambler groups, due to the interconnected nature of their networks, and because so many of their alters are also gamblers.

The study highlights how egocentric social network analysis could be a particularly powerful tool for identifying social influences on an individual basis, and discusses potential strategies for using this information. We also discuss how approaches that challenge and change norms in society are likely to be more successful for these higher risk groups, given the challenges of altering social networks that are so interconnected. However, we note that these possible strategies have not been tested, and the most appropriate approaches are likely to differ depending on the ego's demographics, behaviours, social networks, and various other factors. Determining optimal strategies is the next key step in this line of research.

Conclusions by objective

Objective 1: Capture and map the nature of the social networks (i.e., social context) for low risk and moderate risk gamblers, in terms of the gambling and other potentially risky behaviours (e.g. alcohol consumption) of the most influential people around them; AND

Objective 2: Determine whether the social networks around low risk and moderate risk gamblers differ to those around non-gamblers, non-problem gamblers and problem gamblers, and how they differ.

Low risk and moderate risk gamblers are surrounded by gamblers (as well as smokers and drinkers), more so than non-gamblers and non-problem gamblers, but less so than problem gamblers. Approximately 50% of the most influential people in their lives are gamblers. Low risk and moderate risk gamblers are also surrounded by, and gamble with, more people who experience gambling-related harm compared to non-gamblers and non-problem gamblers, but less so than problem gamblers.

Low risk (and problem) gamblers in particular feel more close to those in their networks compared to non-problem gamblers, although this does not appear to depend on whether those people are gamblers or not. Moderate risk gamblers are not significantly different to either low risk, problem or non-problem gamblers in this regard.

The social networks of moderate risk gamblers in particular are more interconnected (dense) compared to those of non-problem gamblers, but less so than problem gamblers, indicating more social opportunities to gamble with their alters who gamble (either individually or, potentially, as a group). The density of the social networks of low risk gamblers is not significantly different to those of moderate risk or non-problem gamblers, although they are closer to moderate risk gamblers. The network density of those at higher risk presents challenges for reducing social influence.

Objective 3: Consider the potential role of social networks on the normalisation of gambling behaviour.

Because we are influenced by the behaviour of those around us (as well as influencing the behaviour of those around us), the results from the present study indicate that the social networks of gamblers, particularly those in higher risk groups, are influential on their gambling based on the number of gamblers in their networks, as well as on the number of gamblers with whom they gamble.

This extends to gambling-related harm. Those who have experienced more harm are also surrounded by more gamblers who have experienced harm, and are more likely to gamble with them despite experiencing harm. Thus, not only is gambling-related behaviour normalised through these social networks, so too is gambling-related harm.

Chapter 1: Background

1.1 Scope

This study was designed in relation to the Victorian Responsible Gambling Foundation's (VRGF) Grants for Gambling Research Program (Round 8). It was funded as an Early Career Research (ECR) grant, under the research priority of preventing gambling related harm.

This research focuses on Option A from the VRGF's grant specification: Influences on low and moderate risk gambling behaviour. The specific questions addressed are:

Question 2: "What are the social contexts of gambling among low and moderate risk gamblers, including normalisation, and how do the attitudes of peers and the broader community influence their behaviour?"

Question 6: "What kind of strategies would be most effective in reducing gambling-related harm among low and moderate risk gamblers?"

The specific **aims** of the project are to use egocentric social network analysis in order to:

1. Capture and map the nature of the social networks (i.e., social context) for low risk and moderate risk gamblers, in terms of the gambling and other potentially risky behaviours (e.g. alcohol consumption) of the most influential people around them;

2. Determine whether the social networks around low risk and moderate risk gamblers differ to those around non-gamblers, non-problem gamblers and problem gamblers, and how they differ;

3. Consider the potential role of social networks on the normalisation of gambling behaviour.

1.2 State of gambling in Australia and Victoria

Gambling is a popular activity in Australia, with around 64% of the adult population taking part in some form of gambling annually (Hing et al., 2014).Gambling turnover in Australia in 2015-16 was over AU$204 billion (Queensland Government Statistician's Office, 2017), with losses estimated at AU$23.6 billion (approximately $1,273 per capita; Queensland Government Statistician's Office). The most recent Victorian gambling study found that the most common activities are, in order, gambling on: lottery-type games, raffles, races, electronic gaming machines (EGMs, or "pokies"), scratch tickets, phone or SMS competitions, casino table games, and sports betting (Hare, 2015).

Around 80-90% of Australian gamblers can be classified as non-problem gamblers, with the remainder being at some level of risk (e.g., Wilkins, 2017). Most recent prevalence studies have used the Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001) to assess gambling risk severity. The PGSI classifies gamblers into four categories: non-problem, low risk, moderate risk and problem gamblers. Approximately 30.1% of Victorian adults are non-gamblers, 59.5% non-problem gamblers, 7.3% low risk gamblers, 2.3% moderate

risk gamblers and 0.7% problem gamblers (Hare, 2015). Relevant characteristics of problem gamblers are described below.

Until recently, most studies have focussed on the characteristics and behaviours of problem gamblers, or a combination of moderate risk and problem gamblers due to difficulty attracting enough problem gamblers for statistical analysis. However, Browne et al. (2016) found that, at a population level, the majority of gambling-related harms stem from low risk and moderate risk gamblers. While low risk and moderate risk gamblers experience less severe harms, their larger numbers mean that, when aggregated, they experience more harm at a population level than people in the problem gambling category. This finding, which was replicated in New Zealand (Browne et al., 2017), has prompted increased interest in understanding more about low risk and moderate risk gamblers. Thus, part of the scope of the present study was to focus on low risk and moderate risk gamblers.

1.3 Risk factors for problem gambling

Models explaining problem gambling have generally recognised the role of biological, psychological and social influences, both as risk and protective factors for the development of problem gambling. In their influential Pathways paper, Blaszczynski and Nower (2002) describe how (then) current models of gambling behaviour acknowledge “the interaction of key biopsychosocial variables in the aetiological process”. Abbott et al. (2015) recognise general and specific factors that interact with each other, and include biological, social and psychological factors amongst their general factors. Williams, West, and Simpson (2012) argue that the interaction between these biological, psychological, experiential and social variables is complex. Behavioural differences between non-problem and problem gamblers have also been identified in the literature, such as amongst Abbott et al.’s specific risk factors. We first briefly discuss potential biological, psychological and behavioural risk and protective factors for problem gambling, followed by social risk factors.

1.3.1 Biological, psychological and behavioural risk factors

Biological risk factors for problem gambling can include direct and indirect factors. Indirect factors include genetic predisposition, which is expressed through differential neural pathways, particularly related to reward and inhibition (Williams et al., 2012). However, most research has focussed on demographic factors, some of which may be indirect (e.g., gender), and others that may be more direct risk factors (e.g., income or disposable income). In a literature review, Johannson, Grant, Kim, Odlaug, and Götestam (2009) reported that being younger, male and/or less educated, as well as immigrant/ethnicity status, are consistent risk factors for problem gambling. Conflicting results for income and marital status have been found over various studies, and thus the nature of these variables as risk factors is unclear. This may be because different gambling forms appeal to different demographics. For example, lottery gamblers tend to be older and in paid employment, while sports bettors tend to be young males aged 18-34 (Delfabbro, 2012; Humphreys & Perez 2012; Sproston, Hing, & Palankay, 2012; Wardle & Seabury, 2012).

An important risk factor for problem gambling is whether gambling "serves a psychological need" (Williams et al., 2012, p. 9). Gambling may serve a psychological need for those who seek an escape from other problems, including emotional problems (Gupta & Derevensky 1998; Jacobs 1988), mental health issues in general (e.g., Blaszczynski, Russell, Gainsbury, & Hing, 2016; Petry, Stinson, & Grant, 2005), and, more specifically, mood and personality disorders (Blaszczynski & Steele, 1998; Gerstein et al., 1999). Comorbidities with alcohol use and smoking have also been frequently related to problem gambling (e.g., Hing et al, 2014; Hing, Russell, & Browne, 2017). Alternatively, genetic predisposition to gambling problems can manifest in various ways, such as through differences in the prefrontal cortex, which is involved in inhibition (Williams et al., 2012). Reduced inhibition is likely to result in more impulsive behaviour, and those in higher risk groups (including low risk and moderate risk gamblers) tend to be more impulsive compared to lower risk groups (Russell, Hing, Li, & Vitartas, 2018).

Behavioural risk factors for problem gambling generally indicate that more involved gamblers are more likely to develop gambling problems. Higher levels of involvement can include higher gambling expenditure, more frequent gambling, longer gambling sessions, and taking part in riskier forms of gambling (Gainsbury et al., 2014; Hing et al., 2017) including having accounts with more online gambling operators (Gainsbury, Russell et al., 2015; Saugeres, Thomas, Moore, & Bates, 2012).

1.3.2 Mechanisms of social influence on gambling behaviour

Social influences on behaviour can be active or passive (Bandura, 1977; Bandura & Walters, 1963; Kandel & Andrews, 1987. An example of an active influence is pressuring someone to engage in a behaviour, or to engage more than they would otherwise like. Passive influences include modelling behaviour on those around you, or influences on attitudes and beliefs towards the behaviour through normalisation. Below, we discuss both active and passive influences in terms of four types of social influence: early socialisation into gambling; social/peer norms; social selection; and social influence while gambling.

Early socialisation into gambling

Saugeres et al. (2012) identified three key risk factors related to early influences on problem gambling: family climate, child abuse and family attitudes and behaviours towards gambling. More positive, supportive family climates have generally been linked to lower levels of gambling amongst adolescents (Saugeres et al., 2012), and lower levels of gambling problems (Monacis, Sinatra, Tanucci, Taurino, & de Palo, 2014). Child abuse has also been linked to problem gambling. A systematic review by Lane et al. (2016) found that, while different studies have assessed different types of abuse (sexual, physical and emotional abuse, as well as neglect) using different statistical techniques, the literature generally supports a link between child abuse and later problem gambling. However, Lane et al.'s review also found that the link may be complex, as multivariate analyses that controlled for substance abuse and other psychiatric disorders found that the link between childhood maltreatment and problem gambling was no longer significant with these factors in the model. This is likely because problem gambling is usually not the only consequence of child abuse. Those experiencing child abuse are at increased risk of: medical and physiological issues; cognitive and intellectual issues; psychosocial consequences; behavioural consequences; alcohol and other substance abuse; self-destructive behaviour; and amongst adolescents: delinquency; violence; intimacy and sexual problems including teenage pregnancy (see National Research Council, 1993, for a review). All of these

consequences, including gambling, likely serve as an escape mechanism from these issues (Saugeres et al., 2012), and escape has been identified as an important motivation for gambling behaviour (Blaszczynski & Nower, 2002). Furthermore, a study of 30 men from Toronto, Canada, who had experienced homelessness or housing instability as well as problem gambling reported that gambling provided not just an escape, but also a way to gain acceptance into street social culture (Hamilton-Wright et al., 2016).

Perceived and actual family attitudes and behaviours towards gambling have been linked with gambling behaviour, and gambling problems, in later life. Because gambling is generally an age-restricted activity, underage gambling is often facilitated by parents, particularly for certain forms, such as scratch tickets and sports betting (King & Delfabbro, 2016). In the UK, 84% of 11-15 year olds surveyed were with their parents when buying tickets for the National Lottery, which is restricted to those aged 16 or older, indicating acceptance from their parents about this form of gambling (Ipsos MORI, 2016). Parental facilitation of underage gambling normalises gambling as a banal activity (Ipsos MORI).

Normalisation of gambling by parents is not restricted to parental facilitation. Adolescents who observe their parents gambling are likely to model their behaviour (Gupta & Derevensky, 1997). Indeed, correlations have been found between parental gambling and adolescent attitudes towards gambling and intention to gamble (Pitt, Thomas, Bestman, Daube, & Derevensky, 2017), as well as adolescent gambling behaviour (Magoon & Ingersoll, 2006; Oei & Raylu, 2004; Wood & Griffiths, 1998). These links are concerning because those who gamble as adolescents are more likely to become problem gamblers compared to those who do not (Gay, Gill, & Corboy, 2016; Griffiths, 2010; Magoon & Ingersoll, 2006; see Dowling et al., 2017 for a review). In some cases, normalisation can also occur through parents actively engaging with their children in gambling (Gupta & Derevensky, 1997).

The relationship between parental gambling and their children's gambling behaviours and problems is exacerbated when the parent(s) are problem gamblers themselves. Abbott, Cramer, & Sherrets (1995) found such individuals were four times more likely to gamble, while Winters, Stinchfield, Botzet, & Anderson (2002) found that adults who grew up in such households were seven times more likely to experience gambling-related problems. Dowling, Jackson, Thomas, and Frydenberg (2010) found that growing up in a problem gambling household was a unique risk factor for gambling-related problems when controlling for other factors, such as demographics and other family factors. Winters et al. (2002) found that parental history of gambling problems was a significant and (in a multivariate model) unique predictor of problem gambling by young adulthood. Taken together, these and similar studies suggest that parental influence during these formative years are powerful risk factors for the onset of gambling as a behaviour, and development of gambling-related problems.

Thus these early influences are likely to lead to increased gambling (and, in turn, gambling problems) when gambling offers an escape from dysfunctional family climates or from various forms of child abuse, or through direct influences of the parents' behaviours and attitudes, which leads to normalisation of the behaviour. This normalisation appears to extend beyond gambling behaviour to gambling problems, as evidenced by the higher risk of those growing up in problem gambling households becoming problem gamblers themselves.

Social/peer norms

In order to discuss social/peer norms, it is necessary to discuss relevant models, definitions and the different types of social norms. In gambling research, as well as other health behaviours (discussed below), peer and social influences have frequently been studied through the lens of the reasoned action approach. The reasoned action approach, developed by Fishbein and Ajzen, includes models such as the Theory of Planned Behaviour (Ajzen, 1991) and the Theory of Reasoned Action (Fishbein & Ajzen, 1975). The reasoned action approach specifies that behaviours are driven by intentions, that are in turn driven by three key factors: attitudes towards the behaviour, perceived behavioural control, and normative beliefs (or subjective norms). Thus, normative beliefs, which can be derived from parents, peers and society, are a key influence on intention and, through intention, behaviour.

Different types of normative beliefs have been identified. At the broadest level, a social norm "is what people in some group believe to be normal in the group, that is, believed to be a typical action, an appropriate action, or both" (Mackie, Moneti, Shakya, & Denny, 2015, p. 7). Cialdini, Reno, and Kallgren (1990) identify two types of norms: injunctive norms ("what most others approve or disapprove") and descriptive norms ("what most others do"; p. 1015), or in other words, what ought to be done, and what is actually done. Within the reasoned action approach, then, subjective norms are closer to injunctive norms. Subjective norms, used in the reasoned action approach, are defined by Ajzen (1991, p. 188) as "the perceived social pressure to perform or not to perform the behaviour", but are usually defined as an opinion about what "*important others* believe the individual should do" (Finlay, Trafimow, & Moroi, 1999, p. 2383). However, a normative belief based on subjective norms is more influential if the individual is motivated to comply with that belief, and thus both normative belief and motivation to comply are included in models in the reasoned action approach (Oh & Hsu, 2001). Cummings and Corney (1987) note that the belief about how others view the behaviour does not necessarily have to be accurate in order to influence intention and behaviour.

Gambling studies that have used various incarnations of the reasoned action approach have found the model to be a good fit in general, and that subjective norms have been important in predicting intention, and thus, indirectly, behaviour (Dahl, Tagler, & Hohman, 2018; Larimer & Neighbors, 2003; Martin et al., 2010; Moore & Ohtsuka, 1999; Neighbors et al., 2007). However, some studies have found stronger evidence than others. For example, Thrasher, Andrew, and Mahoney (2007) found that the Theory of Reasoned Action model only predicted small amounts of variance in gambling intentions, as did Moore and Ohtsuka (1997). Subsequent work by Thrasher, Andrew, & Mahoney (2011) found that the inclusion of other important variables (gambling motivations and locus of control) improved the predictive power of the model. Within the context of gambling studies using the reasoned action approach, subjective norms have also been measured in a number of different ways, limiting comparisons between studies. Competing norms measures used in gambling research include, but are not limited to, the Gambling Quantity and Perceived Norms Scale (Neighbors, Lostutter, Larimer, & Takushi, 2002, used by Martin et al., 2010) and the Social Norms Scale (Moore & Ohtsuka, 1997, a slightly modified version of which was used by Flack & Morris, 2015), although all have found subjective norms to be important predictors of intention (Hing, Vitartas, Lamont, & Fink, 2014).

Many of the aforementioned studies attempt to predict gambling behaviour, rather than gambling problems. However, some researchers have studied whether the reasoned action approach can also predict gambling-related *problems*, rather than just behaviour. Moore and Ohtsuka (1999) and Wu and Tang (2012), found that gambling-related problems can be indirectly predicted by subjective norms (as well as attitudes and perceived control) through intention, although Moore and Ohtsuka (1999) found that subjective norms both directly and indirectly predicted gambling frequency (i.e., behaviour). Meisel and Goodie (2014) found that

only descriptive norms predicted gambling problems, but both injunctive and descriptive norms predicted gambling behaviour. Thus, while the pathways may differ, it is clear that social norms, particularly through subjective norms, play an important role in predicting gambling behaviour, as well as gambling-related problems.

While these studies show the important role of social norms in terms of gambling behaviour and problems, they do not necessarily identify individual social norms, and the measures of social norms are instead viewed as the "summation of normative beliefs from several salient others" (Cummings & Corney, 1987, p. 197). However, research by Neighbors and colleagues (2007) has found that the nature of the subjective norm depends, at least in part, on whom the norm is derived from. They further examined injunctive norms finding that, amongst college students, perception of higher gambling approval by other students was associated *negatively* with gambling behaviour, whereas *positive* associations were found if the perceived approval was derived from friends and family. Thus the nature of the influence from others depends on who those others are.

While subjective norms (norms derived from others important to the individual) are important, broader societal norms are also relevant. Gambling is a recognised pastime in Australian culture (Productivity Commission, 2010). The annual Melbourne Cup is referred to as the "race that stops the nation" and two-up is played as part of ANZAC Day commemorations. Australians appear to accept recreational gambling as a legitimate activity, as evidenced by little stigma being applied to recreational gamblers (Hing, Russell, Nuske, & Gainsbury, 2015). Thus, the general acceptability of recreational gambling in Australia is also likely to drive gambling intention and behaviour.

Social selection and isolation

Together, the early exposure factor, as well as subjective norms, are generally derived from existing social connections. However, social connections can also be initiated due to shared attitudes and behaviours. This latter process is referred to as social selection. Disentangling social selection from social influence is difficult; "Do people befriend others who are similar to them, or do they become more similar to their friends over time?" (Lewis, Gonzalez, & Kaufman, 2012, p. 68).

Gordon, Gurrieri, and Chapman (2015) brought the concept of lifestyle consumption communities – communities formed on shared consumption interests rather than physical proximity such as neighbourhoods (Friedman, Abeele, & Vos, 1992) – to gambling research by examining sports betting in Australia as a possible lifestyle consumption phenomenon. They interviewed 10 small friendship groups and found that sports betting was an important part of the relationship amongst these groups. Furthermore, gambling could serve to facilitate social interaction with people outside of the group if gambling interests aligned. One group (p. 2167) described being more willing to talk to someone who shared interests in sports betting, but would avoid someone who bet on harness racing. Gordon et al. (2015) therefore argue that at least certain forms of gambling can act to bring people together through the formation or extension of these lifestyle consumption communities.

Raymen and Smith (2017) discuss gambling from the perspective of "deviant leisure", behaviour that violates moral norms. They argue that, previously, gambling was seen as restricted to gambling places, or to populations or demographics who were traditionally associated with problem gambling. However, at least partially due to technological improvements, they argue that gambling is no longer restricted, and instead

21st century gamblers are "found down the pub with their friends, pint in one hand and smartphone in the other, placing bets on the day's football" (p. 3). Like Gordon et al. (2015), Raymen and Smith argue that that this social aspect of gambling can be harmful, contrary to assertions from industry. Because gambling now occurs more frequently in venues other than race courses and casinos, Raymen and Smith argue that a person's identity as a gambler is increasingly intertwined with other behaviours (such as drinking and sports fandom) and other aspects of their personality (masculinity). However, this requires that members of the group are accepting of all of these behaviours and personality traits, and is likely to lead to selection of people with shared interests.

Gupta and Derevensky (2000, p. 331) describe the case study of Angelo, an 18 year old seeking treatment for gambling issues. Angelo reported that he started gambling at around the age of 13, initially on a form of sports betting, which helped him to cope with his father's serious illness. Through this form of gambling, he was introduced to other gamblers his age, and was "soon adopted by these individuals into their 'family'" (p. 332). While he came from a close family, his father's illness (and later death) absorbed the other family members, and his gambling became more involved. His deviant behaviour, including stealing money from the family business to fund his gambling, resulted in severed ties with his oldest brother and several aunts and uncles. Thus, in Angelo's case, not only did gambling lead to new social ties, in the form of the others his age to whom he was introduced, but also in the loss of ties to members of his family; social deselection.

Some forms of gambling harm have impacts on people other than the gambler, such as relationships ending, interpersonal conflict or work-related issues (Li, Browne, Rawat, Langham, & Rockloff, 2017). Because of this, those around gamblers may seek to dissociate themselves with a person experiencing gambling-related harm, socially isolating the gambler from at least some parts of their social network. Social isolation has been identified as a risk factor for problem gambling (Trevorrow & Moore, 1998), and is a form of emotional vulnerability. Emotionally vulnerable gamblers are specifically identified as at-risk of problem gambling in the second pathway of Blaszczynski and Nower's (2002) Pathways Model. Thus if gamblers who are developing problems become isolated from the non-gamblers in their lives, they may seek to fill the void with those who accept them and their behaviours (likely other gamblers), who will then reinforce the behaviour.

Methodological restrictions make it difficult to separate the unique roles of social norms and social selection in shaping behaviours. Longitudinal data are required to observe changes in the individual's behaviour over time, as well as changes in the nature and composition of the individual's social network over time.

Social influences during gambling

The increasingly ubiquitous and social nature of modern gambling, described by Gordon et al. (2015) and Raymen and Smith (2017), means that people are gambling more often in the company of others who are also gambling. Not only can social influences serve to facilitate the start of a session of gambling, but also influence the nature of gambling during a session. Rockloff and Dyer (2007) found that those who perceived other gamblers around them to be winning extended their own duration of play. Raymen and Smith (2017) describe cases whereby gamblers had gone well beyond their limits in the presence of their friends, as well as reluctance to stop gambling after losses in the presence of friends for fear of being "a bit of a tit if you sulk" (p. 9). A study of 1,484 UK gamblers found that those with gambling problems were significantly more likely than those without problems to gamble with family and friends; thus, contrary to a popular responsible gambling message, gambling with others may not necessarily be safer than gambling alone (Wood & Griffiths, 2015).

Summary

In summary, social influences on gambling, whether they are from early socialisation, social/peer norms, social selection, or social influences during gambling, have been linked to gambling behaviour, and to gambling-related problems. Understanding the nature of these social influences is a key piece of the puzzle to understanding at-risk and problem gambling. Given the paucity of research into social influences on gambling, in the next section, we discuss social influences on behaviours other than gambling.

1.4 Social influences on behaviours other than gambling

Social influences are some of the most reliable predictors of a range of health behaviours. They also mediate other normalising effects such as media portrayals and advertising. Systematic reviews of smoking (Seo & Huang, 2012; Wellman et al., 2016), alcohol consumption (Leung, Toumbourou, & Hemphill, 2014), food intake (Robinson, Thomas, Aveyard, & Higgs, 2014; Stok, de Vet, de Ridder, & de Wit, 2016), physical exercise (Laird, Fawkner, Kelly, McNamee, & Niven, 2016; Scarapicchia, Amireault, Faulkner, & Sabiston, 2017), and sexual behaviours (Potki, Ziaei, Faramarzi, Moosazadeh, & Shahhosseini, 2017; Pringle et al., 2017) have all identified social influences as being an important element of a complex web of influences on population health.

Like the gambling literature, much of the literature examining social influences on health behaviours focuses on childhood, adolescence, or youth. From a public health perspective, these periods of the lifecourse are of particular significance due to the long term biological impacts of early experiences, their effects on learning behaviour, and the importance of transitions that represent emerging independence and increasing influence of people outside the family unit. The focus on these age groups is understandable given that many of these behaviours are often understood as age related, where youth adopt and experiment with different attributes or behaviours as they become more autonomous from their parents, and more dependent on their peers (Hutchison, 2005). Furthermore, schools and university settings also offer an easily bounded social network that supports analysis (Valente, Gallaher, & Mouttapa, 2004). However, whilst some experiences are relatively universal, such as smoking, drinking, and sexual activity, contextual differences need to be considered in interpreting findings (such as different legal restrictions between jurisdictions around the age at which behaviours are allowed, and different social norms such as moving away from home for tertiary education).

The most powerful social influences vary and can change across the lifecourse for each health behaviour. Parental and family influences are particularly salient in understanding children's behaviours in relation to childhood obesity (Campbell, 2015), but this is reduced by adolescence, and even further by adulthood as peer, partner, and workplace influences increase in importance (Higgs & Thomas, 2016). For smoking and alcohol consumption, familial influences have a foundational effect, but the strongest influence is from peers (Mrug & McCay, 2013; Perkins, 2002). Several studies have identified an interactive or amplifying effect when parental and peer influences coincide (Epstein, Griffin, & Botvin, 2008; Mrug & McCay, 2013; Perkins, 2002) suggesting a multiplicative effect of repeated social influences. Much peer influence is also due to misperceptions of peer norms around both attitudes and behaviour (Perkins, 2002). A recent study of American college students in a residential setting found that whilst their estimation of the drinking of close

friends was accurate, they overestimated drinking amongst the broader residential peer network (Kenney, Ott, Meisel, & Barnett, 2017). Importantly, that misperception was more significant for heavy drinkers.

In older age groups, research on social influence has mainly focussed on dyadic[1], and mostly therapeutic or clinical, relationships. Methodologically it is difficult to bound social networks for adults given the segmentation of their lives between family, friends, work colleagues, and hobby or sports groups. However, more studies of adult, rather than youth, networks have been conducted, including powerful longitudinal analyses (Christakis & Fowler, 2007, 2008; Rosenquist, Fowler, & Christakis, 2011; Rosenquist, Murabito, Fowler, & Christakis, 2010), to examine the influence of different social influences on adult health behaviours, especially relating to diet and physical activity (Ashida, Wilkinson, & Koehly, 2012; Blok, de Vlas, van Empelen, & van Lenthe, 2017; Kumanyika et al., 2009; McNaughton, Crawford, Ball, & Salmon, 2012; Wang, Pbert, & Lemon, 2014). The emphasis on health behaviours relating to being overweight and obese is unsurprising given the priority and impact for this age group compared to other behaviours. However, increased understanding of the importance of the social determinants of health, and specifically factors such as social isolation, suggests the qualities of social networks are important in understanding broader wellbeing as well as specific behaviours (Fiorillo, Lavadera, & Nappo, 2017).

1.4.1 Mechanisms of social influence on behaviours other than gambling

Like gambling, social influences on other behaviours can be active or passive (Bandura, 1977; Bandura & Walters, 1963; Kandel & Andrews, 1987). Active influences include offers made to a person by others to drink alcohol, smoke tobacco, or ingest illicit drugs, or verbal encouragement or pressure to engage in the behaviour. Passive influences include social modelling and normalisation, such as smoking in someone's company. These passive influences demonstrate the strongest association with alcohol use and misuse in adolescents transitioning from high school, although active influences still have a significant association (Wood, Read, Palfai, & Stevenson, 2001). These processes are best understood through social learning theory, which posits that individuals will exhibit behaviours consistent with those modelled by the people in their immediate social environment.

Similar mechanisms have been observed in other behaviours to those in gambling. In terms of early socialisation, parental behaviour has been linked to the behaviour of their children in terms of alcohol use (Homel and Warren, 2016), smoking (Gilman et al., 2009) and drug use (Johnson, Shontz, & Locke, 1984). Social selection and social norms interact to shape the networks, their behaviours, and the process of normalisation. However, inconsistent findings exist between social influence and selection processes within the literature, even within age groups. Whilst many studies have identified social influence as playing a more significant role in adolescent health behaviours such as alcohol consumption (Sieving, Perry, & Williams, 2000), cigarette smoking (Pearson & Michell, 2000; Wellman et al., 2016) and drug taking (Pearson & Michell, 2000), a large study of adolescents' alcohol use found selection processes played a more significant role than social influence processes (Knecht, Burk, Weesie, & Steglich, 2011). Coggans and McKellar (1994) argue that the overestimation of social influence is due to a failure to consider the effect of selection

[1] From the Greek "dyas", meaning two. Dyadic relationships are those that exist between two individuals.

processes due to the conflation of peer pressure and peer selection in the operational definitions of many studies.

A systematic review of longitudinal studies (Leung et al., 2014) identified significant peer influence on adolescent uptake of drinking, but was unable to isolate the effect of peer selection. Similar findings have been noted with studies examining adolescent drug use, that peer influence for uptake has a role, but not peer selection (Sieving et al., 2000). Another study of peer influence and peer selection in relation to adolescent alcohol use (Abar & Maggs, 2010) suggests this may be due to lifecourse transitions and changes to the peer group associated with that transition. That is, when students transition to college they seek out and join new friendship circles through peer selection. Once those friendship circles are settled, peer influence comes into play. Evidence to support this is limited because even longitudinal studies of adolescent behaviour have had relatively short time spans given the small window of interest. For example, one study that sought to separate selection and influence effects was only conducted over 3 waves of 3 month intervals (Knecht et al., 2011). Whilst short time frames may identify the effect of these processes if data are captured during a transition, such as when moving from junior schooling to high school, or high school to university, they are too short to capture more nuanced and subtle changes in networks when people are not in transition.

Adults are more likely to have more stable social networks and behavioural patterns even during periods of transition. In comparison to adolescence where there is more social mobility, the effect of transitioning to full time employment, establishing long term romantic relationships, and home ownership is more subtle in terms of changes to social networks. Few studies have explicitly looked at older age groups using social network analysis (SNA). However, using longitudinal data for 12,067 participants over 32 years, social network analysis of The Framingham Heart Study, identified that in terms of the roles of social influence and social selection, causality is bidirectional. That is, norms influence attitudes and behaviour, but people also tend to cluster into groups (selective formation of social ties) where attitudes and behaviours are shared (Rosenquist et al., 2010). However, a shorter longitudinal study identified that, in adult groups, social selection effects are stronger than social influence regardless of age, race, gender or marital status (Bullers, Cooper, & Russell, 2001).

1.4.2 Using social influence for behaviour change

Just as these influences have been found to be useful in understanding the uptake and sustainment of health related behaviours, they have subsequently been used to change behaviour and create new social norms for public health issues such as tobacco and alcohol consumption. These interventions also do not occur in isolation, and normally work in collaboration with the influence of broader policy instruments. An example of this is smoking. Whilst peer influence has been found to be particularly powerful in adolescents trying smoking, the multiple approaches to reduce smoking rates such as increased taxes, restriction on availability of places where smoking is permitted, increased education on the harmful effects, and increased costs of smoking, have reinforced and supported the changing social norm that makes smoking less socially acceptable (Cohen, Scribner, & Farley, 2000; Levy, Hyland, Higbee, Remer, Compton, 2007).

These approaches have also been isolated in experimental studies to evaluate their potential impact. Studies of peer drinking norms found exposure to anti-alcohol norms led to more negative views of heavy drinking (Teunissen et al., 2014). The effect of social influence to address obesity has also been examined,

demonstrating the potential impact of social multipliers within networks on overall group weight loss, and the importance of the people's social network structure (Trogdon & Allaire, 2014). The number of not only partners or best friends, but casual friends, who are overweight and stronger social norms for unhealthy eating predicts success in obesity treatment (Leahey, Doyle, Xu, Bihuniak, & Wing, 2015). Similar effects had previously been found for children (Shin et al., 2014).

Normative feedback can also take the form of correcting misperceptions about the behaviour of others. Personalised normative feedback (feedback designed to correct misperceptions by providing information about a person's behaviour compared to others of similar ages; Moreira, Oskrochi, & Foxcroft, 2012) has been tested as a possible intervention for gambling problems. In a randomised controlled trial, Neighbors et al. (2015) found that personalised normative feedback was effective in reducing gambling losses and gambling problems at 3-month follow-up, and reduction in gambling losses (but not gambling problems) were maintained at a 6-month follow-up. Moreover, the reductions were more pronounced for those who more strongly identified with those to whom they were being compared; fellow college students. Celio and Lisman (2014) also found that personalised normative feedback reduced risk-taking, as did Auer and Griffiths (2015). However, a randomised controlled trial by Cunningham and colleagues (2012) did not find an effect due to personalised normative feedback, but personalised feedback without norms reduced number of days gambled compared to participants who received no intervention. Cunningham et al argued that any impact of personalised feedback tools may only have a limited short term impact, and thus other tools are required to maintain any reduction in behaviour or problems.

Social influences however are not homogenous. For example, whilst the value of using social norms to encourage healthier eating has also been identified (Higgs & Thomas, 2016), different patterns of influence were found in terms of effective support from friends, family, and co-workers for healthy eating and physical activity needed for sustained weight management (Wang et al., 2014). In addition to the nature of the relationship with others, important differences have also been identified in relation to the individual's behaviour. In research examining the use of social norms to modify drinking behaviour, the effect of individual's injunctive norms may have unintended negative consequences. Heavier drinkers were found to overestimate other people's alcohol consumption, whilst lighter drinkers and abstainers tended to underestimate it. Potentially, if the promoted "normal" level of alcohol consumption is higher than the lighter drinker or abstainer engages in, it may actually encourage them to increase their drinking (Lintonen & Konu, 2004).

Systematic reviews examining peer led interventions may produce changes in knowledge, attitudes, and intentions, but demonstrating a causal link to outcomes such as behaviour change is not well established, often due to methodological limitations (Kim & Free, 2008). There is a gap in our understanding of the complex network of influences and how they impact on health outcomes of interest. Influence mechanisms cannot be directly observed, but insight can be gained using methods such as SNA, agent based modelling and systems dynamics modelling (Shoham, Hammond, Rahmandad, Wang, & Hovmand, 2015).

1.5 Utility of SNA in terms of understanding social influence on health behaviours

Social network analysis is a method that considers the relationships between an individual and those in his/her networks, and examines how these relationships influence behaviour (Carolan, 2014). It offers a novel and robust method to examine the links between people rather than just the characteristics of the individual (Carolan, 2014). Specifics about the methodology of social network analysis are discussed in detail in the next chapter, including detailed information about egocentric social network analysis (the specific methodology used in this report), but we briefly describe it here to inform the subsequent sections of this chapter, In egocentric social network analysis, each person (ego) provides information about important people in their lives (alters), such as how close the ego is to each of these alters, and how close the alters are to each other. Relevant information about the behaviours (here, gambling behaviour) of the egos and their alters is also captured. This allows researchers to understand the nature and role of social networks, and thus social influences, on individuals. An alternate approach is that of sociocentric social network analysis, which is commonly used for studying behaviours where information is already available (i.e., individuals do not need to be surveyed). The sociocentric approach provides an understanding of social influences on communities as a whole.

Social network analysis has been successfully used within a number of public health domains to examine these influences on health behaviours and the potential influence of public health interventions. SNA allows researchers to model the relationships and structure of groups using relational concepts and processes. The focus of the analysis moves away from the individual to the social context of the people who influence them in a way that the relationships can be linked and verified (Ennett et al., 2008). It allows the capture and measurement of social influences at both the individual and collective level in a transdisciplinary manner (Valente et al., 2004). The relationship of these network measures can be considered in relation to attributes of characteristics of the individuals, including gender, age, education, social class, and health behaviours.

SNA allows us to understand the processes by which social norms are formed and can change. A powerful example of this is a large, longitudinal social network analysis of smoking behaviours, which identified several findings of particular relevance to gambling. In a study of 12,067 people over 32 years, Christakis and Fowler (2008) identified the existence of behavioural clusters for smoking; an association between an individual's behavioural status (smoker or non-smoker) and their social contacts, with the association being dependent on the nature of that social connection. They also reported that education and the intensity of the behaviour had an impact on the inductive influence of the behaviour; and that behaviour modification occurred in sub-networks (contagious normalisation) whilst those that did not modify the behaviour became more socially isolated. The influence on behaviour normalisation was quantified as three degrees of separation. At the first degree of separation the behaviour of a contact increased risk of the behaviour by 61%, at two degrees of separation it was still 29% increased risk, and this dropped to 11% at the third degree of separation, with no excess relationship identified at the fourth degree of separation (Christakis & Fowler, 2008). These findings were consistent with other studies using social network analysis to examine obesity (Christakis & Fowler, 2007) and depression (Rosenquist et al., 2011) and demonstrate the profound impact of the social context in which behaviour and health occur.

The study's findings are also of interest in terms of capturing the process of normalisation of behaviours. In terms of behaviour change, they found that behaviour did not change from the norm at the fringe of the cluster, but whole clusters changed behaviour together (Christakis & Fowler, 2008). This suggests a strong

influence of normalisation of behaviours within social networks. Those who engaged in the normalised behaviour became more central in their social network, and those with the non-normalised behaviour moved to the periphery. These findings are relevant gambling, not only in terms of the capacity of social networks to support the spread of responsible gambling behaviours, but identify the need to provide safety nets for those who may move to the periphery given the risk of social isolation on the escalation of gambling behaviour.

Further findings of interest are around the nature of the links between individuals, and the influence of induction of health behaviours. In a regression analysis, behaviour change to decrease smoking by one person between mutual friends decreased the person's risk of continuing that behaviour by 43% (Christakis & Fowler, 2008). Even for a non-mutual connection (where a subject alone perceives friendship) the influence of the contact was 36% decrease. Educational status was an important factor in this influence, with the risk of the behaviour continuing decreasing by 55-57% if the contact had at least 1 year of college education and 61% if both the subject and contact had at least 1 year of college education. Co-workers were not as influential as friends, although the influence of co-workers was stronger in small companies than large. Unsurprisingly the influence between married couples was strong; if one spouse ceased smoking the other was 67% less likely to continue (regardless of gender) whilst sibling influence was smaller at 25% and neighbours did not have an effect. Importantly geographical distance did not modify the intensity of these effects.

SNA has also identified the role of social positions in understanding the mechanisms of social influence. The nature of people's relationships within a social network is related to their experiences of social influence, both in terms of being influenced, and influencing others (Valente et al., 2004). People with high levels of centrality within a network are more likely to exemplify the norms of the network and be early adopters of behaviour change (positive or negative). The strength of the connections is also important, as demonstrated by people with weaker links to multiple groups (referred to as liaisons; Granovetter, 1973). Whilst liaisons have access to the resources and information beyond a single group, they are exposed to differing group norms without having to conform to a single group. This position can be both a protective and risk factor for negative health behaviours as evidenced in the findings from a systematic review of studies of adolescent smoking behaviour that found that isolates were more likely to smoke (Seo & Huang, 2012).

The utility of SNA in designing and evaluating behaviour change interventions using social influence has also been demonstrated. The knowledge of mechanisms within social contexts to normalise positive health behaviours has been successfully utilised in several public health contexts including obesity (Wing & Jeffery, 1999), smoking (Malchodi et al., 2003), and sexual health (Brückner & Bearman, 2005). These interventions often rely on popular, or central, people within a defined network, being selected as peer educators due to their influence within the network (Valente et al., 2004). However, group or population interventions aimed at normalising healthy behaviours may both more effective both in terms of outcomes and cost (Christakis, 2004; Christakis & Fowler, 2008).

1.6 Social network analysis in gambling research

Of the limited research that has applied social network analysis to gambling, only one study has utilised social network analysis in relation to pathological gamblers (Meisel et al., 2013). The study identified compositional differences in the social networks of people gambling at pathological levels, with a higher number of people who gambled, smoked or consumed alcohol within their network. The authors claimed this

was evidence of the influence of homophily (the tendency of individuals to associate with others who are similar to them) on the social context of individuals, and a subsequent reinforcement of gambling behaviour. However, the study utilised cross-sectional data, and it is only possible to distinguish between the effects of homophily and induction with longitudinal data. While this study generated important insights into the social networks of gamblers the study utilised a relatively small sample of 40 individuals, of whom 18 were pathological gamblers. In light of recent evidence, harm from low and moderate risk gamblers constitutes a significant population health impact and must be assessed accordingly (Browne, Greer, Rawat, & Rockloff, 2017). Therefore, the current study builds on the study by Meisel and colleagues by examining gamblers who are experiencing gambling related harm across the entire spectrum (from individuals experiencing no harm through to problem gamblers), and also including non-gamblers as a reference group. The authors' later work (Meisel, Clifton, MacKillop, & Goodie, 2015), which examined gambling concurrently with alcohol consumption, smoking and use of marijuana, in a larger sample using egocentric social network analysis, identified strong clusters of these behaviours and also the influence of perception of other people's behaviour on an individual's health behaviours.

Thus, while social network analysis has been used in gambling research, the results are limited and there is the opportunity to greatly extend the literature by examining the networks of a larger sample, with a range of gambling risk levels and demographics.

1.7 The present study

As described above, social influences are powerful predictors of a multitude of health behaviours, including gambling, either through active influences to partake in the behaviour, or through more passive influences, such as social modelling and normalisation. While these social influences have been examined before in gambling research, the exact nature and extent of these influences has only been studied using social network analysis in one prior small study. That study examined only pathological gamblers. However, given that low risk and moderate risk gamblers are now identified as important groups to study, due to the amount of gambling-related harm associated with these groups at the population level, there is benefit in extending this research to include all gambler risk groups.

The present study explores the social networks of 784 respondents, with approximately equal groups of non-gamblers, non-problem gamblers, low risk gamblers, moderate risk gamblers and problem gamblers. Using a technique called egocentric social network analysis (see Chapter 2), the nature of the networks and degree of social influence in terms of gambling are measured and compared across groups. The results provide key information about the different types of influences on different risk groups. It extends previous social network analysis research in gambling by using a large sample, which allows for greater statistical power for comparisons between groups, and includes additional groups of respondents, particularly non-gamblers, low risk and moderate risk gamblers.

Chapter 2: Social network analysis: concepts, terminology and measures

2.1 Introduction

This chapter is an introduction to social network analysis. We first discuss the nature of social networks, followed by the differences between sociocentric and egocentric social network analysis approaches. Specific terminology and diagram interpretation for the egocentric approach (the methodology used in this study) are discussed, followed by a summary of variables obtained during egocentric social network analysis[2].

2.2 Social network analysis

2.2.1 Social networks

Social networks are networks of individuals, connected by interpersonal relationships. Studies that examine social networks aim to understand the nature of these relationships, and their influences on the individuals in the network. Thus, the focus is on the nature and structure of the relationships, rather than on the characteristics of the individuals. The individuals within these networks are often people, although examples of social networks described in this chapter show how the methodology can be extended to other types of entities.

Wasserman (1999, p. 4) describes the following important concepts of the social networks perspective:

- Actors and their actions are viewed as interdependent rather than independent, autonomous units
- Relational ties (linkages) between actors are channels for transfer or “flow” of resources (either material or nonmaterial)
- Network models focusing on individuals view the network structural environment as providing opportunities for or constraints on individual action
- Network models conceptualise structure (social, economic, political, and so forth) as lasting patterns of relations among actors.

[2] We cannot cover all possible discussion around social networks in this report. Should a reader be interested in learning more, the following books provide an overview on Social Network Analysis: Social Network Analysis: Fourth Edition (Scott, 2017) and Social Network Analysis: Methods and Applications (Wasserman & Faust, 1994; Wasserman, 1999). Social Network Analysis for Ego-Nets (Crossley et al., 2015) and Analyzing Social Networks (Borgatti, Everett, & Johnson, 2013) specifically cover egocentric social network analysis, which is defined below and was the methodology used in this study. The discussion below is mostly drawn from these books.

Studying social networks is not a new concept. Studies in German sociology in the 1930s describe “points” (individuals), “lines” and “connections” (relationships) in their analyses of patterns of social relations[3]. However, in recent years, the technique has become more popular with advances in computer software, social network measures and more readily available data.

For analysis purposes, social networks describe the relationships between individuals within a population. This population can be small (such as a class within a school), or large (such as Facebook or Twitter). Furthermore, the analysis can focus on the population as a whole (sociocentric analysis) or on the networks around individuals (egocentric analysis).

2.2.2 Sociocentric social networks

Sociocentric social network analysis is useful for situations where a researcher wants to study an entire population. The sociocentric method is described here because it is the most commonly-used version of social network analysis, but also to highlight the limitations of the approach, and thus why it was not used for the present study.

Sociocentric social network analysis is designed to examine relationships between individuals (people or otherwise) in a population. Defining the boundaries of the population can be a challenge. In the present example, we discuss political blogs[4] . Sociocentric social network analysis, then, can study the population of political blogs to determine key influencers, and to understand the flow of information. This is accomplished by examining relationships between these blogs. The relationships can be defined by a number of factors, such as whether each blog republishes information from each other blog (where the blog that originally published the information would be seen as influential), or how often the blogs link to each other.

Figure 2.1 below displays Adamic and Glance’s (2005) famous sociogram showing the interaction between political blogs during the 2004 US Election. Blue dots/circles are liberal/Democrat blogs, while red dots/circles are conservative/Republican blogs. The nature of the blogs is displayed not just in colour, but also size, where larger circles reflect the number of blogs that link to it. The lines between the blogs also convey information: red lines are links between Republican blogs, blue lines between Democrat blogs, yellow are Democrat blogs being followed by Republican blogs, and purple lines are Republican blogs being followed by Democrat blogs. The length of the lines does not indicate anything (discussed further below).

As can be seen, there are many connections amongst the Republican blogs, and amongst the Democrat blogs, but fairly few connections between them. Recalling that a key concept behind social network analysis is the flow of information, this figure indicates that the flow of information between blogs with opposing political viewpoints is low. The figure gives a picture of a highly polarised community. The analysis also indicates other findings, such as which blogs are more influential, and who they influence.

[3] For a more detailed history of social network analysis, see The SAGE Handbook of Social Network Analysis (Scott & Carrington, 2011).

[4] regularly updated websites designed to convey news and views about an individual or group, in this case set up by candidates and/or political parties

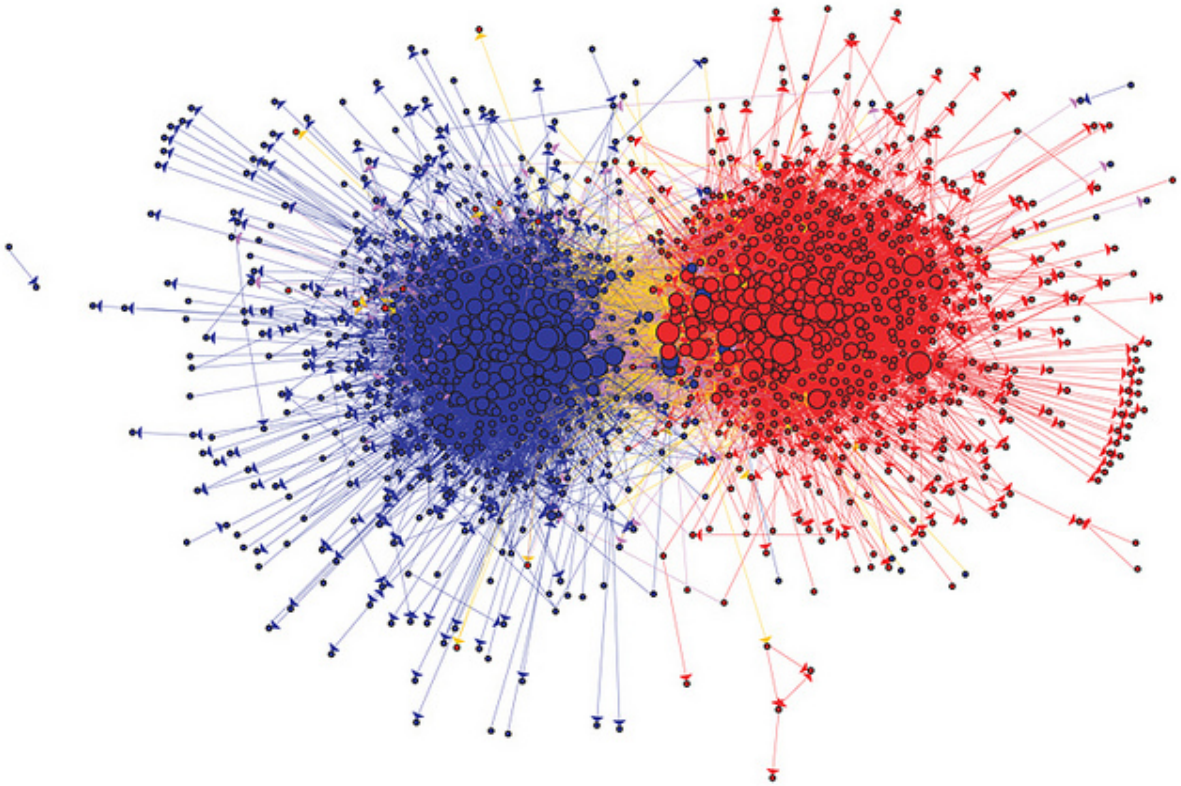

Figure 2.1. Sociogram of community structure of political blogs during 2004 US Election

Sociocentric social network analysis can provide a useful picture of the community as a whole in cases where data are readily available. A key limitation is that the researcher is restricted to the types of data that are available to the public for all (or most) community members. Where data must be collected, missing data are far more prevalent through issues such as the individual refusing to provide certain information, or declining to take part in the study. In the present study, information on links between individuals, as well as information on a per-individual basis of gambling behaviour and gambling problems were not available publicly, and thus information about each person had to be captured. Capturing information from an entire population, then, was deemed impossible because people can refuse to take part in surveys. Thus, for the present study, the sociocentric method was deemed to be unsuitable. However, where populations can be easily defined (such as a community group, or a workplace), such a method could be useful in future studies.

Furthermore, sociocentric social network analysis focuses on the community as a whole. This is key information for some studies. However, in some studies, such as the present study, it is more useful to study influences on particular individuals – the egocentric approach.

2.2.3 Egocentric social networks

Egocentric social networks (sometimes called ego-nets) are social networks that exist around an individual (referred to as the “ego”). The individuals that the ego is directly connected to are their “alters”. The

relationships or connections of interest are those between the ego and the alters, and also between the alters themselves.

Data from egocentric networks can be drawn from two sources: extracting them from sociocentric networks, or purposefully collecting data from individuals. In the example of US political blogs in Figure 2.1, egocentric networks could be drawn from this whole network by studying a particular blog as an individual (such as the blog of the successful candidate) to determine influences on the content. Alternatively, information can be captured from individuals through methods such as interviews or surveys. The latter is particularly useful in cases where the individual- and relationship-level information of interest is not available in a public database. This latter technique (capturing egocentric network data through individual surveys) is the methodology employed for this study.

This technique requires surveying the ego only, with information about alters captured from the ego. By surveying the ego only, we do not need to recruit and survey alters, and can capture data anonymously. The information that the ego supplies about the alters, then, is subject to their knowledge of the alters. Thus, if an alter is a gambler, but the ego does not know this, then that alter will be scored as a non-gambler. At first, this may seem like a limitation. However, since we are interested in influences on the ego, if the ego does not know about an alter's attribute, then it is less likely to influence the ego.

Egocentric social networks do not extend beyond the ego's alters. If an alter has a connection with a person that the ego is not connected to, then that person will not be captured in the ego's network. Thus, egocentric and sociocentric models have different strengths and limitations.

2.2.4 Egocentric social network terminology and variable classes

Egocentric social networks use slightly different terminology to sociocentric networks.

The individuals in a network are referred to as *actors* or *nodes*. In egocentric networks, one of the nodes is an *ego*. As mentioned above, this is the main person of interest in that particular network, and each ego has their own egocentric network. The other nodes in an egocentric network are *alters*: the individuals who are connected to the ego.

The relationships between individuals in networks are referred to as *edges*, *ties*, *lines* or *links*. These include relationships between the ego and each of their alters, and between each possible pair of alters. These relationships can be undirected or directed. If the nature of the tie is whether an ego and alter know each other, then an undirected tie assumes that both would say that they know each other, and thus the researcher only needs to ask one of them (the ego). In contrast, a directed tie allows the ego to say they know the alter, but for the alter to say that they do not know the ego. Undirected ties are often assumed in egocentric social network analysis research because the alters do not need to be surveyed (for ego-alter relationships) and because alter-alter relationships can be captured with a single rating, rather than two ratings, which halves the relevant data collection, and thus reduces participant burden.

Thus, four types of variables captured for egocentric social network analysis are:

1. Variables that describe the ego

2. Variables that describe the alters
3. Variables that describe the links (ties) between the ego and their alters
4. Variables that describe the links (ties) between pairs of alters, which are used to calculate the structure of the network as a whole

2.2.5 Egocentric social network diagrams

Figure 2.2 shows a simple example of an egocentric social network. The ego (red circle) is connected to each of the five alters. Alters A and B are also connected to each other, and alters C, D and E are connected to each other, but alters A and B have no direct connection to alters C, D and E. A key concept of social networks is the flow of information, and the only way that information can flow from alters A or B to alters C, D or E is through the ego. However, alters A and B can share information between each other without the ego.

Because the ego is, by definition, connected to each of their alters, the ego is sometimes removed from egocentric network diagrams to clarify the picture. Figure 2.3 shows the same network as Figure 2.2, but with the ego removed. It is easier to see that alters A and B are one distinct social circle, while alters C, D and E are a separate social circle for the ego. From the ego's perspective, if the ego shares information only with alter A, then it is possible that alter B will at some point receive this information. However, as there are no direct connections between alter A (or B) and alters C, D or E, that same piece of information will not flow to alters C, D or E unless it flows through the ego.

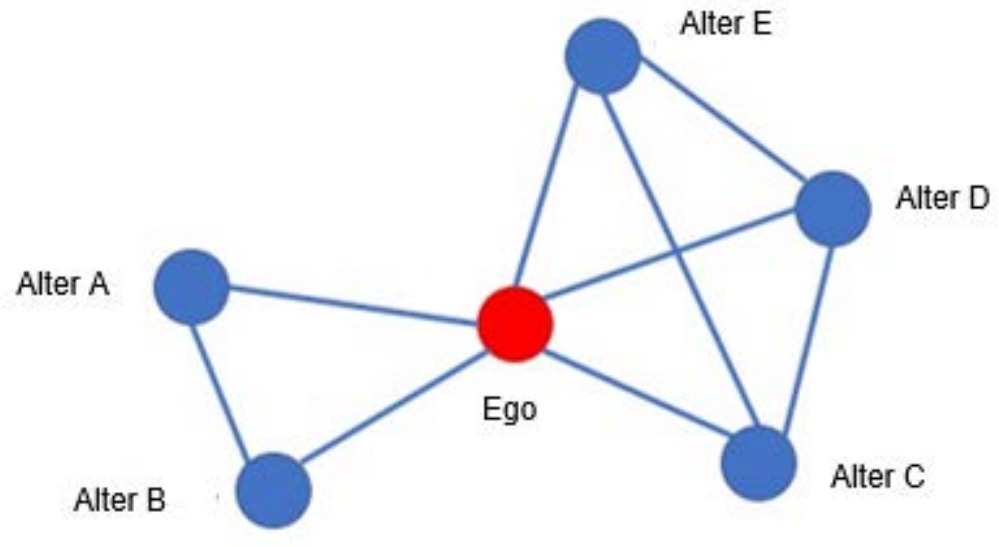

Figure 2.2 Example of an egocentric social network

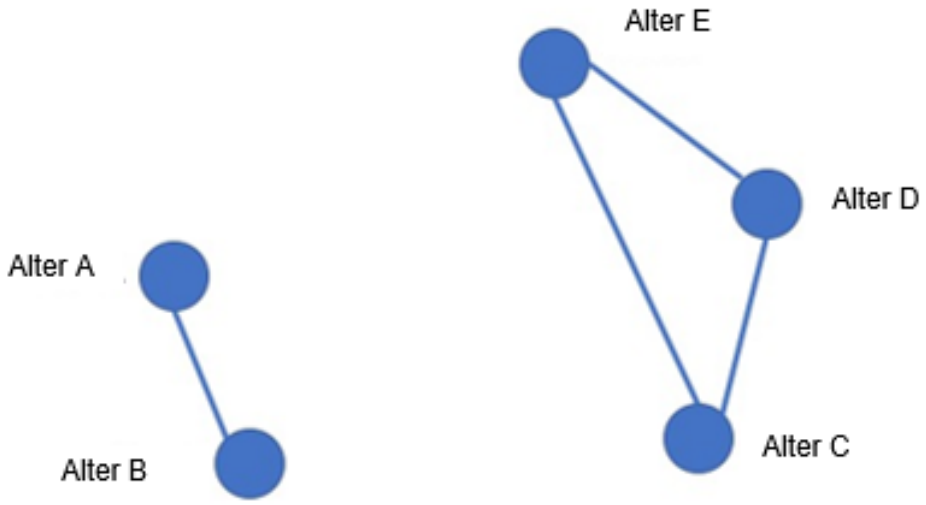

Figure 2.3 Example of an egocentric social network with the ego removed

The nature of the individuals in networks can be depicted in the diagrams by altering the size, shape and colour of the circles (e.g., different shapes could indicate gender, or different colours could indicate alters who are family vs friends vs coworkers). Similarly, the relationships (lines) could be altered to indicate different factors about the relationship, like how strong the relationship is between two individuals.

Of note is that the length of the lines is not usually indicative of the nature of the relationship. As Ognyanova (2016) demonstrates, egocentric social networks can be graphed in a number of configurations depending on the requirements of the researchers (see Figure 2.4). In general, it is preferable to select a layout that minimises the number of lines/ties that cross each other.

Egocentric networks allow researchers to understand social influences on and from individuals (egos) by understanding the nature of their alters (for example, do they gamble?), the nature of the relationship between the ego and the alters (How close are they? Do they socialise often?), as well as the nature of the relationships between each possible pair of alters (How well do they know each other? Do they socialise often?). Furthermore, metrics can be drawn from egocentric networks to compare the nature of these networks between different types of individuals, such as those with different levels of gambling risk.

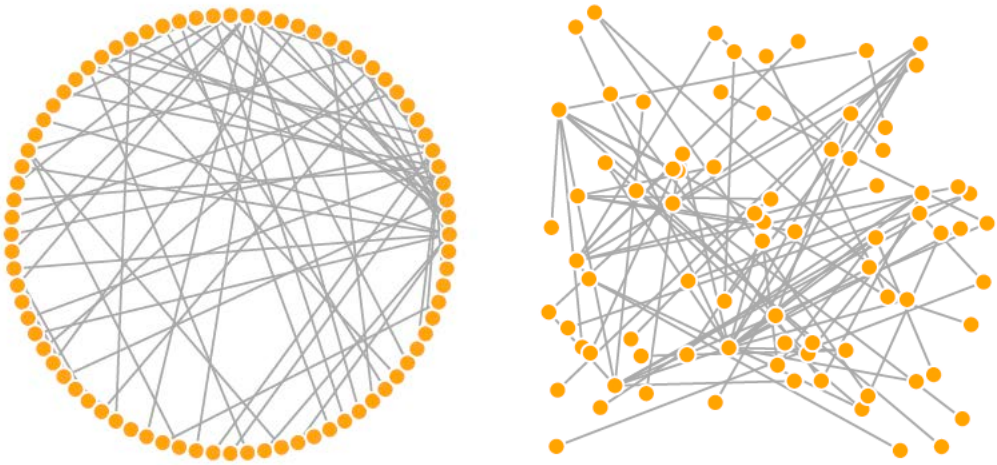

Figure 2.4 Two different layouts of the same egocentric social network

2.2.6 Egocentric network variables

Using the four types of data described in 2.2.4 above, Borgatti et al. (2013) identified six families of measures. These are:

1. Tie central tendency
2. Tie dispersion
3. Alter central tendency
4. Alter dispersion
5. Ego-alter similarity
6. Structural shape

These are discussed in detail by Borgatti et al. (2013), and summarised here.

Tie central tendency and dispersion

Tie central tendency and dispersion are based on ego-alter ties. Tie central tendency can simply refer to the number of ego-alter ties for each ego (that is, how many alters there are in each ego's network), while dispersion can take into account different types of ties, for example if a person has more ties to family than to friends. A commonly-used metric is Blau's H or Agresti's IQV, which are related measures (see Crossley et al., 2015).

Alter central tendency and dispersion

Alter central tendency and dispersion are based on the attributes of the alters. For central tendency, we might report the proportion who fall into each gender, or mean (or median) age. Dispersion reflects the spread of these variables, using Blau's H (or Agresti's IQV) for categorical variables, and standard deviation (SD) for continuous variables.

Ego-alter similarity

While the alter central tendency and dispersion variables describe the alters, they do not capture how similar they are to the ego. Thus, the ego-alter similarity family of measures assist with this. In many cases, we expect egos to associate with people who are similar to them (known as *homophily*). Clearly, ego-alter similarity requires attribute information from both the ego and each of their alters. As Crossley et al. (2015) cautions, in the absence of a longitudinal design, it is difficult to infer whether associating with people who engage in a particular behaviour *caused* an ego to engage in that behaviour. That is, the design is correlational.

A common measure of ego-alter similarity for categorical variables is the EI index (Krackhardt & Stern, 1988). As described by Crossley et al. (2015, p. 81): "Here the E stands for the number of external ties – that is, the number of ties ego has to alters in a category different to their own. The I stands for the number of internal ties – that is, the number of ties ego has to actors in the same category as they are in." The EI index is (E - I) / (E + I). A score of negative 1 indicates that an ego has ties only with people like themselves (internal ties), indicating perfect homophily. In contrast, a score of positive 1 means the ego only has ties to people who are different to them.

For continuous variables, absolute differences between the ego's score and each of the alters' scores can be determined and the mean of these calculated. As these are means of absolute differences, scores closer to 0 indicate that the ego associates with people with more similar characteristics to themselves (e.g., closer in age), while higher scores indicate the ego associates with people with different characteristics to themselves.

Alter-alter similarity

While homophily is a measure of how similar an ego is to their alters, heterogeneity (or homogeneity) is a measure of how similar the alters are to each other. Like alter central tendency and dispersion, this can be measured using Blau's H or Agresti's IQV for categorical variables, and standard deviation for continuous variables. For Blau's H, the measure used in this report, scores closer to 0 indicate that an ego's network of alters are mostly similar to each other (homogeneity), while a score closer to 1 indicates that an ego's alters are mostly different to each other.

Structural shape of the egocentric network

The final family of measures is around the structural shape of the network. We summarise the five most commonly used measures: density, effective size, efficiency, constraint and hierarchy (Crossley et al., 2015).

In an egocentric social network with five alters, each alter can be connected to a maximum of four other alters. If all alters in a network are connected to each other, with a tie in every possible place, the network is at maximum density. Density is a measure of the number of ties divided by the maximum possible number of ties. With maximum density, information shared with any alter can potentially travel to any other alter. This can be beneficial where information flow is crucial, such as in workplaces. However, Crossley et al. (2015) give the example of less dense networks being useful. In the case of gambling research, both situations could be useful for informing clinical interventions. For example, where the network of an ego has a range of distinct social circles, it affords them the possibility to take on a different persona in each social circle, such as a gambler in one network, and a non-gambler in another, allowing them to limit their gambling based on who they associate with.

Effective size is another measure of the size of an egocentric network and differs from the tie central tendency measure described above by accounting for redundancy of certain ties. Efficiency is a normalised measure of effective size. Effective size considers the number of alters in the network (i.e., the number of ties) and then considers the average number of ties between each alter and the other alters in the network. If the network has 6 alters, and none of the alters know each other, the effective size is: number of alters (6) divided by mean number of alter-alter ties per alter (0) = 6. The more alter-alter ties, the lower the effective size will be. Burt (1995) suggested that merely knowing many alters does not necessarily provide the ego with a lot of resources/information unless the alters provide unique resources or information. If all of the ego's alters know each other, then they are likely to provide similar resources or information, whereas networks containing more unconnected alters are more likely to provide unique resources or information to the ego. Thus the effective size measure aims to account for these alter redundancies. In our study, since we set the required number of alters at 20 per ego, efficiency is just a linear transformation of effective size and thus both measures provide the same information.

Constraint is the extent to which the ego's connections are to alters who are also connected to each other. Crossley et al. (2015) explain that if alters are connected to other alters, they may opt to trade resources or information with other alters, rather than with the ego. As egocentric networks do not extend beyond the ego's alters, in the context of an egocentric social network analysis, it is assumed that if an alter is not connected to other alters, then that alter has no (or few) alternatives to trading resources or information with the ego, and the ego is less constrained. However, if an ego's network is more dense, and the alters are all connected to many of the other alters, then the ego is more constrained. Crossley et al. (2015) state that "The measure of constraint focuses upon investment (of time and energy) in relations". The calculations are complex, and are not described here (see Burt, 1995 for details).

The final measure is hierarchy, which describes the nature of constraint. If constraint is centred around one alter, then that network will have a high score for hierarchy. If an ego relies on particular alters more than others for information or resources, then the ego is constrained by this relationship (and by the lack of other beneficial relationships). This may be the case for people who are relatively socially isolated and spend most of their time with a small number of people.

As noted above, further structural shape variables are identified in the literature but are not relevant to this particular project.

2.3 Summary

This chapter introduced the specifics around social network analysis. The nature of social networks, particularly in terms of flow of information, were initially discussed, followed by descriptions of both sociocentric and egocentric approaches to social network analysis. Because the present study uses egocentric social network analysis, we then discussed egocentric social network terminology, diagrams and measures, including measures that are specific to the egocentric approach. Finally, the “structural shape” variables were discussed, particularly network density, constraint and hierarchy. In the next chapter, we discuss the specific methods for the present study.

Chapter 3: Method

3.1 Introduction

This chapter explains the research methods used in this study. The first section includes information on recruitment, sampling, inclusion criteria, consent, data quality checks and completion statistics. The final sample of respondents is described. The second section, in conjunction with Appendix A, includes detailed information about the survey and measures used for the study. Finally, the data analysis approach is outlined.

3.2 Methods

3.2.1 Recruitment, sampling, inclusion/exclusion criteria, quotas, and consent

Responses were collected via an online survey, conducted on the Qualtrics survey platform between 15th August and 5th September 2017. The target sample size was 800 Victorian adults. Respondents were recruited through Qualtrics. Qualtrics does not operate any panels of research participants, and instead recruits participants for research by working with operators of existing online research panels. The exact compensation per participant was not disclosed to the research team, but was in line with general online survey reimbursement amounts.

Respondents were required to be 18 years of age or older and to live in Victoria[5], based on the postcode of their primary residence. No respondents were excluded for failing to meet the age requirement, and 397 potential respondents lived outside of Victoria and were thus excluded from the survey.

As per the research specifications, we were specifically interested in comparing low risk and moderate risk gamblers to non-gamblers, non-problem gamblers and problem gamblers. Quotas were set to obtain approximately equal numbers of these five groups.

Before the start of the survey, respondents were presented with an information sheet that outlined the nature of the research, and were asked to consent to taking part. Those who did not consent were excluded (*n* = 112).

3.2.2 Data quality checks

In previous surveys, Qualtrics has recommended using “attention checks”. These are questions that are placed in the survey such as “Please select ‘Strongly disagree’ for this question as an attention check” and are designed to detect respondents who are not reading the questions. Recently, Qualtrics has changed

[5] The funding body is a state-based agency from Victoria, Australia, and thus all respondents were Victorians.

their recommendation from using attention checks to inserting a question at the start of the survey that asks respondents to commit to providing their best answers[6]. Respondents who could not commit to doing so, or who refused to do so, were screened out of the survey (*n* = 39). A speed check was also implemented, to exclude respondents who completed the survey in less than 5 minutes. No respondents were excluded on the basis of this check.

Finally, respondents were asked to provide the names of the 20 most influential people in their lives. Respondents were told that they could use nicknames if they preferred, and that names were required so that questions could be asked such as "How close is James to Peter?". Upon examining the names provided, it was clear that some respondents had not provided names that would allow them to complete the survey, either because they had entered gibberish, or because all names were public figures (e.g., previous Australian Prime Ministers, characters from television shows), or because the respondents had entered "no one" or similar for all 20 names[7]. These respondents were excluded and replaced with additional respondents (*n* = 100).

3.2.3 Exclusion statistics, completion rates and completion time

A total of 2,024 respondents started the survey. Table 3.1 outlines reasons for exclusion, incompletes and the final sample size.

Table 3.1 Exclusion statistics and completion rates

Criterion	Number excluded	Number remaining
Total number of respondents who attempted the survey	-	*2,024*
Under the age of 18	0	2,024
Not living in Victoria	397	1,627
Did not consent	112	1,515
Did not commit to providing their best answers	39	1,476
Speeding check	0	1,476
Poor quality data	100	1,376
Total eligible respondents	-	*1,376*
Started but did not complete the survey	592	784
Final sample size	-	*784*

[6] https://www.qualtrics.com/blog/using-attention-checks-in-your-surveys-may-harm-data-quality/

[7] During survey development, one potential concern was that problem gamblers in particular may have had trouble listing 20 people that they are close to in their lives, due to social isolation. Respondents were told that should they be unable to list 20 people they are close to, to put down names of those who they are not particularly close to, because they would be able to indicate that in a subsequent question. This was reflected in the results when assessing mean closeness to alters. A small number (~10) of respondents listed nonsense names or "no one". This did not appear to be related to PGSI groups, and they were removed from analysis under the "poor data quality" criterion.

Thus 784 respondents from a potential pool of 1,376 eligible respondents completed the survey, for a completion rate of 57.0%[8], Median completion time was 28.8 minutes. Upon completion of the survey and verification of data quality, respondents were compensated for their time in line with the panel provider's reward policies.

3.2.4 Final sample characteristics

Of the final 784 respondents, 359 (45.8%) were male and 425 (54.2%) female, with no respondents selecting the 'other' option as their gender. Age ranged between 18 and 77 years (*M* = 35.3, *SD* = 14.5, median = 31). Respondents were approximately equally split between being non-gamblers (*n* = 159) and each of the four PGSI categories: non-problem (*n* = 169), low risk gambler (*n* = 151), moderate risk gambler (*n* = 157) and problem gambler (*n* = 148).

For the remainder of the method and results chapters, the respondents will be called egos in order to be clear when results apply to egos and to alters, in line with social network analysis terminology (see Chapter 2).

3.2.5 Ethics

Approval was obtained from CQUniversity's Human Research Ethics Committee (H17/05-080). As a requirement of this ethics approval, respondents were presented with the phone number and website for Gambler's Help, and were informed that this help line is free and confidential, and operates 24 hours a day, 7 days a week.

3.3 Measures

The survey instrument is attached in Appendix A. Please see the survey for exact wording of questions.

3.3.1 Measures about egos

Egos provided the following information about themselves:

Demographics:

- Age (in years)
- Gender (male, female, other [please specify])

[8] One peer reviewer noted that an alternative completion rate could be calculated based on the 1,627 respondents who lived in Victoria, which includes those who did not consent, did not commit to provide their best answer, and provided poor quality data. If the completion rate is calculated to include these respondents, it is 784/1627 (*100) = 48.2%.

- Aboriginal or Torres Strait Islander status (Aboriginal, Torres Strait Islander, both, neither)
- Main language spoken at home (English, other [please specify])
- Country of birth (Australia, other [please specify])
- Highest completed level of education (Year 10 or below, Year 11 or equivalent, Year 12 or equivalent, a trade technical certificate or diploma, a university or college degree, postgraduate qualifications)
- Living arrangements (live alone, couple [no dependents], couple with at least one dependent child, couple living with independent child[ren], single parent living with at least one dependent child, single parent living with independent child[ren], share house with other adults, live with parents, other [please specify])
- Number of dependent children living with them (1 to 5 or more), and their age
- Work status (work full-time, work part-time or casual, student [you may also be working part time to support your study], unemployed and looking for work, full-time home duties, retired, sick or on a disability pension, other [please specify])
- Income (in brackets, including the option to respond “prefer not to say”)
- Disposable income (in brackets, including the option to respond “prefer not to say”).

Gambling behaviour:

- Frequency of gambling over the last 12 months on each of nine forms of gambling (instant scratch tickets, bingo, lotto/lottery games like Powerball, keno, poker, poker machines (pokies), sports betting, race betting, other casino table games (such as roulette, but not poker))
- Gambling expenditure per month over the last 12 months on each form on which they gamble (defined as money invested, not including recycling wins)
- Gambling mode (from exclusively online, defined as gambling via websites including smartphone, tablet or smart television apps, to exclusively offline, defined as telephone and land-based venues)

Gambling risk, gambling harm and positive play/responsible gambling:

Each ego’s gambling risk was assessed with the Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001). The PGSI consists of nine questions, such as “how often have you bet more than you could really afford to lose?” with response options: never (0), sometimes (1), most of the time (2), and almost always (3), and respondents are asked to consider their answers with respect to the last 12 months. Scores on the nine items are summed (possible scores range from 0 to 27), and respondents are placed into risk groups based on these scores: non-problem gamblers (PGSI = 0), low risk gamblers (PGSI 1 to 2), moderate risk gamblers

(PGSI 3 to 7) and problem gamblers (PGSI 8 to 27). The PGSI is regularly used in Australian surveys (Thomas et al., 2011). Cronbach's alpha for the PGSI in this sample was .94. The PGSI was not asked of non-gamblers.

Each ego's gambling-related harm was assessed by the Short Gambling Harms Scale (Browne, Goodwin & Rockloff, 2017). Respondents are asked whether they have experienced any of ten statements as a result of their gambling in the last 12 months, such as "reduction of my available spending money" or "felt like a failure". Response options are no (0) and yes (1), with scores summed for a total number of harms experienced. The scale was developed using Australian samples and both a long form, and the present short form, have been validated.

Each ego's responsible gambling behaviour was assessed using the Positive Play Scale (Wood, Wohl, Tabri, & Philander, 2017). The scale consists of 14 items. Seven items assess behaviour and are split into two subscales: pre-commitment and honesty/control. The remaining seven items assess beliefs, and are also split into two subscales: personal responsibility and gambling literacy. Response options for the seven items in Scale A were on a 7-point Likert scale ranging from never to always, and for the six items in Scale B were on a 7-point Likert scale ranging from strongly disagree to strongly agree. Scores on the relevant items for the subscales are averaged, with higher scores on each subscale indicating more responsible behaviours and beliefs towards gambling. Cronbach's alpha for the four subscales ranged from .80 to .94 in this sample. This scale was not completed by non-gamblers.

Attitude to Gambling

Each ego's attitude towards gambling was assessed using the Attitudes Towards Gambling Scale (ATGS; Orford, Griffiths, Wardle, Sproston, & Erens, 2009). The ATGS is a 14 item scale examining general attitudes towards gambling and has been validated on Australian samples (Donaldson et al., 2016).

Comorbid behaviours

Respondents were asked how frequently they smoked cigarettes and drank alcohol (not in the past year to daily).

3.3.2 Measures about alters

Prior to questions about the alters, respondents were presented with four images, each with brief instructions about the social network component of the survey. These images explained that the egos would be asked to nominate the 20 most influential adults (18+) in their life over the last 12 months. The images described why we required names for their alters, to reassure respondents.

Egos provided the following information for each of their 20 alters:

Names

Respondents were asked to provide the names or nicknames of the 20 most influential adults in their lives within the last 12 months (alters).

Restriction to the last 12 months was because the PGSI (a key scale in this study) is based on the last 12 months. Alters were required to be adults because we were interested in their gambling behaviour, which is only legal for adults (18+) in Australia.

The number of alters (20) was based on previous research. Previous egocentric social network analysis studies have required participants to nominate anywhere between 3 (Wang & Muessig, 2017) and 30 (Meisel et al., 2013) alters. We found 20 alters to be an acceptable compromise in terms of obtaining rich information about the networks, without requiring too much cognitive burden from the participants (Carolan, 2014), while keeping the survey length acceptable. Furthermore, Meisel et al. (2013) found that the information from the first 20 alters was the most useful, with alters 21-30 adding little additional information.

Alter demographics

For each of the 20 alters, the egos supplied their gender (male, female) and age (in years).

Alter gambling behaviours and gambling-related harm

To contain the length of the survey, we were unable to ask egos how frequently each alter engaged in each type of gambling. Instead, egos were asked how frequently they thought each alter engaged in gambling forms other than lottery games, instant scratch tickets and bingo in the last 12 months (not in the past year to daily). These forms were excluded because they are generally not associated (or weakly associated) with gambling-related harm or problems.

If an ego reported that an alter had engaged in gambling during the last 12 months, then the ego was asked which form of gambling they most engaged in over the last 12 months (keno, poker, poker machines [pokies], sports betting, race betting, other casino table games [such as roulette, but not poker]), and the level of harm due to gambling that the alter had experienced over the last 12 months (no harm, minor harm, moderate harm, severe harm).

3.3.3 Measures about the nature and strength of the relationships between ego and alters

The egos provided information about who each alter is in relation to the ego (response options: mother, father, brother, sister, other family member, friend, colleague, spouse, romantic partner [other than spouse], housemate, other).

Egos also provided information about how close they are to each of the alters (not particularly close, somewhat close, very close, extremely close), and how long they had known each alter (in years).

If the ego indicated that the alters gambled, smoked or drank alcohol (and if the ego also engaged in each behaviour), the ego was asked how frequently each of the alters engaged in that behaviour with the ego in the last 12 months (not in the past year to daily).

3.3.4 Measures about the strength of the relationships between pairs of alters

To measure the strength of the relationships between pairs of alters, we first asked how close alter 1 (by name) was to each of the remaining 19 alters (not particularly close, somewhat close, very close, extremely close).

The same table was repeated for alter 2, with the ego required to give ratings of closeness for alter 2 with each of alters 3 through 20. As the strength of the relationship between alters 1 and 2 had already been ascertained, it was not necessary to ask for this again[9]. The procedure was completed for each subsequent ego until they had rated the strength of the relationship between each possible pair of alters (190 relationships in total). These ratings were used to calculate measures related to the structural nature of the social networks. Initial analyses treated these relationships (both ego-alter and alter-alter) as scales and also as a “don’t know” (not particularly close) vs “know” (somewhat, very or extremely close) measure. We found little difference in the results and opted for the dichotomous approach for this report.

3.4 Data analysis

As per the scope of the study, the focus of the analyses was on low risk (LRs) and moderate risk (MRs) separately, compared to non-gamblers (NGs), non-problem gamblers (NPs) and problem gamblers (PGs), separately. However, it was immediately clear from early results that the networks of the different risk groups indicated an order (for example, the number of alters who gambled was the lowest for NGs, then NPs, then LRs, then MRs and finally PGs). As such, focusing only on LRs and MRs, while fulfilling the scope of the study, appeared to neglect some of the most interesting results. As such, we have fulfilled the scope by comparing LRs and MRs to all other groups, but also conducted comparisons between NGs, NPs and PGs, using (appropriately-corrected) pairwise comparisons.

[9] In egocentric social network analysis, it is possible that the relationship (a.k.a. tie, edge, link) between any two alters could be different from the perspective of either alter. For example, alter 1 might feel particularly close to alter 2, but alter 2 may not feel particularly close to alter 1. However, it is common to consider the relationships as equally weighted from both sides. If we had collected information about the strengths of the relationships from both perspectives, the egos would have had to complete 380 questions about alter-alter relationships. In our opinion, the additional burden on the ego was not worth any additional information this would have provided.

The analysis plan was to initially determine which variables differentiate the groups by examining each variable individually. These variables included ego characteristics, alter characteristics, ego-alter relationship characteristics, and social network structural variables. These initial analyses were conducted via omnibus tests with group as the independent variable (one-way Analysis of Variance [ANOVA] for continuous variables, Kruskal-Wallis tests for ordinal variables and chi-square tests of independence for categorical variables). In some cases, the assumptions of one-way ANOVA were violated (specifically, homogeneity of variance). In those circumstances, we conducted Welch tests, which are robust to violations of assumptions.

Pairwise comparisons were then conducted to determine specific differences between the groups. These were in the form of Tukey's Honest Significant Differences for continuous variables, Bonferroni-corrected Mann-Whitney tests for ordinal variables and Bonferroni-corrected tests of proportions for categorical variables.

Multivariate models were conducted to determine whether differences in social network structural characteristics remained between PGSI groups when controlling for other variables. The analysis strategy for these tests is further described in section 4.6 below.

We explored some variables as both a dichotomy, and as a scale. For example, alter gambling-related harm was captured using four points: no harm, minor harm, moderate harm and severe harm. Treating this as a dichotomy (no harm vs any harm) or as a scale made little difference to the results. Furthermore, the ego's gambling-related harm was captured using a 10-item screen, which would be onerous to conduct on up to 20 alters. Dichotomising both allowed for easier comparisons between ego and alter gambling-related harm. Similarly, gambling, tobacco and alcohol use were dichotomised into none vs any categories.

The survey was conducted online and all questions were mandatory. However, respondents were able to respond with either "don't know" or "prefer not to say" to the income and disposable income variables. Thus analyses that include those variables only consider those who responded. Some variables were only asked of particular respondents. For example, if an ego was a gambler, and they reported that 10 of their alters did not gamble in the last 12 months, then the ego was not asked how frequently they had gambled *with those alters* in the last 12 months (but the ego was still asked about how frequently they had gambled with the other alters who were gamblers). Thus, any missing data was by design, rather than due to egos refusing to answer or unintentionally missing questions. Analyses involving these variables either excluded respondents who were not asked the questions (e.g., income, disposable income), or summary variables were calculated that negated the missing data. For example, considering the example above about gambling with alters, a variable was created that captured how many of their alters they had gambled with.

Analyses were conducted using a combination of SPSS v25.0 (IBM Corp, 2017; for descriptive and inferential statistics), E-Net v0.41 (Borgatti, 2006; for calculating network structural variables) and R v3.4.0 (2017), with the following packages in particular: igraph, network, sna, ndtv, visNetwork (for creating network diagrams).

Chapter 4: Results

4.1 Introduction

This chapter presents the results of the study. Initially, we present comparisons of the egos across the five groups (non-gamblers [NG] and the four PGSI groups, non-problem [NP], low risk [LR], moderate risk [MR] and problem gamblers [PG]), to determine whether the groups are representative based on previous research findings, and also to determine possible control variables for later analyses. The nature of the alters in the social networks are described and compared based on which of the five groups the ego belongs to. Ego-alter relationships are described and compared across the groups, and then variables that describe the structure of the networks (based on alter-alter relationships) are compared across the groups.

Multivariate analyses are then reported, based on the results of the bivariate analyses above – specifically, network density and the number of alters who gamble, because these emerged as two key variables from the bivariate results, and can be modelled across the non-gamblers and the four gambling risk groups. While not specifically part of the scope of the present study, we also modelled ego gambling harm as a dependent variable, because understanding gambling harm is a topic of growing research interest. The aim of these analyses was to determine whether gambling risk group status (or non-gambler status) was related to each of these dependent variables, when controlling for other variables such as demographics, behaviours, and the nature of the social networks around egos – that is, whether group membership *uniquely* explained differences in network density, number of alters who gamble, and gambling harm.

4.2 Ego characteristics by PGSI group

Ego characteristics are presented below to describe the nature of the sample. Furthermore, the nature of social networks tend to vary by key demographics, such as age (Morgan, 1988), and these demographic variables also vary between gambling risk groups. Thus this section of results also determined demographic differences between the groups that would serve as potential control variables in the later multivariate analyses.

4.2.1 Demographics

Demographic comparisons are shown between Table 4.1 and Table 4.4. PGs were significantly more likely to be male compared to all other groups, while MRs were significantly more likely to be male compared to NPs. No significant differences were observed between NGs, LRs and MRs in terms of gender.

NGs were significantly younger than NPs and LRs, with NPs the oldest of all groups on average. No significant differences were observed between MRs and PGs with other groups, apart from the older NPs.

NGs were significantly more likely to speak a language other than English at home compared to LRs, MRs and PGs. NGs and NPs were also significantly more likely to be born in a country other than Australia compared to PGs.

LRs, MRs and PGs all reported significantly higher incomes than NGs, and PGs also reported significantly higher incomes than NPs. Similar results were observed for disposable income.

Gamblers in the sample were significantly less likely to be living with their parents, but no other significant differences in living arrangements were observed.

Problem gamblers were significantly more likely to be currently employed compared to NGs, NPs and LRs. MRs were significantly more likely to be employed than NGs and NPs. No significant differences were observed between LRs, NPs and NGs in terms of employment status.

No significant differences were observed between any of the groups in terms of: Aboriginal or Torres Strait Islander status, number of dependent children or education.

Table 4.1 Comparisons of ego demographic characteristics by group

Demographic	NG (*n* = 159)	NP (*n* = 169)	LR (*n* = 151)	MR (*n* = 157)	PG (*n* = 148)	Inferential statistics
Gender (% male)[1]	35.8[ab]	32.5[b]	45.7[ab]	51.0[ac]	66.2[c]	$\chi^2(4, N = 784) = 9.94$, $p < .041$, $\Phi = .24$
Age (mean [SD])	30.84[a] (13.15)	42.33[c] (16.06)	36.05[b] (14.14)	34.20[ab] (14.36)	32.47[ab] (11.63)	*Welch*(4, 388.97) = 14.63, $p < .001$
Aboriginal or Torres Strait Islander status (% no)[2]	96.9	98.8	98.0	93.0	95.3	$\chi^2(4, N = 784) = 9.94$, $p = .041$
Main language spoken at home (% English)	88.7[a]	95.3[ab]	97.4[b]	97.5[b]	98.0[b]	$\chi^2(4, N = 784) = 20.88$, $p < .001$, $\Phi = .16$
Country of birth (% Australia)	78.6[ab]	75.1[b]	78.8[ab]	87.9[ac]	93.9[c]	$\chi^2(4, N = 784) = 26.12$, $p < .001$, $\Phi = .18$
Number of dependent children (mean [SD])[3]	1.80 (.66)	1.65 (.64)	1.39 (.72)	1.47 (.59)	1.69 (.82)	$F(4, 205) = 2.29$, $p = .061$
Income (annual pre-tax personal income, median bracket)[4]	$20,800 - $31,100[a]	$31,200 - $41,599[b]	$31,200 - $41,599[bc]	$31,200 - $41,599[bc]	$41,600 - $51,999[c]	$H(df = 4) = 54.62$, $p < .001$
Disposable income (per week, median bracket)[4,5]	$51-$75[a]	$76-$100[ab]	$101-$150[bc]	Between $76-$100 and $101-$150[b]	$151-$200[c]	$H(df = 4) = 55.86$, $p < .001$

Note: Inferential statistics are omnibus tests. F indicates a parametric ANOVA test for continuous variables (or Welch test where variances are not homogenous), H indicates a nonparametric Kruskal-Wallis test for ordinal variables, and χ^2 indicates a chi-square test of independence for categorical variables. Pairwise comparisons were conducted using Tukey Honest Significant Differences (continuous variables), Bonferroni-corrected Mann-Whitney tests (ordinal variables) and Bonferroni-corrected tests of proportions (categorical variables). Differences based on pairwise tests are indicated using superscripts. Groups may have more than one superscript. Any groups that share any similar superscript are not significantly different from each other. Superscripts are not presented where no significant differences were observed. [1] Egos were given the option of "Other (please specify)" for gender, but none selected the option. [2] For Aboriginal and Torres Strait Islander status, the omnibus test was significant, but no pairwise test was significant. Thus no significant differences were observed. [3] Number of dependent children was only asked of those who reported living with dependent child(ren). [4] For income and disposable income, egos were given the options "don't know" and "prefer not to say". Egos that selected those options were removed from analysis (*n* = 77 and 51 excluded for income and disposable income respectively). [5] The median disposable income for MRs falls between these two response options. NG = non-gambler. NP = non-problem gambler. LR = low risk gambler. MR = moderate risk gambler. PG = problem gambler.

Table 4.2 Comparisons of ego education characteristics by group

Demographic	NG (*n* = 159)	NP (*n* = 169)	LR (*n* = 151)	MR (*n* = 157)	PG (*n* = 148)
Yr 10 or below	9.4	6.5	6.6	8.3	6.1
Yr 11 or equivalent	6.9	4.7	7.9	5.1	3.4
Yr 12 or equivalent	28.3	18.9	19.9	23.6	18.9
A trade, technical certificate or diploma	20.8	30.8	26.5	21.7	23.6
A university or college degree	27.7	30.8	29.1	31.8	32.4
Postgraduate qualifications	6.9	8.3	9.9	9.6	15.5

Note: Omnibus test: $\chi^2(20, N = 784) = 21.77$, $p = .353$. Pairwise comparisons were conducted using Bonferroni-corrected tests of proportions. No significant pairwise differences detected.

Table 4.3 Comparisons of ego living arrangements characteristics by group

Demographic	NG (*n* = 159)	NP (*n* = 169)	LR (*n* = 151)	MR (*n* = 157)	PG (*n* = 148)
Live alone	15.1	16.0	12.6	16.6	20.9
Couple (no dependents)	19.5	23.1	28.5	20.4	24.3
Couple with at least one dependent child	17.0	24.9	21.9	22.3	25.7
Couple living with independent child(ren)	3.8	8.3	6.0	6.4	4.1
Single parent living with at least one dependent child	1.9	3.6	7.3	5.1	4.7
Single parent living with independent child(ren)	2.5	1.8	3.3	1.3	2.0
Share house with other adults	7.5	7.7	8.6	11.5	7.4
Live with parents	32.1[a]	14.2[b]	11.9[b]	16.6[b]	9.5[b]
Other	.6	.6	.0	.0	1.4

Note: Omnibus test $\chi^2(32, N = 784) = 56.31$, $p = .005$, $\Phi_C = .13$. Pairwise comparisons were conducted using Bonferroni-corrected tests of proportions. Differences based on pairwise tests are indicated using superscripts. Groups may have more than one superscript. Any groups that share any similar superscript are not significantly different from each other. Superscripts are not presented where no significant differences were observed.

Table 4.4 Comparisons of ego work status characteristics by group

Demographic	NG (*n* = 159)	NP (*n* = 169)	LR (*n* = 151)	MR (*n* = 157)	PG (*n* = 148)
Work full-time	23.9[a]	26.6[a]	42.4[b]	45.2[bc]	59.5[c]
Work part-time or casual	21.4[ab]	30.2[b]	15.9[a]	26.8[ab]	18.2[ab]
Student	27.7[a]	7.1[b]	11.3[b]	12.1[b]	7.4[b]
Unemployed and looking for work	10.1	8.9	10.6	3.2	4.7
Full-time home duties	7.5	13.0	12.6	7.6	4.7
Retired	1.9[ab]	8.9[b]	5.3[ab]	3.8[ab]	.7[a]
Sick or on a disability pension	5.0	4.1	1.3	1.3	4.7
Other	2.5	1.2	.7	.0	.0
Employed	45.3[a]	56.8[a]	58.3[ab]	72.0[bc]	77.7[c]
Not employed	54.7	43.2	41.7	28.0	22.3

Note: Omnibus test $\chi^2(28, N = 784) = 125.59$, $p < .001$, $\Phi_C = .20$ for ungrouped work status, and $\chi^2(4, N = 784) = 43.66$, $p < .001$, $\Phi = .24$ for employed vs not employed. Pairwise comparisons were conducted using Bonferroni-corrected tests of proportions. Differences based on pairwise tests are indicated using superscripts. Groups may have more than one superscript. Any groups that share any similar superscript are not significantly different from each other. Superscripts are not presented where no significant differences were observed.

4.2.2 Gambling behaviour

Gambling frequency was assessed by gambling form. In general those in higher risk groups gambled significantly more frequently on each form that those in lower risk groups. The exact pattern of difference varies by form (see Table 4.5), but in most cases, LRs and MRs gambled more frequently on each form compared to NPs, and PGs gambled more frequently on all forms compared to all other groups.

There were fewer significant differences in terms of expenditure on each form, although expenditure was only asked of those who gambled on each form, and thus these analyses are based on fewer people (and thus have less power). Significant expenditure differences were not observed for all forms of gambling, but where they were found, once again, those in higher risk groups were significantly more likely to spend more on those forms (Table 4.6).

Table 4.7 indicates the amount of gambling that is done online by each PGSI group. In general, higher risk groups were significantly more likely to bet online at all, and generally do a larger proportion of their betting online, particularly using a mixture of online and offline gambling (Table 4.7).

Table 4.5 Mean (SD) and median [med] gambling frequency by group

Gambling frequency x form	NP	LR	MR	PG	Inferential statistics
Instant scratch tickets	1.85[a] (1.14) Med = Not in the past year	2.05[b] (1.28) Med = Less than once a month	2.43[c] (1.45) Med = Less than once a month	3.53[d] (1.75) Med = About once a fortnight	*H*(df = 3) = 94.31, *p* < .001
Bingo	1.40[a] (1.04) Med = Not in the past year	1.50[a] (1.03) Med = Not in the past year	1.79[b] (1.31) Med = Not in the past year	2.84[c] (1.78) Med = Between less than once a month and about once a month	*H*(df = 3) = 95.13, *p* < .001
Lotto/ lottery games like Powerball	2.59[a] (1.52) Med = Less than once a month	2.91[a] (1.84) Med = Less than once a month	2.80[a] (1.57) Med = About once a month	3.59[b] (1.60) Med = About once a fortnight	*H*(df = 3) = 31.86, *p* < .001
Keno	1.20[a] (.67) Med = Not in the past year	1.42[b] (.88) Med = Not in the past year	1.69[c] (1.19) Med = Not in the past year	2.93[d] (1.87) Med = Between less than once a month and about once a month	*H*(df = 3) = 121.45, *p* < .001
Poker	1.27[a] (.95) Med = Not in the past year	1.64[b] (1.13) Med = Not in the past year	1.90[b] (1.29) Med = Not in the past year	3.26[c] (1.90) Med = About once a month	*H*(df = 3) = 148.41, *p* < .001
EGMs / poker machines	1.58[a] (.86) Med = Not in the past year	2.04[b] (1.40) Med = Not in the past year	2.43[c] (1.48) Med = Less than once a month	3.73[d] (1.78) Med = About once a fortnight	*H*(df = 3) = 136.26, *p* < .001
Sports betting	1.70[a] (1.36) Med = Not in the past year	2.42[b] (1.82) Med = Less than once a month	2.49[b] (1.73) Med = Less than once a month	3.68[c] (1.84) Med = About once a fortnight	*H*(df = 3) = 100.02, *p* < .001
Race betting	1.62[a] (1.23) Med = Not in the past year	2.07[b] (1.62) Med = Not in the past year	2.33[b] (1.62) Med = Less than once a month	3.53[c] (1.93) Med = Between once a month and once a fortnight	*H*(df = 3) = 100.56, *p* < .001
Other casino table games (e.g. roulette, but not poker)	1.33[a] (.90) Med = Not in the past year	1.46[a] (.94) Med = Not in the past year	1.89[b] (1.32) Med = Not in the past year	3.26[c] (1.90) Med = About once a month	*H*(df = 3) = 145.34, *p* < .001

Note: NGs not included as, by definition, they did not gamble in the last 12 months. Pairwise comparisons were conducted using Bonferroni-corrected Mann-Whitney tests. Differences based on pairwise tests are indicated using superscripts. Groups may have more than one superscript. Any groups that share any similar superscript are not significantly different from each other. Superscripts are not presented where no significant differences were observed. Analyses are non-parametric, and thus medians are more appropriate, however in some cases, differences were observed despite the medians being the same. Thus means are also presented for interpretation.

Table 4.6 Mean (SD) and median [med] monthly gambling expenditure by group

Gambling expenditure by form	NP	LR	MR	PG	Inferential statistics
Instant scratch tickets	27.32^{ab} (42.70) Med = 10	17.96^{a} (23.83) Med = 10	27.70^{bc} (41.61) Med = 20	47.07^{c} (108.25) Med = 20	H(df = 3) = 21.24, p < .001
Bingo	22.86 (26.27) Med = 10	18.95 (26.18) Med = 10	39.13 (137.37) Med = 10	42.40 (75.23) Med = 12	H(df = 3) = 5.54, p = .136
Lotto/ lottery games like Powerball	82.87 (242.55) Med = 30	165.85 (616.59) Med = 25	116.22 (359.70) Med = 20	87.51 (250.95) Med = 20	H(df = 3) = .39, p = .942
Keno	26.19^{ab} (43.47) Med = 10	12.79^{a} (13.61) Med = 10	69.80^{a} (406.89) Med = 7.5	2543.61^{b} (24076.77) Med = 12	H(df = 3) = 13.02, p = .005
Poker	42.05 (106.44) Med = 10	30.64 (43.67) Med = 16.5	162.88 (658.38) Med = 25	94.22 (245.43) Med = 20	H(df = 3) = 6.62, p = .085
EGMs / poker machines	38.84^{a} (119.80) Med = 15	107.77^{b} (282.12) Med = 32.5	242.29^{b} (1081.39) Med = 40	337.87^{b} (1169.12) Med = 40	H(df = 3) = 28.58, p < .001
Sports betting	44.76^{a} (73.57) Med = 20	144.18^{ab} (411.82) Med = 20	92.60^{b} (162.84) Med = 40	1156.47^{b} (7857.10) Med = 20	H(df = 3) = 7.28, p = .064
Race betting	43.09^{ab} (70.68) Med = 20	60.31^{a} (156.79) Med = 18	92.50^{ab} (311.31) Med = 20	18190.17^{b} (185838.23) Med = 25	H(df = 3) = 7.08, p = .070
Other casino table games (e.g. roulette, but not poker)	95.15 (194.86) Med = 20	79.73 (140.97) Med = 20	169.62 (626.21) Med = 20	461.57 (2916.41) Med = 20	H(df = 3) = 2.21, p = .530

Note: NGs not included as, by definition, they did not gamble in the last 12 months. Pairwise comparisons were conducted using Bonferroni-corrected Mann-Whitney tests. Differences based on pairwise tests are indicated using superscripts. Groups may have more than one superscript. Any groups that share any similar superscript are not significantly different from each other. Superscripts are not presented where no significant differences were observed. Analyses are non-parametric, and thus medians are more appropriate, however in some cases, differences were observed despite the medians being the same. Thus means are also presented for interpretation.

Table 4.7 Amount of online gambling in the last 12 months by group

Amount of gambling online	NP	LR	MR	PG
I have only gambled online	18.9[a]	23.2[a]	15.9[a]	17.6[a]
I have mostly gambled online, but I have sometimes gambled offline	7.1[a]	18.5[b]	19.1[b]	29.7[b]
About half of my gambling has been online and half has been offline	7.1[a]	7.9[ab]	21.0[c]	17.6[bc]
I have mostly gambled offline, but I have sometimes gambled online	8.9[a]	14.6[ab]	18.5[ab]	23.6[b]
I have only gambled offline	58.0[a]	35.8[b]	25.5[b]	11.5[c]

Note: Each cell is proportion of respondents who selected that response. Omnibus test $\chi^2(12, N = 625) = 108.29$, $p < .001$, $\Phi C = .24$. NGs not included as, by definition, they did not gamble in the last 12 months. Pairwise comparisons were conducted using Bonferroni-corrected tests of proportions. Differences based on pairwise tests are indicated using superscripts. Groups may have more than one superscript. Any groups that share any similar superscript are not significantly different from each other. Superscripts are not presented where no significant differences were observed.

4.2.3 Gambling harms

Gambling harms were strongly related to PGSI group, with PGs experiencing the most harms, followed by MRs, then LRs, then NPs (Table 4.8).

Table 4.8 Mean (SD) gambling harms score by group

Measure	NP	LR	MR	PG	Inferential statistics
Gambling harms	.54[a] (1.60)	1.38[b] (1.50)	3.55[c] (2.24)	6.41[d] (2.36)	$F(3, 621) = 277.30$, $p < .001$

Note: NGs not included as, by definition, they did not gamble in the last 12 months. Pairwise comparisons were conducted using Tukey's HSD. Differences based on pairwise tests are indicated using superscripts.

4.2.4 Positive play / responsible gambling

For the positive play subscales, the general trend was that those in higher gambling risk groups were significantly: less likely to precommit in terms of their gambling; less likely to feel in control or be honest about their gambling to themselves or others; and less likely to take personal responsibility for their gambling behaviour. Higher scores on gambling literacy were associated with LOWER gambling literacy (e.g., believing that gambling is a good way to make money), and thus those in higher risk groups were significantly more likely to have lower gambling literacy (Table 4.9).

Table 4.9 Mean (SD) positive play subscale score by group

Positive play subscale	NP	LR	MR	PG	Inferential statistics
Behaviour – Precommitment	5.75[a] (1.52)	5.41[a] (1.30)	4.75[b] (1.16)	4.20[c] (1.16)	$F(3, 621) = 43.95$, $p < .001$
Behaviour – Honesty and control	6.31[a] (1.27)	5.73[b] (1.46)	4.52[c] (1.46)	4.01[d] (1.47)	$F(3, 621) = 89.78$, $p < .001$
Belief – Personal responsibility	6.60[a] (1.03)	6.40[a] (1.22)	5.75[b] (1.33)	5.33[c] (1.32)	$F(3, 621) = 35.67$, $p < .001$
Belief – Gambling Literacy	1.93[a] (1.54)	2.48[b] (1.66)	2.93[b] (1.49)	3.75[c] (1.51)	$F(3, 621) = 38.45$, $p < .001$

Note: NGs not included as, by definition, they did not gamble in the last 12 months. Pairwise comparisons were conducted using Tukey's HSD. Differences based on pairwise tests are indicated using superscripts.

4.2.5 Gambling attitudes

All at-risk gambling groups have significantly more positive attitudes towards gambling compared to NPs and NGs, and NPs have significantly more positive attitudes to gambling compared to NGs. No significant differences were observed between LRs, MRs and PGs (Table 4.10).

Table 4.10 Mean (SD) gambling attitudes scale score by group

Measure	NG	NP	LR	MR	PG	Inferential statistics
Gambling attitudes	28.91[a] (9.35)	34.02[b] (9.08)	37.77[c] (7.39)	38.79[c] (7.16)	37.66[c] (8.31)	$F(4, 779) = 37.60$, $p < .001$

Note: Pairwise comparisons were conducted using Tukey's HSD. Differences based on pairwise tests are indicated using superscripts.

4.2.6 Comorbid behaviour

Gamblers reported drinking and smoking more frequently than NGs, and PGs reported drinking and smoking more frequently than all other groups. Overall, higher risk gamblers reported drinking and smoking more frequently than lower risk gamblers, with the results varying slightly for alcohol and smoking.

Specifically, for alcohol, LRs reported drinking alcohol significantly more frequently than NPs, with MRs not significantly different to either LRs or NPs. For smoking, MRs reported smoking more frequently than NPs, with LRs not significantly different to either group (Table 4.11).

Table 4.11 Mean (SD) and median frequency for alcohol drinking and smoking by group

Comorbid behaviour	NG	NP	LR	MR	PG	Inferential statistics
Alcohol drinking	2.45[a] (1.69) Med = Less than once a month	3.54[b] (1.98) Med = Once a fortnight	4.01[c] (1.86) Med = Once a fortnight	3.95[bc] (1.81) Med = Once a fortnight	4.55[d] (1.67) Med = Once a week	H(df = 4) = 101.75, p < .001
Smoking	2.09[a] (2.21) Med = Not in the past year	2.43[ab] (2.47) Med = Not in the past year	2.67[bc] (2.48) Med = Not in the past year	2.99[c] (2.57) Med = Not in the past year	4.28[d] (2.51) Med = Once a week	H(df = 4) = 76.67, p < .001

Note: Pairwise comparisons were conducted using Bonferroni-corrected Mann-Whitney tests. Differences based on pairwise tests are indicated using superscripts. Groups may have more than one superscript. Any groups that share any similar superscript are not significantly different from each other. Superscripts are not presented where no significant differences were observed

4.3 Alter characteristics, by ego's PGSI group

4.3.1 Demographics

As described in section 2.2.6, it is possible to consider either alter characteristics in isolation, or in terms of how similar they are to the ego. We have considered demographic variables in terms of ego-alter similarity.

Using the Krackhardt and Stern's (1988) EI measure (described in section 2.2.6, and summarised under Table 4.12), no significant differences were found in relation to alter gender across the five groups. That is, it does not appear that egos in any of the groups were significantly more likely to associate with more alters of the same (or different) gender to the ego (Table 4.12).

For age, where we used mean absolute difference between the age of the ego and their alters, MRs and PGs were significantly more likely to associate with alters who were closer to them in age, compared to NPs (Table 4.13).

Table 4.12 Mean (SD) EI scores for gender amongst alters by group

Alter type	NG	NP	LR	MR	PG	Inferential statistics
EI score	-.26 (.32)	-.24 (.31)	-.22 (.31)	-.24 (.33)	-.26 (.34)	F(4, 779) = .38, p = .821

Note: Scores are EI scores. EI is calculated by examining the number of "external" ties (alters who are the opposite gender to the ego) and "internal" ties (alters who are the same gender as the ego), and calculating: EI = (E-I)/(E+I) . Negative scores indicate more internal ties (associating with more people of the same gender) and positive scores indicate more external ties (associating with more people of the opposite gender). See Krackhardt and Stern (1988).

Table 4.13 Mean (SD) absolute difference of age between egos and alters by group

Alter type	NG	NP	LR	MR	PG	Inferential statistics
Absolute age difference	10.70[ab] (6.78)	12.28[a] (6.06)	11.03[ab] (7.65)	9.77[b] (5.35)	9.27[b] (4.96)	*Welch*(4, 386.84) = 6.83, $p < .001$

Note: Pairwise comparisons were conducted using Tukey's HSD. Differences based on pairwise tests are indicated using superscripts.

4.3.2 Gambling behaviour

Rather than using ego-alter similarity metrics for alter gambling behaviour, we instead opted for the alter central tendency (and dispersion) measures (see section 2.2.6). This is because all groups were gamblers except for the non-gamblers. Furthermore, this is a key result, and thus untransformed data are more interpretable.

The number of alters who were gamblers was strongly related to which of the five groups the respondents were in. As may be expected, those in higher risk groups reported a higher number of their alters who were gamblers. It is notable that, for PGs, 13.01 of their 20 alters (on average) were gamblers, which was significantly higher than MRs and LRs (9.85 and 9.38 alters who were gamblers respectively), which were significantly higher than that NPs (7.30). NGs ($M = 3.72$) reported the lowest number of gamblers amongst their alters.

Alters were then analysed by type (family, friends, colleagues). Table 4.14 and Figure 4.1 indicate that the same general pattern followed across different types of alters.

Heterogeneity measures indicated that the alters in the networks low risk and moderate risk gamblers in particular were more different to each other in terms of gambling participation than were those in the networks of problem gamblers and non-gamblers. Furthermore, non-gamblers and problem gamblers were significantly more likely to have ties with people like themselves in terms of gambling participation, than were non-problem, low risk and moderate risk gamblers. This was more the case for non-gamblers than for problem gamblers.

Table 4.14 Mean (SD) number and percentage of gamblers amongst alters by group

Alter type	NG	NP	LR	MR	PG	Inferential statistics
Number of gamblers	3.72[a] (5.26)	7.30[b] (7.17)	9.38[c] (6.73)	9.85[c] (6.91)	13.01[d] (7.30)	Welch(4, 386.02) = 48.26, *p* < .001
Family	1.29[a] (2.70) 17.74%	2.75[b] (3.29) 35.08%	3.20[bc] (3.03) 45.46%	3.26[bc] (3.38) 45.41%	4.15[c] (4.03) 59.00%	Welch(4, 385.78) = 17.67, *p* < .001
Friends	1.99[a] (3.64 18.51%)	3.55[b] (4.55) 37.80%	4.66[bc] (4.39) 46.38%	5.04[c] (4.70) 49.92%	6.75[d] (5.48) 67.50%	Welch(4, 385.46) = 24.43, *p* < .001
Colleagues	.43[a] (1.15) 21.71%	1.01[ab] (2.15) 36.47%	1.52[bc] (2.40) 52.16%	1.55[bc] (2.40) 56.86%	2.11[c] (3.49) 71.13%	Welch(4, 368.76) = 16.47, *p* < .001
Network heterogeneity	.17[a] (.18)	.21[ab] (.19)	.27[c] (.19)	.26[bc] (.19)	.19[a] (.19)	*F*(4, 779) = 9.79, *p* < .001
Network homophily	-.63[a] (.53)	.27[b] (.72)	.06[c] (.67)	.02[c] (.69)	-.30[d] (.73)	Welch(4, 386.02) = 54.23, *p* < .001

Note: Pairwise comparisons conducted using Tukey's Honest Significant Difference tests. Groups with different superscripts are significantly different to each other. Percentages were calculated by taking the number of alters who gamble in each category and dividing it by the number of alters in total in that category. For example, non-gamblers have, on average, 7.27 family members in their social networks, and 1.29 of them, on average, are gamblers. 1.29/7.27 (*100) = 17.74%. Heterogeneity was calculated using Blau's H, with higher scores indicating more heterogeneity amongst alters. Homophily was calculated using EI scores, with negative scores indicating the an ego is more similar to their alters. See Krackhardt and Stern (1988).

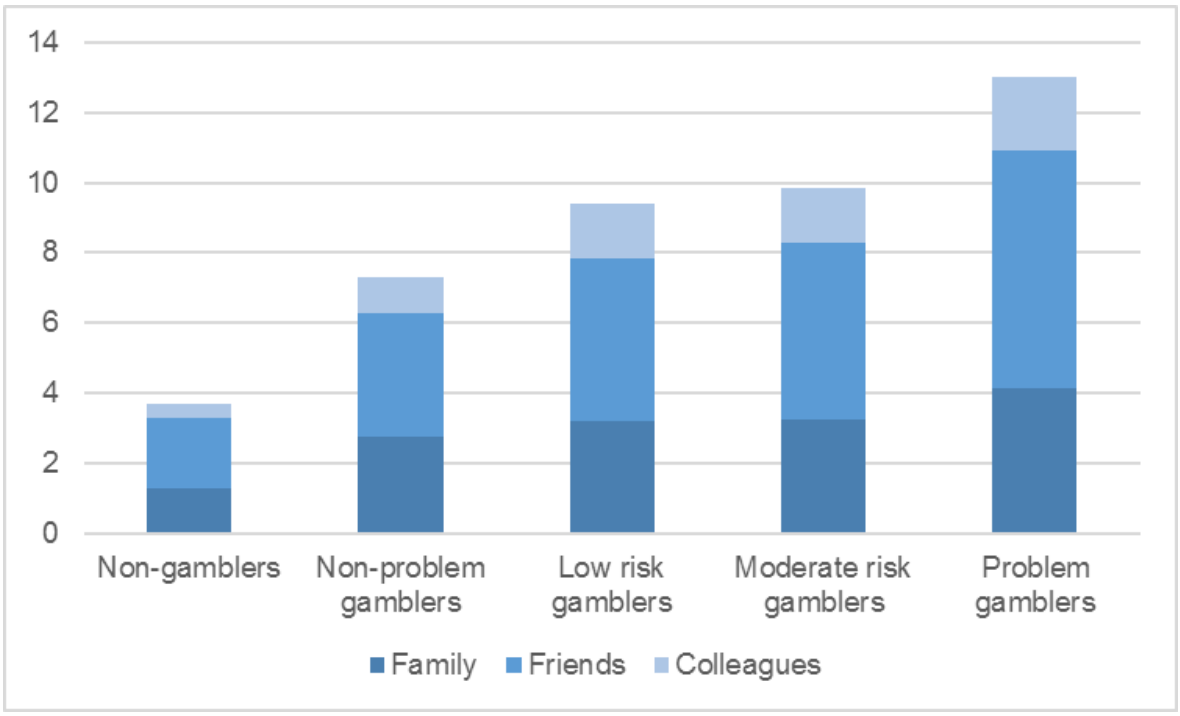

Figure 4.1 Number of gamblers amongst alters by type (family, friends, colleagues) by group

4.3.3 Gambling harms

LRs, MRs and PGs were significantly more likely to associate with a higher number of alters who had experienced harm from their gambling in the last 12 months compared to NGs and NPs. Furthermore, the number of alters experiencing harm increased significantly for MRs, and again for PGs. As for gambling behaviour, the pattern of gambling risk by alter type (family, friends, colleagues) was similar, indicating that those in higher risk groups associated with more gamblers in all of their social circles who experience gambling-related harm (Table 4.15).

When examining the proportion of gamblers experiencing gambling harms by PGSI group of the ego, only 8.90% of the gamblers amongst the alters of NPs experienced harm, compared to 27.08% for LRs, 41.42% for MRs, and 59.49% for PGs.

Heterogeneity measures indicated that the alters in the networks of non-gambler and non-problem gambler groups were mostly similar to each other in terms of gambling-related harm (in that the ego reported that most had not experienced any), whereas the alters in low risk groups were significantly more different (i.e., more had experienced harm). This heterogeneity effect continued to increase for moderate risk gamblers, and again for problem gamblers.

When taking into account the ego's level of harm, homophily scores indicated that non-gamblers and non-problem gamblers were significantly more likely to associate with people like themselves (i.e., no gambling-related harm) compared to those in the at-risk groups. Moderate risk gamblers were significantly more likely to associate with alters who were different to them in their experiences of gambling-related harm, compared to low risk and problem gamblers.

Table 4.15 Mean (SD) number and percentage of alters who have experienced gambling-related harm by group

Alter type	NG	NP	LR	MR	PG	Inferential statistics
Number of alters who experienced harm	1.34[ab] (3.59)	.65[a] (1.89)	2.54[b] (4.62)	4.08[c] (5.27)	7.74[d] (6.54)	Welch(4, 356.42) = 53.47, *p* < .001
Family	.59[ab] (2.22) 8.12%	.24[a] (.74) 3.06%	.69[ab] (1.36) 9.80%	1.22[b] (2.01) 17.00%	2.58[c] (3.37) 36.68%	Welch(4, 353.87) = 24.93, *p* < .001
Friends	.57[ab] (1.74) 5.30%	.24[a] (.88) 2.56%	1.41[bc] (2.91) 14.03%	2.17[c] (3.54) 21.49%	4.05[d] (4.36) 40.50%	Welch(4, 345.31) = 40.29, *p* < .001
Colleagues	.18[a] (.77) 9.09%	.16[a] (.73) 5.78%	.44[ab] (1.30) 15.10%	.69[bc] (1.55) 25.31%	1.11[c] (2.26) 37.42%	Welch(4, 370.00) = 10.06, *p* < .001
% of alter gamblers harmed (#)	36.02%	8.90%	27.08%	41.42%	59.49%	
Network heterogeneity	.06[a] (.13)	.04[a] (.10)	.12[b] (.15)	.19[c] (.18)	.26[d] (.19)	Welch(4, 377.26) = 52.94, *p* < .001
Network homophily	-.87[a] (.36)	-.61[b] (.74)	.20[cd] (.86)	.40[c] (.68)	.17[d] (.67)	Welch(4, 373.17) = 168.94, *p* < .001

Note: Pairwise comparisons conducted using Tukey's Honest Significant Difference tests. Groups with different superscripts are significantly different to each other. Percentages were calculated by taking the number of alters who gamble in each category and dividing it by the number of alters in total in that category. For example, non-gamblers have, on average, 7.27 family members in their social networks, and 0.59 of them, on average, have experienced gambling-related harm. 0.59/7.27 (*100) = 8.12%.#: These percentages were calculated by taking the number of alters who had experienced gambling related harm as a proportion of the number of alters who gamble (see Table 4.14). For example, of the 13.01 alters who gamble in the social networks of problem gamblers, 7.74 of those experienced harm. 7.74/13.01 (*100) = 59.49%. Heterogeneity was calculated using Blau's H, with higher scores indicating more heterogeneity amongst alters. Homophily was calculated using EI scores, with negative scores indicating the an ego is more similar to their alters. See Krackhardt and Stern (1988).

4.3.4 Comorbid behaviour

In terms of comorbid behaviour amongst the alters, egos in higher gambling risk groups were significantly more likely to associate with a higher number of alters who drink alcohol, and who smoke. As for gambling behaviour and gambling harms, alcohol and smoking behaviours by alters does not appear to be associated with any one type of alter (family, friends, colleagues; Table 4.16 and Table 4.17).

Significant differences were observed in terms of heterogeneity for both drinking and smoking. For drinking, the alters in the networks of problem gamblers were significantly more likely to be similar compared to those in the networks of non-problem and moderate risk gamblers. For smoking, alters in the networks of low risk and moderate risk egos were significantly more likely to be different to each other compared to non-problem gamblers.

When taking the ego's drinking behaviour into account, the alters of problem gamblers were significantly more likely to be similar to them in terms of drinking behaviour compared to moderate risk, non-problem and non-gamblers. For smoking behaviour, the results was reversed, with moderate risk gamblers

significantly less likely to associate with people like them in terms of smoking behaviour compared to non-problem gamblers and non-gamblers.

Table 4.16 Mean (SD) number and percentage of alcohol drinkers amongst alters by group

Alter type	NG	NP	LR	MR	PG	Inferential statistics
Number of alters who drink alcohol	13.06[a] (6.61)	14.83[b] (5.82)	16.44[bc] (4.90)	15.19[bc] (5.65)	16.86[c] (5.23)	Welch(4, 388.68) = 9.93, p < .001
Family	4.42[a] (3.88) 60.79%	5.76[b] (4.17) 73.47%	5.73[b] (3.71) 81.40%	5.11[ab] (3.50) 71.19%	5.74[b] (4.14) 81.61%	F(4,779) = 3.60, p = .006
Friends	7.22[ab] (5.51) 67.17%	6.98[a] (4.75) 74.33%	8.21[ab] (4.53) 81.72%	7.95[ab] (4.64) 78.75%	8.54[b] (5.25) 85.40%	Welch(4, 387.53) = 2.77, p = .027
Colleagues	1.42[a] (5.51) 71.68%	2.09[ab] (3.00) 75.47%	2.50[b] (2.74) 85.80%	2.13[ab] (2.65) 78.13%	2.57[b] (3.60) 86.64%	Welch(4, 386.36) = 4.30, p = .002
Network heterogeneity	.24[a] (.19)	.22[ab] (.18)	.17[bc] (.18)	.21[ab] (.17)	.13[c] (.17)	F(4, 779) = 8.35, p < .001
Network homophily	-.33[a] (.65)	-.45[ab] (.61)	-.62[bc] (.52)	-.47[ab] (.61)	-.67[c] (.54)	Welch(4, 388.90) = 8.78, p < .001

Note: Pairwise comparisons conducted using Tukey's Honest Significant Difference tests. Groups with different superscripts are significantly different to each other. Percentages were calculated by taking the number of alters who gamble in each category and dividing it by the number of alters in total in that category. For example, non-gamblers have, on average, 7.27 family members in their social networks, and 4.42 of them, on average, are drinkers. 4.42/7.27 (*100) = 60.79%. Heterogeneity was calculated using Blau's H, with higher scores indicating more heterogeneity amongst alters. Homophily was calculated using EI scores, with negative scores indicating the an ego is more similar to their alters. See Krackhardt and Stern (1988).

Table 4.17 Mean (SD) number and percentage of tobacco smokers amongst alters by group

Alter type	NG	NP	LR	MR	PG	Inferential statistics
Number of alters who smoke	5.00[a] (5.97)	4.40[a] (4.82)	6.97[b] (5.63)	7.90[b] (6.18)	12.36[c] (6.72)	Welch(4, 384.71) = 40.41, *p* < .001
Family	1.87[a] (3.06) 25.72%	1.63[a] (2.04) 20.79%	2.12[a] (2.27) 30.11%	2.45[a] (2.99) 34.13%	3.76[b] (3.76) 53.46%	Welch(4, 380.86) = 10.15, *p* < .001
Friends	2.59[ab] (3.84) 24.10%	2.18[a] (3.59) 23.21%	3.74[bc] (3.75) 37.23%	4.22[c] (4.36) 41.80%	6.60[d] (5.21) 66.00%	Welch(4, 385.03) = 22.09, *p* < .001
Colleagues	.53[a] (1.35) 26.75%	.59[a] (1.39) 18.06%	1.11[ab] (1.80) 38.09%	1.24[b] (2.11) 45.49%	1.99[c] (3.24) 67.09%	Welch(4, 377.97) = 10.29, *p* < .001
Network heterogeneity	.20[a] (.18)	.23[a] (.17)	.30[b] (.18)	.29[b] (.18)	.25[ab] (.21)	Welch(4, 386.95) = 8.29, *p* < .001
Network homophily	-.49[a] (.60)	-.40[ab] (.62)	-.39[abc] (.50)	-.21[c] (.62)	-.23[bc] (.67)	Welch(4, 387.63) = 5.82, *p* < .001

Note: Pairwise comparisons conducted using Tukey's Honest Significant Difference tests. Groups with different superscripts are significantly different to each other. Percentages were calculated by taking the number of alters who gamble in each category and dividing it by the number of alters in total in that category. For example, non-gamblers have, on average, 7.27 family members in their social networks, and 1.87 of them, on average, are smokers. 1.87/7.27 (*100) = 25.72%. Heterogeneity was calculated using Blau's H, with higher scores indicating more heterogeneity amongst alters. Homophily was calculated using EI scores, with negative scores indicating the an ego is more similar to their alters. See Krackhardt and Stern (1988).

4.4 Ego-alter relationship characteristics, by ego's PGSI group

Alters were categorised into three types: family, friends and colleagues. We examined the number of each type of alter by gambling risk group, as well as mean closeness to alters of each type, in order to determine if egos in higher risk groups are more likely to associate with particular types of alters.

4.4.1 Types of relationships (number of family, friends, colleagues)

We examined how many of the 20 alters fall into each type: family, friends, colleagues. No significant differences were observed across the five ego groups in terms of how many of the 20 alters are family or friends. For colleagues, a weak omnibus effect was detected, however no significant difference were found in pairwise comparisons (Table 4.18). We also calculated Blau's H to determine whether the networks were different across groups. Blau's H ranged from .51 to .53 for each group, and no significant differences were found between groups ($F(4,779) = .66$, $p = .618$).

Table 4.18 Mean (SD) number of alters who are family, friends and colleagues by group

Alter type	NG	NP	LR	MR	PG	Inferential statistics
Family	7.27 (4.47)	7.84 (4.26)	7.04 (3.97)	7.18 (3.82)	7.03 (4.07)	$F(4,783) = 1.06$, $p = .374$
Friends	10.75 (5.01)	9.39 (4.99)	10.05 (4.22)	10.10 (4.31)	10.00 (4.66)	*Welch*(4, 388.64) = 1.51, $p = .198$
Colleagues	1.98 (2.96)	2.77 (3.61)	2.91 (3.02)	2.73 (2.92)	2.97 (3.88)	*Welch*(4, 387.12) = 2.61, $p = .035$ *

Note: * No significant pairwise differences.

4.4.2 Strength of relationships overall and by alter type

In terms of strength of relationship to alters overall, LRs and PGs were significantly more likely to report being closer to their alters than NPs, with NGs and MRs not significantly different to any of the groups.

When considering mean closeness to alters by alter type, generally similar patterns were observed. LRs were significantly more likely to report being closer to family members than NPs, while PGs were significantly more likely to report being closer to friends compared to NPs. PGs were also significantly more likely to report being closer to colleagues compared to all groups apart from MRs (Table 4.19).

We also explored mean closeness to alters depending on whether the alter was a gambler or not. Compared to egos who do not gamble, LRs and PGs were significantly more likely to feel close to alters who were gamblers. And in an interesting result, compared to NPs, PGs were also significantly more likely to report feeling closer to alters who do *not* gamble. We also explored comparisons of closeness to those who do and do not gamble within groups. NP, LR, MR and PGs did not differ significantly in terms of how close they felt to gamblers compared to non-gamblers (largest difference for NPs, $t(114) = -1.55$, $p = .123$). Only NGs differed, reporting significantly closer connections to alters who do not gamble, compared to those who do, $t(89) = 2.67$, $p = .009$.

Table 4.19 Mean (SD) relationship strength between ego and their 20 alters by group

Group	NG	NP	LR	MR	PG	Inferential statistics
All alters	1.65^{ab} (.63)	1.52^{a} (.66)	1.74^{b} (.60)	1.71^{ab} (.57)	1.75^{b} (.54)	*Welch*(4, 389.02) = 3.52, $p = .008$
Family	2.09^{ab} (.75)	1.99^{a} (.73)	2.25^{b} (.67)	2.18^{ab} (.61)	2.15^{ab} (.64)	$F(4, 741) = 3.17$, $p = .013$
Friends	1.58^{ab} (.67)	1.43^{a} (.72)	1.62^{ab} (.69)	1.58^{ab} (.62)	1.68^{b} (.64)	$F(4, 770) = 3.04$, $p = .017$
Colleagues	1.13^{a} (.85)	$.95^{a}$ (.75)	1.11^{a} (.78)	1.23^{ab} (.76)	1.46^{b} (.72)	$F(4, 440) = 5.40$, $p < .001$
Non-gamblers	1.70^{ab} (.60)	1.55^{a} (.69)	1.77^{ab} (.73)	1.72^{ab} (.71)	1.79^{b} (.61)	$F(4, 669) = 2.73$, $p = .028$
Gamblers	1.48^{a} (.85)	1.64^{ab} (.84)	1.82^{b} (.70)	1.72^{ab} (.66)	1.80^{b} (.62)	*Welch*(4, 301.98) = 3.29, $p = .012$

Note: Pairwise comparisons conducted using Tukey's Honest Significant Difference tests. Groups with different superscripts are significantly different to each other.

4.4.3 How many gamblers does the ego gamble with, and what proportion have experienced harm?

The results in 4.2.2 and 4.3.3 above considered how many of the alters were gamblers, or had experienced gambling harm, but did not take into account whether the ego actually gambled with them. Table 4.20 shows that NPs gambled with (on average) 38.77% of their alters who were gamblers. For LRs and MRs, this increased to 50.11% and 57.08% respectively. Finally, PGs gambled with 80.17% of their alters who were gamblers.

When considering whether egos in different risk groups gambled with alters who had experienced gambling harms, a similar pattern emerged. NPs gambled with only a small number of alters who had experienced gambling-related harm, while for LRs and MRs the proportion was higher, and higher still for PGs (Table 4.20).

Table 4.20 Mean (SD) number of alters who ego gambles with, and who have experienced problems by group

Group	NP	LR	MR	PG	Inferential statistics
Number of gamblers with which ego gambles	2.83[a] (5.51)	4.70[ab] (6.23)	5.62[b] (6.56)	10.43[c] (7.98)	*Welch*(3, 337.69) = 31.91, $p < .001$
As % of gamblers	38.77	50.11	57.06	80.17	
Number of gamblers with which ego gambles who have experienced harm	.30[a] (1.51)	1.73[b] (4.07)	2.55[b] (4.60)	6.51[c] (6.72)	*Welch*(3, 285.98) = 51.94, $p < .001$
Harmed gamblers as % of gamblers with which ego gambles	10.60	36.81	45.37	62.42	

Note: NGs excluded from this analysis, as they do not gamble. Pairwise comparisons conducted using Tukey's Honest Significant Difference tests. Groups with different superscripts are significantly different to each other.

4.5 Structural measures, by ego's PGSI group

The structural measures of egocentric social networks are described in section 2.2.6. A brief summary is provided here.

For this particular study, due to the study design (each respondent provided exactly 20 alters), density, effective size and efficiency gave very similar information, as seen from almost identical inferential statistics in Table 4.21. Density is the total number of observed alter-alter relationships divided by the maximum possible number of alter-alter relationships. As seen in Table 4.21, the social networks of PGs were significantly more dense than all other groups, and the social networks of NPs were significantly less dense than those of NGs and of MRs.

The same pattern of results was observed for effective size and efficiency. Effective size accounts for redundancy amongst alters. Merely knowing a lot of alters does not mean that the ego has access to a lot of *different* resources or information if the alters all know each other (and therefore share many of the resources or information). Because there were more alter-alter ties in the social networks of PGs, there

was more redundancy amongst their alters, and the effective size was therefore lower than that for other groups. Effective size results followed the same pattern as density: PGs had the lowest effective size compared to all other groups, and NPs had significantly larger networks (in terms of effective size) compared to NGs and MRs, with LRs not significantly different to NGs, NPs or MRs.

Efficiency is a normalised version of effective size that takes into account the total number of alters per person. In this study, each alter provided information on 20 alters, and thus the efficiency results are identical to effective size.

Constraint refers to the extent to which the ego's connections are to others who are also tied to other alters. If egos are connected to highly-connected alters, their behaviour is more constrained. As the networks of PGs were more dense, and their alters more connected, it was unsurprising to see that they were more constrained than other groups. NGs were significantly more constrained than NPs, and LRs and MRs were not significantly different to NGs and NPs.

Finally, hierarchy describes the nature of any constraint. If constraint is centred around one or a small number of alters, then hierarchy will be higher. For PGs (the most constrained group), the hierarchy value is *lower* than all other groups apart from MRs, indicating that while they were more constrained, this was due to multiple alters being more highly connected (as expected from the density result above). No other significant differences in terms of hierarchy were observed amongst the groups.

Taken together, the results on the structural shape of the egocentric networks showed that MRs (compared to NPs) were in networks where many alters knew each other, and this was even more so for PGs. The implications of this are discussed in Chapter 5.

Table 4.21 Mean (SD) network structural measures by group

Alter type	NG	NP	LR	MR	PG	Inferential statistics
Density	.20^{b} (.13)	.16^{a} (.11)	.20^{ab} (.13)	.21^{b} (.13)	.32^{c} (.15)	*Welch*(4, 384.81) = 29.76, $p < .001$
Effective size	12.38^{b} (4.85)	13.94^{a} (4.07)	12.55^{ab} (4.84)	11.94^{b} (4.92)	7.82^{c} (5.71)	*Welch*(4, 384.81) = 29.75, $p < .001$
Efficiency	.62^{a} (.24)	.70^{b} (.20)	.63^{ab} (.24)	.60^{a} (.25)	.39^{c} (.29)	*Welch*(4, 384.81) = 29.75, $p < .001$
Constraint	.17^{b} (.02)	.16^{a} (.04)	.17^{ab} (.03)	.17^{ab} (.03)	.18^{c} (.02)	*Welch*(4, 388.12) = 11.25, $p < .001$
Hierarchy	.048^{a} (.053)	.054^{a} (.073)	.049^{a} (.077)	.038^{ab} (.047)	.025^{b} (.047)	$F(4, 779) = 5.58$, $p < .001$

Note: Pairwise comparisons conducted using Tukey's Honest Significant Difference tests. Groups with different superscripts are significantly different to each other.

4.6 Summary of group comparisons

The demographic comparisons between the groups were generally in line with what might be expected of the literature: those in higher risk groups were more likely to be male, and younger, and have a higher income. Because these findings are in line with what might be expected of respondents in these groups

from the literature, they add strength to the subsequent findings. However, because some of these factors have been previously linked to social networks (e.g., social networks vary by age), it is important to determine if the differences between these groups in terms of important social network features remain significant when controlling for some of these factors, such as age. The next section of results addresses these potential issues.

Those in higher risk groups were more involved gamblers (frequency and expenditure), and more likely to experience gambling-related harm. They were less likely to display responsible gambling/positive play behaviours, and more likely to engage in comorbid behaviours (alcohol and smoking) more frequently. They had more positive attitudes towards gambling.

Those in higher risk groups tended to be closer in age to their alters, but no similarities in terms of gender were found. Those in higher risk groups had more alters who gamble in their network, including more who had experienced harm (notably, NPs reported a relatively high percentage of alters experiencing gambling-related harm), and this appeared to be the case for all types of alters: family, friends and colleagues. Similarly, those in higher risk groups had alters who engaged in comorbid behaviours (alcohol, smoking) more frequently.

Mean closeness to alter did not vary by risk group, nor did the type of alter. That is, those in different risk groups did not appear to have significantly different numbers of family, friends or colleagues amongst the 20 most influential people in their lives. LRs and PGs reported significantly stronger relationships with their alters compared to NPs, including by alter type, with similar results for mean closeness to alters who are gamblers and non-gamblers.

Not only were those in higher risk groups surrounded by more gamblers, they were also significantly more likely to gamble with more of their alters, including those who had experienced gambling-related harm.

The social networks of PGs and MRs were significantly more dense than those of NPs, meaning that their alters were more connected, with density being the strongest for PGs. PGs were also more constrained in their behaviour compared to all other groups, and this constraint was not limited to influence from key alters (hierarchy).

4.7 Bivariate and multivariate analysis of density, number of alters who gamble and gambling harms

4.7.1 Bivariate and multivariate analysis overview and initial analyses

As noted above, the groups differed in terms of key demographic variables, such as age, and some of these variables have previously been found to be related to social network characteristics. Thus, the differences between the groups in terms of network characteristics could be due to their gambling behaviour, or it could be because those in higher risk groups tend to be younger. To determine if gambling risk group status has a unique effect on social networks, we conducted multivariate analyses. Initially our intention was to treat group as the dependent variable and conduct a multinomial logistic

regression. We were interested in a multivariate model predicting group. Iln doing so, we encountered numerous issues with conducting a multivariate model on the present data.

First, if we included non-gamblers in the model, then we would not be able to include gambling behaviour or harm variables, as they would be constant or missing for that group. Second, initial attempts at a multinomial logistic regression model just using the four PGSI groups found that including network density in the model would result in models that would either not converge, or would have inflated confidence interval bounds for density. Since density was a key finding, we opted to instead conduct a linear regression with PGSI as a continuous dependent variable.

We initially considered the following variables, chosen based on earlier bivariate results for the groups: age, gender, Aboriginal or Torres Strait Islander status, main language spoken at home, income, disposable income, work status, gambling frequency, gambling expenditure, attitudes towards gambling, ego smoking and drinking frequency, number of alters who gamble, smoke and drink, number of alters who have experienced gambling related harm, network density, constraint and hierarchy. Based on initial analyses, we determined that constraint could not be included in a model with density (r = .62), so dropped constraint. Income and work status were excluded due to correlations with disposable income, and number of alters who had experienced gambling related harm, and who smoked, were also correlated with each other, and number of alters who gamble, as well as other variables. Thus we dropped number of alters who had experienced harm and who smoked. Factor and reliability analyses was run on gambling frequency across the nine gambling forms. They formed a single factor (Cronbach's alpha = .91) and were thus averaged to form an overall gambling frequency variable. Gambling expenditure from each form was summed and was highly skewed, so we took the natural logarithm (total expenditure +1). Tolerance checks indicated no variables with tolerance lower than .4.

The model thus excluded all non-gamblers. Overall, the model accounted for 48.8% of variance in PGSI scores, which was statistically significant, $F(15, 579) = 36.83$, $p < .001$. Those with higher PGSI scores were significantly more likely to be male, younger, gamble more frequently and spend more, have more negative attitudes towards gambling, smoke more frequently, and have denser social networks (see Table 4.22).

Table 4.22 Multivariate linear regression predicting PGSI score

	B	*SE B*	*β*	*t*	p
(Constant)	-2.96	1.25		-2.36	.019
Gender (ref = female)	**1.03**	**.38**	**.09**	**2.73**	**.007**
Age (in years)	**-.04**	**.01**	**-.10**	**-3.21**	**.001**
ATSI status (ref = non-Indigenous)	-.36	.90	-.01	-.39	.694
LOTE status (ref = English)	.85	1.06	.03	.80	.423
Disposable income	-.08	.06	-.05	-1.39	.166
Work status (ref = no)	.48	.40	.04	1.19	.236
Gambling frequency	**2.15**	**.19**	**.44**	**11.07**	**< .001**
Gambling Expenditure (log)	**.70**	**.12**	**.21**	**6.11**	**< .001**
Attitude towards gambling	**-.05**	**.02**	**-.07**	**-2.13**	**.034**
Drinking frequency	-.08	.11	-.03	-0.76	.445
Smoking frequency	**.41**	**.07**	**.19**	**5.77**	**< .001**
Number of alters who gamble	-.04	.03	-.05	-1.28	.201
Number of alters who drink alcohol	.00	.04	.00	.08	.933
Density	**7.72**	**1.61**	**.19**	**4.80**	**< .001**
Hierarchy	4.57	3.58	.04	1.28	.202

Note: *B* = Unstandardised beta. *SE B* = standard error for unstandardized beta. β = standardised beta.

However we were unsatisfied with this analysis due to not being able to treat group as a categorical dependent variable. Since we were still interested in the relationship between the groups (rather than PGSI score) and network characteristics when controlling for these other variables, we instead treated group as an independent variable. We considered two network characteristics that had emerged as key differences between the groups: the number of alters who gamble, and network density. We then determined which variables other than group were related to the number of alters who gamble and network density using bivariate analyses; and then conducted hierarchical regression models, first with all of the significant variables from bivariate analyses as predictors, and then adding group. If group uniquely predicted the number of alters who gamble, or network density, then it would be a significant predictor. Group was entered as a dummy-coded variable, with NPs as the reference group.

We also considered including other network characteristics, such as constraint and hierarchy. However, the network measures (density, hierarchy and constraint) were all correlated with each other (*rS* between -.35 and .83), and thus we opted to drop constraint and hierarchy as dependent variables.

While gambling-related harm was not a specific focus of the present study, it is an important focus of the funding agency, and we thus also included a model with gambling-related harm as the dependent variable, and network characteristics as key independent variables. The aim of this analysis was to determine if the nature of social networks uniquely predicts gambling-related harm when controlling for other factors.

All variables that showed significant differences between the PGSI groups above were considered for inclusion in multivariate models.

4.7.2 Bivariate data analysis

Apart from egos' education, and work status (nominal variables), all possible independent variables were either binary (e.g., ego's gender), ordinal (e.g., income, frequency of behaviour) or continuous (e.g., number of alters experiencing harm, number of alters who are family, friends, colleagues, and attitudes towards gambling). We therefore used Spearman's nonparametric correlations for all of these variables, for consistency.

Some variables were only asked of particular respondents. For example, egos were only asked about gambling expenditure on each form if they took part in that form. For gambling expenditure, missing values were replaced with $0, and expenditure across the nine surveyed forms was summed. Income and disposable income both included a "prefer not to say" option, and missing data were not replaced for these variables (77 cases for income, 51 cases for disposable income)[10]. Positive play, preferred gambling mode and gambling-related harm were only asked of gamblers, and thus data were missing for the non-gambler group. No sensible values could be substituted for positive play or preferred gambling mode. As NGs were unable to experience gambling-related harm (because they do not gamble), NGs were given a score of 0 on the gambling harms variable. However, we have considered only gamblers when modelling gambling-related harm as the dependent variable.

Initial analyses included comparisons between different ego education levels, living arrangements and work status for all of the dependent variables. Statistically significant differences were observed for some of the variables, however pairwise tests indicated that these differences were generally due to the "other" group (e.g., those in an "other" living arrangement differed to those who lived alone). Because very few respondents were in the "other" categories (n = 3 for education and work status, n = 4 for living arrangement), effect sizes were small and potentially non-interpretable due to the nature of the "other" category. We also explored potential groupings, such as comparing those who had undertaken tertiary education compared to those who had not, but found no significant results. Based on these findings, these variables were not considered for inclusion in the multivariate models, and bivariate results are not reported below.

[10] Missing values for income come from: 30 NGs, 15 NPs, 12 LRs, 15 MRs and 4 PGs. For disposable income: 21 NGs, 15 NPs, 5 LRs, 7 MRs and 3 PGs. Weak correlations were observed between missingness for both variables and number of alters who gamble, gambling-related harm and network density (r ~ .02 to .1). These relationships are minimal, and thus we believe there is little influence on the results because of this missingness.

4.7.3 Bivariate relationships by dependent variable

Table 4.23 shows all bivariate results between each of the possible predictor variables and the three dependent variables: density, number of alters who gamble and gambling harm.

Egos in more dense social networks were significantly more likely to: be male, be younger, be Indigenous, be born in Australia, and to have a higher disposable income. They were significantly more likely to gamble on more gambling forms, to have higher gambling expenditure, to have a more positive attitude towards gambling, to be problem gamblers (compared to NPs) and to experience more gambling related harms. They were also significantly more likely to drink alcohol more frequently. In terms of their alters, those in higher density networks were significantly more likely to have alters who are closer to their own age, and more alters who: gamble, smoke, drink and have experienced harms with their gambling. They felt closer to alters who gamble, and gambled with more of them, including those alters who had experienced gambling-related harm.

Egos in networks with more alters who gambled were significantly more likely to: be male, speak English as their main language at home, be born in Australia, have more dependent children, and have a higher income and disposable income. In terms of their gambling behaviour, they were significantly more likely to: engage in more gambling forms, have higher gambling expenditure, NOT be a NG, be a MR or PG, and to drink and smoke more frequently. Their alters are less likely to be family members, and more likely to be colleagues, who smoke, drink and have experienced more harms due to their gambling. They felt closer to alters who gamble, and gambled with more of their alters, including those who had experienced gambling-related harm.

Egos who had experienced more gambling-related harm were significantly more likely to: be male, be younger, be Indigenous, speak English at home, be born in Australia, and have a higher income and disposable income. In terms of their gambling behaviour, they were significantly more likely to engage in more gambling forms and have higher gambling expenditure, NOT be LRs (compared to NPs), but more likely to be MRs or PGs. They had more positive attitudes towards gambling, and more of their alters gambled. They were significantly more likely to conduct a larger proportion of their gambling online. They were less likely to precommit, be honest or have control with their gambling, take personal responsibility for their gambling, and have lower gambling literacy. They were more likely to smoke and drink more frequently. Their alters were closer to their own age, and more of them gambled, smoked and drank. A significantly higher proportion of their alters had experienced gambling-related harms, and the egos felt closer to them and gambled with them.

Table 4.23 Bivariate relationships (Spearman correlations) between each possible predictor and each of the four dependent variables (density, hierarchy, number of alters who gamble, gambling harm)

Variables	Density	Number of alters who gamble	Gambling harm
Ego Demographics			
Gender (ref = female)	.22**	.22**	.19**
Age (in years)	-.25**	.01	-.18**
ATSI status (ref = non-Indigenous)	.10*	.05	.13*
LOTE status (ref = English)	-.03	-.15**	-.10*
Country of birth (ref = Australia)	-.09*	-.14**	-.18**
Dependent children (number)	-.01	.10*	.04
Income	.07	.16**	.14*
Disposable income	.18**	.19**	.18**
Gambling behaviour			
Number of gambling forms	.28**	.53**	.39**
Gambling Expenditure	.08*	.40**	.35**
PGSI groups (ref = non-problem)			
Non-gambler	-.05	-.35**	-
Low risk	-.06	.07	-.23**
Moderate risk	.00	.10*	.20**
Problem	.33**	.28**	.61**
Attitude towards gambling	.18**	.31**	.08*
Comorbid behaviours			
Smoking frequency	.05	.86*	.25**
Drinking frequency	.08*	.34**	.18**
Alter characteristics			
Gender (EI score)	-.01	-.00	.02
Age (mean absolute difference)	-.18**	-.06	-.17**
Number of alters who are family	.06	-.07*	-.08
Number of alters who are friends	-.02	.03	.08
Number of alters who are colleagues	.02	.12**	.05
Number of alters who smoke	.26**	.41**	.35**
Number of alters who drink alcohol	.19**	.49**	.10*
Number of alters who have experienced gambling-related harm	.29**	.54**	.46**
Mean closeness to alters who gamble	.22**	.39**	.13*
Number of alters who gamble with the ego	.29**	.71**	.31**
Number of alters who experience gambling related harm and gamble with the ego	.29**	.52**	.48**

Variables that do not appear in all models			
Gambling harms	.25**	.33**	
Density		.31**	.29**
Number of alters who gamble	.31**		.20**
Positive play: Precommitment			-.41**
Positive play: Honesty and control			-.54**
Positive play: Personal responsibility			-.34**
Positive play: Gambling Literacy			.37**
Online gambling (higher = more offline)			-.19**

Note: * < .05, ** < .001. ATSI = Aboriginal and Torres Strait Islander status. LOTE = Language Other Than English as the main language spoken at home.

4.7.4 Multivariate data analysis

The preceding bivariate analyses indicated variables that were associated with density, number of alters who gamble, and gambling-related harm. Bivariate analyses, however, only consider each variable against each dependent variable individually. These analyses do not take into account any other variables in the model, and thus the results above can overlap with each other.

In order to account for other variables in the model, we conducted multivariate analyses. These analyses determine which predictors uniquely account for variance in the dependent variables. For each variable, we conducted a two-step model, where each of these predictors is entered into the model in one single block, and PGSI status (dummy-coded against NPs) was entered in a second step. The aim was to determine if any other variables accounted for these dependent variables apart from problem gambling status.

Prior to conducting the models, we assessed multicollinearity using tolerance measures. Multicollinearity occurs to when two predictors are very strongly correlated with each other, which can cause problems when they are entered in the same model.

For all models, tolerance issues were identified with the following variables: number of alters with whom the ego gambles, number of alters who have experienced harm with whom the ego gambles and the number of alters who have experienced gambling related harm. As these variables were conceptually related, the number of alters who have experienced harm with whom the ego gambles was retained, and the remainder were removed from the model. Further tolerance issues were found in the models predicting density and number of alters who gamble between PGSI and gambling-related harm, and number of gambling forms. As PGSI was the main variable of interest, harm and number of forms were removed from the model. Following these decisions, no further tolerance issues were found.

4.7.5 Multivariate model – density

The initial model without PGSI accounted for 34.0% of variance for density, and this was significant ($F(14,718) = 26.37$, $p < .001$). Adding the PGSI dummy variables to the model accounted for an additional 2.7% of variance explained, and this increase was significant ($\Delta F(4,714) = 7.62$, $p < .001$). Coefficients are presented in Table 4.24.

When controlling for other variables in the model, being a problem gambler (compared to being a non-problem gambler) was related to an egocentric social network with higher density. That is, being a problem gambler uniquely explains network density over and above the other variables in the model.

The remaining significant predictors for higher density networks were: being male, being younger, having higher disposable income, lower gambling expenditure, more alters who gamble, being closer to alters who gamble, and having a higher number of alters who experienced gambling-related harm.

Table 4.24 Multiple linear regression predicting density

Model	Predictor	β	*t*	*p*
Model 1	Intercept		6.70	<.001
	Gender (ref = female)	**.15**	**4.62**	**<.001**
	Age (in years)	**-.15**	**-4.43**	**<.001**
	ATSI status (ref = non-Indigenous)	.04	1.43	.152
	Country of birth (ref = Australia)	-.03	-.79	.430
	Disposable income	**.07**	**2.12**	**.035**
	Gambling expenditure (log)	**-.11**	**-3.01**	**.003**
	Attitude towards gambling	.06	1.64	.101
	Drinking frequency	-.02	-.55	.582
	Age (mean absolute difference)	-.06	-1.86	.064
	Number of alters who smoke	**.10**	**2.50**	**.013**
	Number of alters who drink alcohol	-.04	-1.07	.287
	Number of alters who gamble	**.11**	**2.41**	**.016**
	Mean closeness to alters who gamble	**.10**	**2.96**	**.003**
	Number of alters who experience gambling related harm and gamble with the ego	**.32**	**8.00**	**<.001**
Model 2	Intercept		5.81	<.001
	Gender (ref = female)	**.12**	**3.78**	**<.001**
	Age (in years)	**-.14**	**-4.07**	**<.001**
	ATSI status (ref = non-Indigenous)	.05	1.53	.127
	Country of birth (ref = Australia)	-.01	-.35	.724
	Disposable income	**.07**	**2.26**	**.024**
	Gambling expenditure (log)	**-.20**	**-3.59**	**<.001**
	Attitude towards gambling	.06	1.78	.076
	Drinking frequency	-.03	-.83	.409
	Age (mean absolute difference)	-.06	-1.83	.068

	Number of alters who smoke	.05	1.35	.179
	Number of alters who drink alcohol	-.03	-.73	.464
	Number of alters who gamble	**.12**	**2.83**	**.005**
	Mean closeness to alters who gamble	**.10**	**2.96**	**.003**
	Number of alters who experience gambling related harm and gamble with the ego	**.26**	**6.27**	**<.001**
	PGSI status (ref = NPs)			
	Non-gambler	-.03	-.61	.543
	Low risk	.01	.24	.814
	Moderate risk	.04	.84	.399
	Problem	**.22**	**4.62**	**<.001**

Note: Due to the scale of the density variable, most unstandardized coefficients are very small; these are not presented. β = standardised beta.

4.7.6 Multivariate model – number of alters who gamble

The initial model without PGSI accounted for 55.6% of variance for the number of alters who gamble, and this was significant ($F(20,672) = 42.13$, $p < .001$). Adding the PGSI dummy variables to the model accounted for an additional .1% of variance explained, and this increase was not significant ($\Delta F(4,668) = .35$, $p = .843$). Coefficients are presented in Table 4.25.

When controlling for other variables, PGSI does not contribute a significant amount of information towards understanding how many alters gamble. Thus, while higher risk PGSI groups are surrounded by more gamblers, actual PGSI group status is not a significant predictor in and of itself. This may be because the models include various other variables that are associated with problem gambling (such as number of gambling forms that the ego engages in).

The remaining significant predictors for the model indicated that those who were surrounded by more alters who gamble: were male, were older, took part in more gambling forms, had more positive attitudes towards gambling, smoked less frequently but had more alters who smoked and drank, were closer to their alters who gamble, and gambled with more alters who experienced gambling-related harm.

Table 4.25 Multiple linear regression predicting number of alters who gamble

Model	Predictor	*B*	*SE B*	β	95% CI for *B*		*t*	*p*
					Lower	Upper		
Model 1	Intercept	-4.48	1.38		-7.19	-1.76	-3.24	.001
	Gender (ref = female)	**1.84**	**.42**	**.12**	**1.01**	**2.67**	**4.34**	**< .001**
	Age (in years)	**.05**	**.02**	**.09**	**.01**	**.08**	**2.87**	**.004**
	LOTE status (ref = English)	-.08	.97	-.00	-1.99	1.84	-.08	.938
	Country of birth (ref = Australia)	-.67	.55	-.03	-1.74	.41	-1.22	.223
	Dependent children (number)	.20	.25	.02	-.29	.69	.78	.433
	Income	-.10	.07	-.04	-.24	.05	-1.34	.180
	Disposable income	-.12	.07	-.05	-.26	.02	-1.68	.095
	Number of gambling forms	**.40**	**.11**	**.17**	**.19**	**.61**	**3.72**	**< .001**
	Gambling Expenditure (log)	.22	.13	.07	-.04	.47	1.67	.095
	Attitude towards gambling	**.06**	**.02**	**.07**	**.01**	**.10**	**2.33**	**.020**
	Gambling-related harm	**-.22**	**.08**	**-.09**	**-.39**	**-.06**	**-2.68**	**.007**
	Smoking frequency	**-.38**	**.09**	**-.13**	**-.56**	**-.21**	**-4.27**	**< .001**
	Drinking frequency	.13	.12	.03	-.11	.37	1.05	.295
	Number of alters who are family	-.01	.05	-.01	-.11	.09	-.26	.798
	Number of alters who are colleagues	.04	.06	.02	-.08	.16	.70	.485
	Number of alters who smoke	**.20**	**.04**	**.18**	**.12**	**.28**	**4.95**	**< .001**
	Number of alters who drink alcohol	**.32**	**.04**	**.24**	**.24**	**.40**	**7.78**	**< .001**
	Mean closeness to alters who gamble	**1.23**	**.23**	**.15**	**.79**	**1.67**	**5.46**	**< .001**
	Number of alters who experience gambling related harm and gamble with the ego	**.43**	**.05**	**.28**	**.32**	**.53**	**7.94**	**< .001**
	Density	2.86	1.74	.05	-.56	6.28	1.64	.101
	Intercept	-4.31	1.59		-7.44	-1.18	-2.70	.007
	Gender (ref = female)	**1.88**	**.43**	**.13**	**1.05**	**2.72**	**4.41**	**< .001**

Model 2	**Age (in years)**	**.05**	**.02**	**.09**	**.014**	**.08**	**2.83**	**.005**
	LOTE status (ref = English)	.03	.98	.00	-1.90	1.95	.03	.977
	Country of birth (ref = Australia)	-.70	.55	-.04	-1.78	.38	-1.27	.205
	Dependent children (number)	.19	.25	.02	-.31	.68	.74	.458
	Income	-.09	.07	-.04	-.24	.05	-1.27	.204
	Disposable income	-.12	.07	-.05	-.26	.02	-1.63	.104
	Number of gambling forms	**.42**	**.11**	**.17**	**.20**	**.64**	**3.70**	**< .001**
	Gambling Expenditure (log)	.19	.16	.06	-.13	.51	1.16	.247
	Attitude towards gambling	**.05**	**.02**	**.07**	**.01**	**.10**	**2.19**	**.029**
	Gambling-related harm	-.17	.11	-.07	-.38	.05	-1.51	.133
	Smoking frequency	**-.37**	**.09**	**-.13**	**-.55**	**-.19**	**-4.10**	**< .001**
	Drinking frequency	.12	.12	.03	-.12	.36	1.00	.316
	Number of alters who are family	-.01	.05	-.01	-.11	.09	-.26	.792
	Number of alters who are colleagues	.04	.06	.02	-.08	.16	.64	.520
	Number of alters who smoke	**.20**	**.04**	**.18**	**.12**	**.28**	**4.99**	**< .001**
	Number of alters who drink alcohol	**.32**	**.04**	**.24**	**.24**	**.40**	**7.78**	**< .001**
	Mean closeness to alters who gamble	**1.20**	**.23**	**.15**	**.75**	**1.65**	**5.25**	**< .001**
	Number of alters who experience gambling related harm and gamble with the ego	**.43**	**.05**	**.29**	**.33**	**.54**	**7.99**	**< .001**
	Density	3.13	1.76	.06	-.33	6.60	1.78	.076
	PGSI status (ref = NPs)							
	Non-gambler	-.32	.85	-.02	-2.00	1.35	-.38	.706
	Low risk	-.23	.63	-.01	-1.46	1.01	-.36	.717
	Moderate risk	-.12	.73	-.01	-1.55	1.31	-.17	.866
	Problem	-.90	1.00	-.05	-2.87	1.07	-.90	.370

Note: *B* = Unstandardised beta. *SE B* = standard error for unstandardized beta. β = standardised beta.

4.7.7 Multivariate model – gambling-related harm

The initial model without PGSI accounted for 48.2% of variance for gambling-related harm, and this was significant ($F(24, 544) = 21.11$, $p < .001$). Adding the PGSI dummy variables to the model accounted for an additional 16.7% of variance explained, and this increase was significant ($\Delta F(3,541) = 86.11$, $p < .001$). Coefficients are presented in Table 4.26.

As expected, those in higher PGSI groups experience significantly more gambling-related harm when controlling for the other variables in the model. That is, gambling risk status uniquely explains gambling harms over and above the other variables in the model.

The remaining significant predictors of gambling-related harm in this model were: being Indigenous, speaking English as their main language, less honesty and control with their gambling, taking more personal responsibility for gambling, being less literate with their gambling, having a more negative attitude towards gambling, drinking alcohol more frequently, being closer to alters who gamble, and gambling with more alters who have experienced gambling-related harm.

Table 4.26 Multiple linear regression predicting egos' gambling-related harm

Model	Predictor	*B*	*SE B*	β	95% CI for *B*		*t*	*p*
					Lower	Upper		
Model 1	Intercept	4.62	1.00		2.66	6.59	4.62	< .001
	Gender (ref = female)	.33	.21	.06	-.09	.75	1.54	.124
	Age (in years)	**-.02**	**.01**	**-.08**	**-.03**	**-.00**	**-2.08**	**.038**
	ATSI status (ref = non-Indigenous)	**1.28**	**.50**	**.08**	**.30**	**2.25**	**2.57**	**.010**
	LOTE status (ref = English)	-.50	.61	-.03	-1.70	.71	-.81	.419
	Country of birth (ref = Australia)	-.39	.28	-.05	-.94	.17	-1.37	.172
	Income	.04	.04	.04	-.03	.11	1.10	.271
	Disposable income	-.01	.04	-.01	-.08	.06	-.21	.834
	Number of gambling forms	.06	.05	.06	-.04	.16	1.26	.209
	Gambling Expenditure (log)	**.17**	**.07**	**.09**	**.03**	**.32**	**2.37**	**.018**
	Positive play: Precommitment	-.16	.09	-.08	-.34	.02	-1.77	.078
	Positive play: Honesty and control	**-.69**	**.08**	**-.39**	**-.85**	**-.54**	**-8.76**	**< .001**
	Positive play: Personal responsibility	**.28**	**.09**	**.12**	**.10**	**.46**	**3.00**	**.003**

	Positive play: Gambling Literacy	**.28**	**.07**	**.16**	**.15**	**.42**	**4.07**	**< .001**
	Online gambling (higher = more offline)	.04	.07	.02	-.09	.18	.66	.511
	Attitude towards gambling	**-.04**	**.01**	**-.12**	**-.07**	**-.02**	**-3.42**	**.001**
	Smoking frequency	**.10**	**.04**	**.09**	**.02**	**.19**	**2.41**	**.016**
	Drinking frequency	**.12**	**.06**	**.07**	**.00**	**.23**	**2.03**	**.043**
	Age (mean absolute difference)	-.01	.02	-.03	-.05	.02	-.85	.394
	Number of alters who smoke	.01	.02	.01	-.03	.05	.30	.766
	Number of alters who drink alcohol	-.01	.02	-.01	-.05	.04	-.31	.758
	Number of alters who gamble	**-.04**	**.02**	**-.10**	**-.08**	**-.00**	**-2.11**	**.035**
	Mean closeness to alters who gamble	**.27**	**.12**	**.08**	**.04**	**.49**	**2.30**	**.022**
	Number of alters who experience gambling related harm and gamble with the ego	**.10**	**.03**	**.18**	**.05**	**.15**	**4.04**	**< .001**
	Density	1.24	.88	.06	-.49	2.96	1.41	.159
Model 2	Intercept	2.34	.85		.67	4.00	2.76	.006
	Gender (ref = female)	.04	.18	.01	-.31	.39	.21	.834
	Age (in years)	-.01	.01	-.06	-.03	.00	-1.78	.077
	ATSI status (ref = non-Indigenous)	**1.16**	**.41**	**.08**	**.35**	**1.98**	**2.81**	**.005**
	LOTE status (ref = English)	**-1.01**	**.51**	**-.06**	**-2.00**	**-.01**	**-1.99**	**.048**
	Country of birth (ref = Australia)	-.10	.23	-.01	-.56	.36	-.42	.677
	Income	.01	.03	.02	-.04	.07	.48	.635
	Disposable income	.02	.03	.02	-.04	.08	.57	.568
	Number of gambling forms	-.07	.04	-.06	-.15	.01	-1.65	.100
	Gambling Expenditure (log)	.01	.06	.01	-.11	.13	.16	.873
	Positive play: Precommitment	-.08	.08	-.04	-.23	.07	-1.08	.281
	Positive play: Honesty and control	**-.38**	**.07**	**-.22**	**-.52**	**-.25**	**-5.58**	**< .001**
	Positive play: Personal responsibility	**.32**	**.08**	**.14**	**.17**	**.47**	**4.17**	**< .001**
	Positive play: Gambling Literacy	**.18**	**.06**	**.10**	**.07**	**.29**	**3.16**	**.002**
	Online gambling (higher = more offline)	.02	.06	.01	-.09	.13	.38	.701

	Attitude towards gambling	**-.04**	**.01**	**-.10**	**-.06**	**-.02**	**-3.42**	**.001**
	Smoking frequency	.03	.04	.02	-.05	.10	.72	.475
	Drinking frequency	**.11**	**.05**	**.07**	**.01**	**.20**	**2.25**	**.025**
	Age (mean absolute difference)	-.01	.01	-.01	-.03	.02	-.42	.675
	Number of alters who smoke	-.02	.02	-.03	-.05	.02	-.89	.373
	Number of alters who drink alcohol	-.01	.02	-.02	-.05	.03	-.59	.558
	Number of alters who gamble	-.02	.02	-.04	-.05	.01	-1.16	.247
	Mean closeness to alters who gamble	**.31**	**.10**	**.09**	**.12**	**.50**	**3.23**	**.001**
	Number of alters who experience gambling related harm and gamble with the ego	**.06**	**.02**	**.10**	**.01**	**.10**	**2.60**	**.010**
	Density	-.25	.73	-.01	-1.69	1.19	-.34	.731
	PGSI status (ref = NPs)							
	Low risk	**.47**	**.23**	**.07**	**.02**	**.93**	**2.04**	**.042**
	Moderate risk	**2.21**	**.26**	**.32**	**1.70**	**2.72**	**8.45**	**< .001**
	Problem	**4.71**	**.32**	**.68**	**4.07**	**5.34**	**14.59**	**< .001**

Note: *B* = Unstandardised beta. *SE B* = standard error for unstandardized beta. β = standardised beta.

4.8 Example network diagrams

Egocentric social network diagrams are calculated at the individual respondent level, rather than the group level. It would not be particularly useful to include all 784 network diagrams in this report.

However, we present five diagrams, one from each group, for discussion. For example, the information in these diagrams could be particularly useful in a clinical setting. Understanding the nature of an individual's social network, including which alters are gamblers (particularly harmed gamblers), would inform potential clinical interventions, or development of strategies to reduce or eliminate influence from those individuals. The approaches that we discuss for each diagram are individual approaches, and more general approaches, such as changing norms, are discussed in further detail in Chapter 5.

For this discussion, we chose one ego from each group (NGs, NPs, LRs, MRs and PGs). Each ego is as representative as possible of their group based on two variables: number of alters who gamble and network density. Network density was represented here to show that, while the higher density in the MR and PG networks seems relatively low (.21 and .32, on average, from a possible score of 1), the diagrams indicate that these are particularly interconnected networks.

We note that two people with the same scores on both of these variables (number of gamblers and density) can still have very different networks, and it is thus important to consider the nature of the diagrams, not just the metrics. We also note that these particular individuals are not representative of their group based on many other variables. We therefore stress that the diagrams presented below should not be taken to represent all people in that group.

4.8.1 Diagram explanation

- Circles or squares (nodes) in each diagram are alters. The ego is not shown, as by definition the ego is connected to each alter, and would simply appear as an additional circle or square with a connection to everyone. The diagrams would be much harder to interpret.
- The size of the alters indicates whether or not they are gamblers. Large nodes are gamblers, while small nodes are not.
- Nodes that are square in shape indicate alters who have experienced harm from their gambling.
- The colour of the nodes indicates alters who are family (light blue), friends (grey), or colleagues (dark blue).
- Lines between alters indicate alter-alter connections; that is, whether the alters know each other. If alters are not connected to each other (do not know each other), there is no line between them.
- We note that the length of the line does not mean anything. As discussed in section 2.2.5, these diagrams can be laid out in a number of different ways depending on researcher preferences.
- Each diagram is drawn from data for a respondent in the study.

4.8.2 An example egocentric social network diagram for a non-gambler

Figure 4.2 shows a diagram for a particular ego who was a NG. In this person's network, there were four gamblers, and they appeared to be in groups of two – one amongst their colleagues, one amongst their friends. This network was fairly connected, in that there were no alters who were isolated from the rest of the network. Most of their alters were friends, and their friends appeared to be integrated into their family, while their colleagues were a somewhat distinct group with few connections to the rest of the ego's social network. One gambler in this network, a colleague, had experienced gambling-related harm.

As this person was a NG, they would be unlikely to seek help for gambling issues. However, advice could still be provided. Advice could include being aware of which people gamble in their network, and thus where social influence to gamble may come from. This could be useful information in case they wish to remain a non-gambler. Alternately, should this person be interested in trying gambling, it would seem prudent to do so with the two friends who gamble, and who are well connected to other friends and family, rather than with the colleagues. Gambling with the colleagues, including one who experiences harm, may give this person a distorted view of gambling, and may normalise experiencing gambling-related harm.

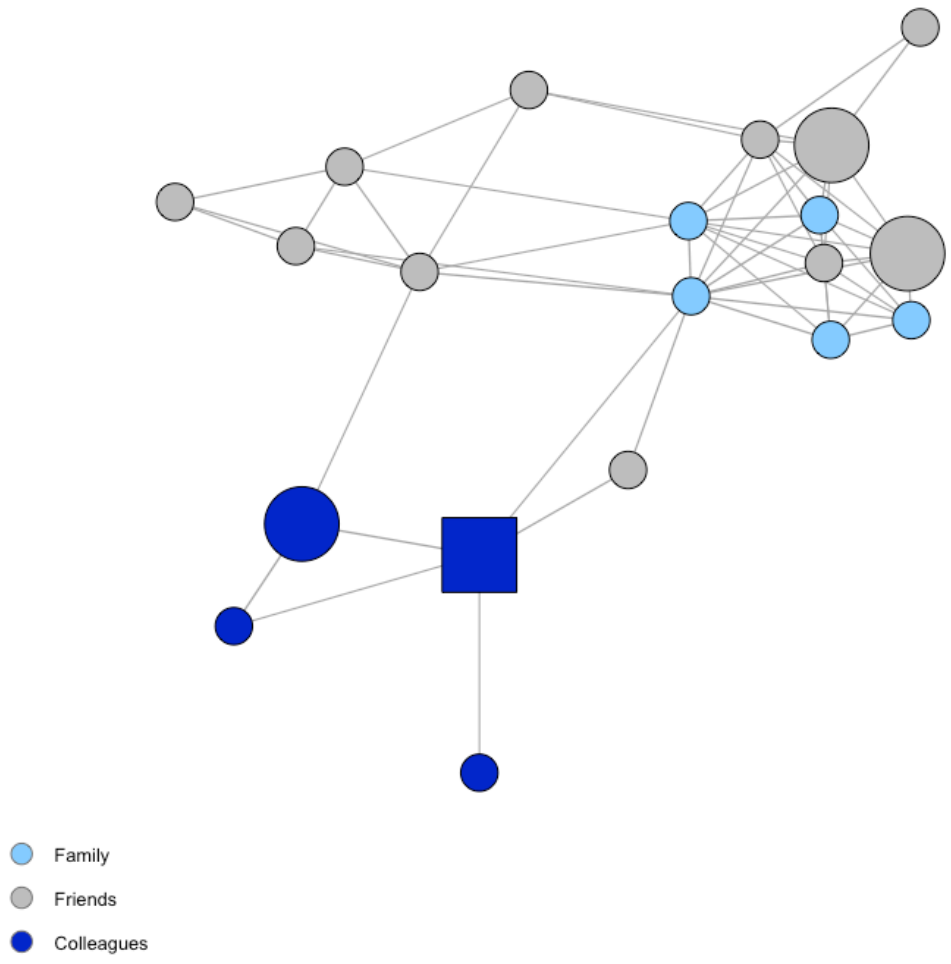

Figure 4.2 Egocentric social network example for an ego who is a non-gambler

4.8.3 An example egocentric social network diagram for a non-problem gambler

Figure 4.3 shows an egocentric social network diagram for a particular non-problem gambler. This person's network was less dense. There were four quite distinct social circles: one that mostly consisted of family (most of whom gamble), two separate groups of friends, and a group of colleagues. The colleagues were not directly connected to the family group, but there was one friend (the large grey circle between the groups) that connected one person from the family to one of the colleagues.

Compared to the ego in Figure 4.2, this ego's network was far less dense. There were far fewer connections between alters, and there were distinct subgroups. This means that this ego was less constrained. Different groups of alters were likely to provide different information to the ego, or to allow the ego to take on a different persona in one group, without any of the other alters knowing about it.

In this case, all of the alters who were gamblers fall within one group, the family group (and the 1 gambling friend who is connected to 1 of the family members). Within this group, there were 7 gamblers, 6 of whom were family. According to the ego, none of these people had experienced gambling-related harm. At present, this ego is a NP, and thus would be unlikely to seek advice about addressing gambling-related problems. However, if they did seek advice, it could include monitoring for changes amongst the gambling behaviour of the gamblers in their network, such as experiencing gambling-related harms.

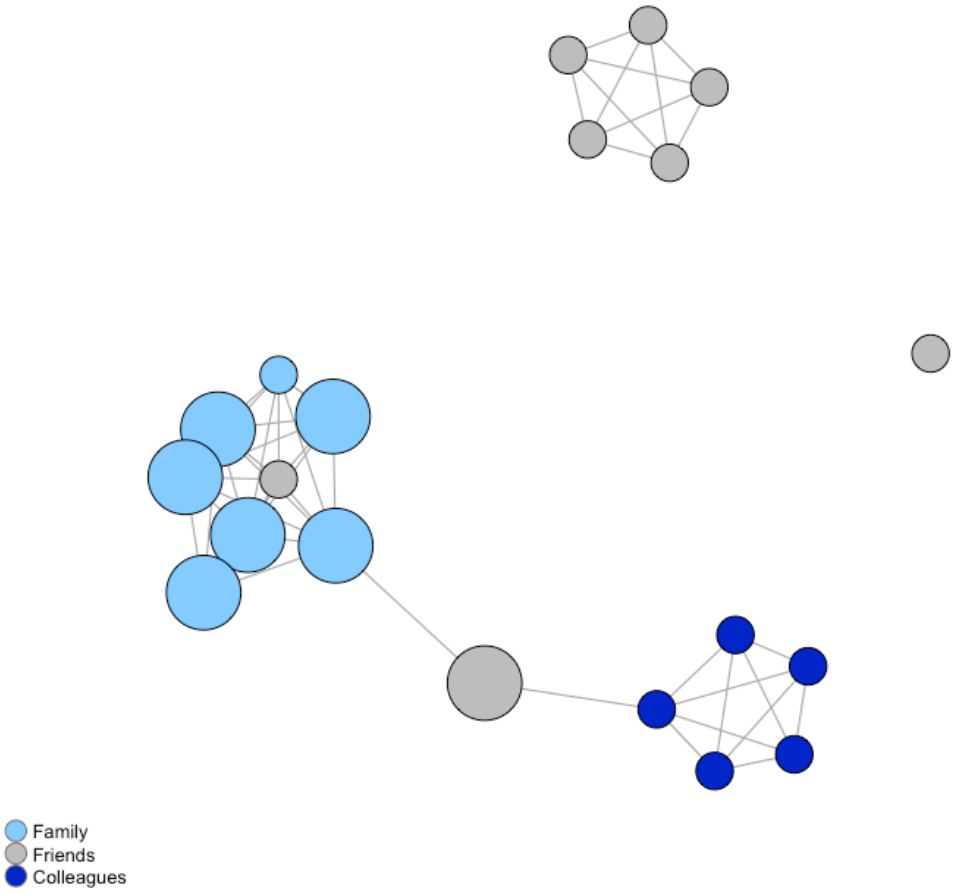

Figure 4.3 Egocentric social network example for an ego who is a non-problem gambler

4.8.4 An example egocentric social network diagram for a low risk gambler

Figure 4.4 shows an egocentric social network for a particular low risk gambler. In this network, the gamblers were all relatively well connected to each other, and came from family and friends. This person did not count any of their colleagues amongst the 20 most influential people in their life. Five of their family and four of their colleagues gambled. Two members of their family had experienced gambling-related harm.

There were some friends on the fringe who were not connected to many gamblers (e.g., the two friends who are lowest in the diagram). Thus if this person wished to reduce their gambling risk by taking steps to minimise the influence of others, they could choose to spend more time with those particular people. Alternatively, advice could include gambling with their friends, or non-harmed members of their family, rather than those who have experienced harm, in order to reduce the normalisation of experiencing gambling-related harm.

Because the gamblers, particularly the harmed gamblers, were so well integrated in their social network, avoidance strategies are less likely to be successful. Other strategies may include setting (and sticking to) limits when gambling with these alters, to avoid development of further problems.

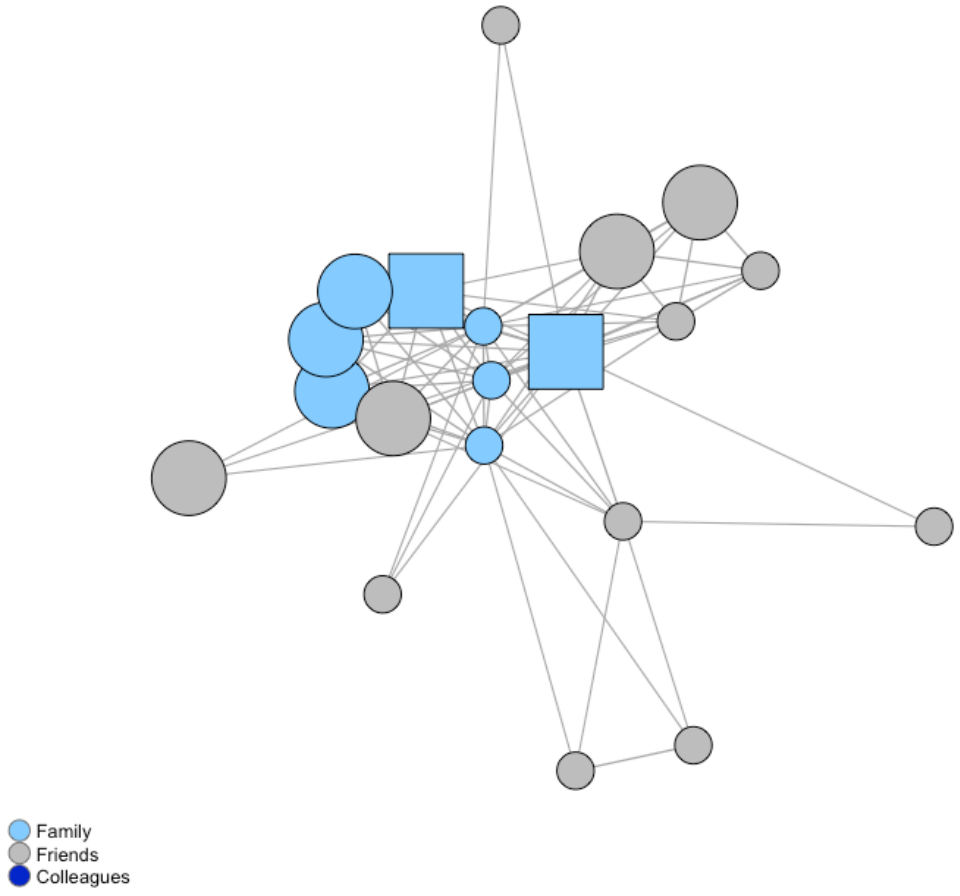

Figure 4.4 Egocentric social network example for an ego who is a low risk gambler

4.8.5 An example egocentric social network diagram for a moderate risk gambler

Figure 4.5 shows an egocentric social network for one particular moderate risk gambler. This person had no family in their social circle, only friends and colleagues. Their network was quite dense, with most alters connected to multiple other alters. Three of the ten gambling alters had experienced gambling-related harm; two colleagues and one friend.

The gamblers in this person's network were connected both to other gamblers, and to non-gamblers. Their work colleagues were connected to their friends. There were relatively few places for this person to go within the network to minimise social influences in terms of gambling. While six of their colleagues were gamblers, so too were four of the friends. Leaving their job to avoid gambling influences may not be effective, as the friends that they were likely to socialise with were all connected to their colleagues. Instead, methods to be aware of and minimise these influences are more likely to be effective. Alternatively, forming new groups of friends may also be a useful strategy in situations like this.

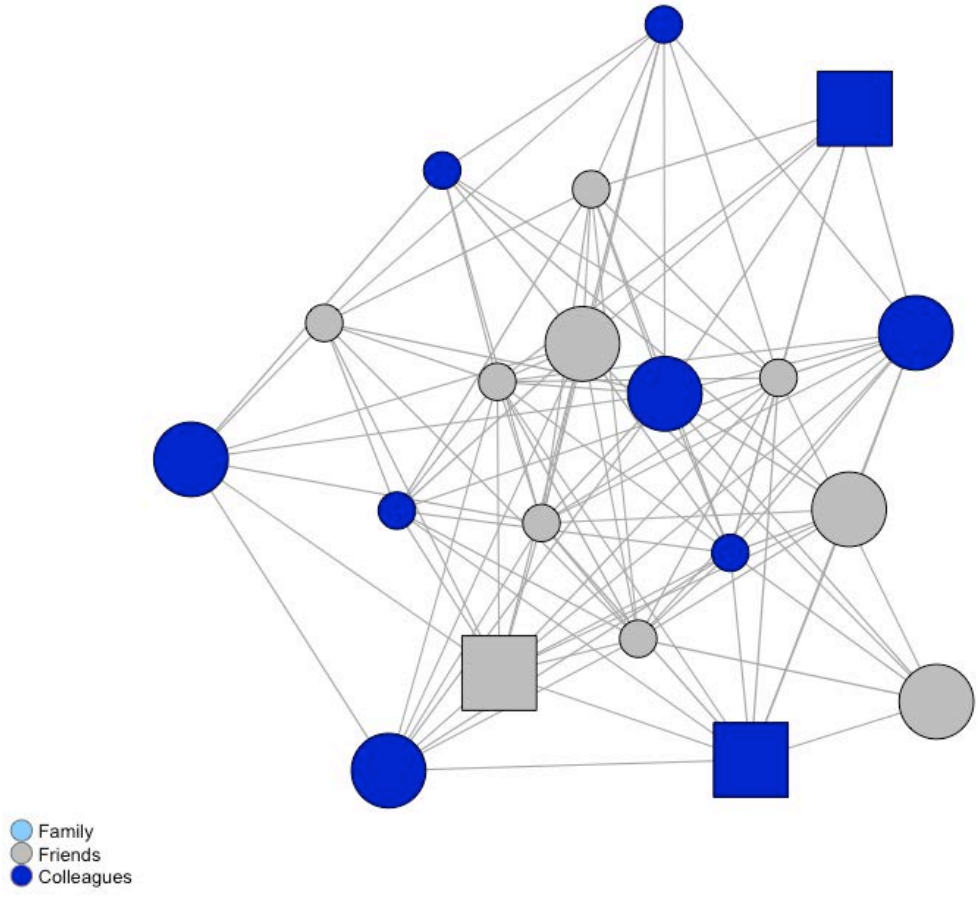

Figure 4.5 Egocentric social network example for an ego who is a moderate risk gambler

4.8.6 An example egocentric social network diagram for a problem gambler

Figure 4.6 is an egocentric social network diagram for a particular ego who is a problem gambler. The results in section 4.4 indicated that problem gamblers had networks that were more dense than egos from other groups, and this is demonstrated within this diagram. Thirteen of their 20 alters were gamblers, five of whom had experienced gambling-related harm. Most of those who were not gamblers are family (the small light blue circles), but as can be seen, they were connected to many other alters, almost all of whom gambled. These alters were family, friends and colleagues, so leaving one particular environment (e.g., work, a group of friends) may not make much difference in terms of avoiding gambling influences.

The degree of network density in this image is the average network density of problem gamblers. Many problem gamblers are in networks that are denser than this. The diagram highlights the issue for problem gamblers: not only are they surrounded by other gamblers, but those gamblers are also highly connected within their networks, and thus difficult to escape from.

For this problem gambler, almost all of their friends gamble, as do their colleagues. Should a person in a situation like this wish to reduce their gambling problems, they could look at developing friendships with new groups of people who are not gamblers and spending more social time with them, rather than with their existing alters. A change of workplace may be useful, or perhaps the development of workplace-based strategies to reduce gambling-related discussion at work. However, the existence of bonds between the colleagues and other alters in the network (family and friends) may mean that changing workplace could only have a limited effect on reducing the ego's gambling. Thus an important tool for this ego may be the development of strategies to say no when asked if they wish to gamble (or even socialise with other gamblers).

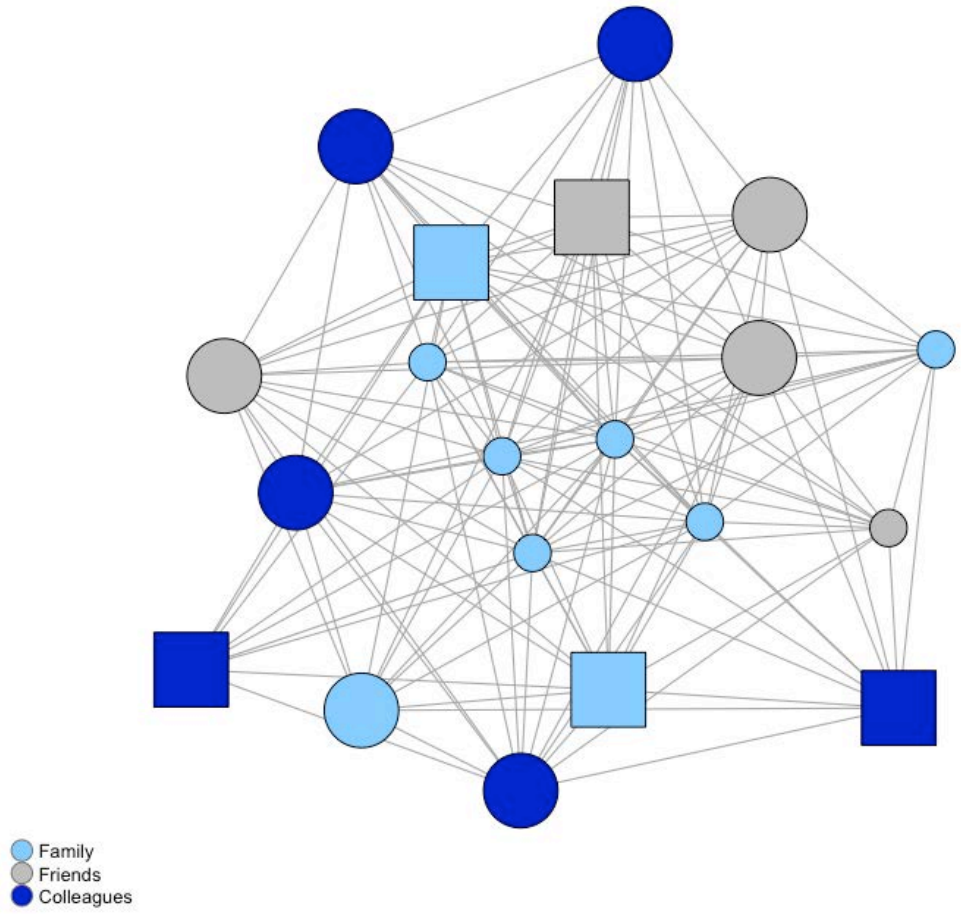

Figure 4.6 Egocentric social network example for an ego who is a problem gambler

4.8.7 Summary of interpreting egocentric social network diagrams

The figures above are presented as examples of how mapping these diagrams can inform specific interventions for particular people, based on where the gamblers are in their social networks. It is important to note that these possible interventions have not been tested, and are presented for illustrative purposes only. Furthermore, as noted above, these diagrams are not representative of all NGs, NPs, LRs, MRs and PGs. These diagrams are for particular individuals, and thus the example interventions included in this section should not be employed for anyone based solely on their risk group. Further research is needed to determine which interventions for social influence are most effective in different types of egocentric social networks. As discussed in Chapter 5, approaches that change norms within society should also be considered.

4.9 Chapter summary

As seen in section 4.1, the gambler risk groups are generally representative of what might be expected: egos in higher risk groups tend to be male, younger, and employed with a higher income. They gamble more frequently on more gambling forms, have higher gambling expenditure and tend to experience more gambling-related harms. Their scores on positive play/responsible gambling measures exhibit less responsible gambling behaviour and beliefs. They engage in drinking and smoking more frequently. That is, they are broadly representative of higher risk gamblers in general, and thus the study sample appears to be a good representation of NGs, as well as gamblers in the various risk levels.

Those in higher risk groups are more likely to associate with people (alters) around the same age as themselves, while this is not the case for gender. Higher risk groups associate with more gamblers, and more people who have experienced gambling-related harm. Alters for higher risk egos are also more likely to smoke and drink.

There is no evidence to suggest that egos in higher risk groups are more likely to associate with either family, friends or colleagues, but those in higher risk groups are significantly more likely to feel closer to their alters, and this does not depend on whether the alter gambles or not. Egos in higher risk groups gamble with significantly more of their alters, including those who have experienced gambling-related harm.

The networks of MRs and PGs are significantly more dense (more highly connected) than those of NPs, with the networks of PGs being particularly dense. As a result of this, PGs are significantly more constrained than all other groups, with LRs and MRs showing no significant difference in constraint compared to either NGs or NPs. Furthermore, as shown in the bivariate and multivariate analyses, being a PG (but not a LR or MR) is associated with more dense networks even when controlling for other variables that are related to network density.

However, gambling risk group is not associated with the number of alters who gamble when controlling for other variables. This may be because some of the other variables in the model are somewhat related to gambling risk group (e.g., number of gambling forms engaged in, gambling expenditure, attitude towards gambling) and thus there was little unique variance in the model to explain with gambling risk group. Regardless, on a bivariate basis, those in higher risk groups engage with more alters who gamble.

Finally, even when taking into account other variables, including network density and number of alters gambled with, LRs, MRs and PGs experienced significantly higher harms due to gambling compared to NPs.

Chapter 5: Discussion

5.1 Overview of the study and key results

As per the scope of the research, the specific aims of the research were to:

1. Capture and map the nature of the social networks (i.e., social context) for low risk and moderate risk gamblers, in terms of the gambling and other potentially risky behaviours (e.g. alcohol consumption) of the most influential people around them;

2. Determine whether the social networks around low risk and moderate risk gamblers differ to those around non-gamblers, non-problem gamblers and problem gamblers, and how they differ;

3. Consider the potential role of social networks on the normalisation of gambling behaviour.

To address Aims 1 and 2, we used egocentric social network analysis to compare and contrast the nature of the social networks around non-gamblers and non-problem, low risk, moderate risk and problem gamblers. For each respondent (ego), we captured information about, and the relationships between, the 20 most influential people in their lives (alters). We focused particularly on low risk and moderate risk gamblers, because gambling amongst these groups accounts for most of the aggregate harm related to gambling, due to their large numbers in the population (Browne et al., 2016). Thus, understanding social influences on their gambling is important to inform related risk and protective strategies aimed at reducing this harm.

The demographics and behaviours of the respondents in each gambler group appear to be in line with those found in other studies and, in most of the results, non-problem gamblers were significantly different to low risk and moderate risk gamblers, who were significantly different to problem gamblers (specific results are discussed below). A similar pattern was observed for many of the measures assessing the nature of their alters (e.g., the number of alters who gambled, smoked, or who experienced harm from their gambling). The social networks of moderate risk gamblers were significantly denser, on average, compared to non-problem gamblers, with low risk gamblers not significantly different to either group, and the social networks of all of these groups were significantly less dense than those of problem gamblers.

Taken together, the results suggest that, as an individual's gambling risk severity increases, so does the number of gamblers within their social networks (increased homophily), and the networks become more tight knit (increased network density). The implications of this are discussed below, including in relation to the role of social networks in normalising gambling (Aim 3).

5.2 Egos

The focus of social network analysis is on the people around the ego, rather than on the egos themselves. However, it is worth noting that the composition of the gambler groups in this study was in line with previous studies, which adds confidence to the results. Those in higher risk groups were generally younger, and more likely to be male (Johannson et al., 2009). Those in higher risk groups

gamble more frequently on all forms, and spend more on most forms than those in lower risk groups (e.g., Gainsbury et al., 2014), and experienced significantly more gambling harm than those in lower risk groups (Browne et al., 2016). Higher PGSI groups displayed significantly less responsible gambling/positive play beliefs and behaviours (Wood et al., 2017), and engaged in drinking alcohol and smoking tobacco significantly more frequently than those in lower risk groups (Haw, Holdsworth, & Nisbet, 2013).

An interesting finding was that low and moderate risk gamblers, as well as problem gamblers, were all less honest to others about their gambling behaviour compared to non-problem gamblers. The questions relating to this subscale include “I was honest with my family and/or friends about the amount of money I spent gambling”. The social networks of these groups contain many gamblers, including family and friends, and this finding may indicate that those in higher risk groups may hide the extent of their gambling from others, even if they are close to them. However, should gambling be a shared interest between the ego and alter, then it is less likely that the ego would feel the need to hide or be dishonest about this behaviour. The wording of the present question does not discriminate between honesty with family and friends who are and who are not gamblers, so this raises a question for future research – are those in higher risk groups less honest about their gambling only with the non-gamblers in their social circles?

As would be expected, most of the metrics for low risk and moderate risk gamblers were between those for non-problem and problem gamblers. For example, in gambling frequency and gambling harms, low risk and moderate risk gamblers gamble more frequently, and experience more harms, compared to non-problem gamblers, but not as much as problem gamblers. This pattern occurs throughout most of the results, apart from network density (see below).

5.3 Alters

The alters in the networks of moderate risk and problem gamblers were significantly closer to the ego in age compared to alters of non-gamblers and non-problem gamblers; however no differences were found in terms of gender (i.e., whether the alters were the same gender as the ego). The age similarity may indicate a degree of social selection of those who share interests, such as the sports betting groups described by Raymen and Smith (2017), although one would also potentially expect a similarity in gender, given that at least some forms of gambling tend to appeal to particular genders (Delfabbro, 2012). This could be further explored by comparing the similarity of gamblers and non-gamblers to each ego separately, based on the ego’s preferred form of gambling. Such an analysis would require a larger or purposefully-recruited sample to explore particular forms of gambling that are somewhat less common (e.g., sports betting), but regularly characterised as social forms in the literature (Gordon et al, 2015; Raymen & Smith, 2017).

An unsurprising result was that gamblers had more alters who gamble than do non-gamblers, and that egos in higher risk groups were surrounded by more gamblers, on average, than were egos in lower risk groups. For low risk and moderate risk gamblers, almost half of the 20 most influential people in their lives are gamblers, and for problem gamblers, 13 on average are gamblers. Since the literature suggests that social/peer norms influence gambling behaviour (e.g., Dahl, Tagler, & Hohman, 2018; Larimer & Neighbors, 2003; Martin et al., 2010; Moore & Ohtsuka, 1999; Neighbors et al., 2007), then it is clear that

gambling is more normalised for higher risk groups. We note that accuracy of the ego's perception of whether or not someone is a gambler is a potential limitation of this methodology, and we discuss this in the limitations section below.

As seen in Figure 4.1, it appears that alters who gamble are not necessarily more likely to be either family or friends or colleagues. This appears to support the role of early socialisation and social/peer norms, rather than social selection, as people generally have less choice about who their family and colleagues are compared to their choice of friends. It should be noted, however, that people are still able to choose which family and colleagues they choose to develop closer relationships with, so the role of social selection cannot be completely discounted on this evidence alone. This principle that similarity creates connection, known as homophily, influences social ties across a range of relationship types and sources of similarity (McPherson, Smith-Lovin, & Cook, 2001). These strong social ties are often identified in networks of people with similar cultural differences, ethnic and religious identities, and other demographic factors (Abbott, Bellringer, Garrett & Mundy-McPherson, 2014). This result remained when we controlled for other potential variables, such as age, gender, and cultural differences.

However, it is possible that the influences from different types of alters are different in nature. As noted in the introduction, early exposure is a key influence (Saugeres et al., 2012), and by its very nature, this influence is virtually unable to come from colleagues, and more likely to come from family than from friends. Thus, it is possible that influence from family members is more likely to be related to initial uptake of the behaviour and the development of more positive attitudes towards that behaviour. In contrast, influence from friends and colleagues is instead related to social/peer norms and to social selection and may exacerbate the behaviour, through uptake of new forms, or through creation of more opportunities to partake in the behaviour in a social setting. This is an avenue for future investigation. Regardless, the results indicate that social influences in terms of gambling are likely to come from family, friends *and* colleagues, rather than just one of these groups, although this will naturally differ from gambler to gambler.

Not only are those in higher risk groups surrounded by more gamblers, they are surrounded by more gamblers who experience gambling-related harm. The social/peer norm literature suggests that associating with more gamblers normalises the activity, and it is reasonable to assume that associating with more harmed gamblers normalises experiencing harm from gambling. Again, alters who experienced gambling-related harm did not necessarily come from any one domain of alters (family, friends, colleagues). For low risk gamblers, 27% of their alters who gamble, on average, experienced harm, and for moderate risk, the figure is 41%. These compare to 9% for non-problem gamblers and 59% for problem gamblers. Of interest, while non-gamblers had relatively few gamblers in their networks, they reported that 36% of them, on average, experienced harm. Non-gamblers may be more sensitive, or even oversensitive, to observing gambling-related harm in others, or conversely gamblers may be more likely to ignore lower level harms, or be normalised to them. Regardless, the finding that higher risk PGSI groups had so many gamblers who experience harm in their networks indicates a troubling type of social influence.

In terms of comorbid behaviour, higher risk groups were also more likely to be surrounded by more drinkers and more smokers, indicating that just as gambling, smoking and drinking behaviours are linked, so are the social influences in these activities. The alcohol statistics, particularly for the higher risk groups, appear to be in line with that of the Australian population (Australian Bureau of Statistics, 2015), although the measures are different and cannot be directly compared. In contrast, tobacco intake is reducing in

Australia (Greenhalgh, Bayly, & Winstanley, 2017), and the figures for the number of alters who smoke in the networks of low risk to problem gamblers are higher than would be expected if smoking were not part of their socialising or social selection. In the present study, we captured whether each ego's alter gambled, smoked and drank alcohol with the ego, but we were unable to capture which of these behaviours the ego partook in simultaneously with each alter, due to survey length limitations. However, links between the behaviours have been observed before, such as by Raymen and Smith (2017) who observed their participants taking part in sports betting at the local pub with their friends, while consuming alcohol.

Taken together, the results for alters indicate a high degree of homophily for those in higher risk groups, including low risk and moderate risk gamblers, with egos significantly more likely to associate with those who are closer in age to them, who engage in gambling, and who (like these higher risk egos) are also more likely to smoke and drink alcohol. The next section takes into account whether or not the egos engage in those behaviours with the alters. As also noted, the proportion of alters who experience gambling harm is related to PGSI risk group, indicating that egos experiencing higher levels of harm are more likely to associate with others experiencing gambling harm.

5.4 Ego-alter relationships

As noted in Chapter 1, the networks that surround people are formed in some part by chance, but more so by social selection – seeking out those who engage in the same behaviour/s. With the present cross-sectional design, it is impossible to determine the nature of the relationship between the ego's gambling risk severity and the structure of the network. It is possible that, as an ego's gambling increased to higher risk severity accompanied by gambling-related harms, they changed the nature of their network, by associating more with gamblers, including those also experiencing harm. That is, social selection formed at least part of their network. Such a network change could also be because previous members of their networks chose to associate less with them as their gambling increased and became more problematic, in order to protect them from associated harms, or because they found that they had less in common with the ego once they took up gambling. A finding that may have supported this would be degree of closeness with alters who do not gamble in their network. However, as indicated in Table 4.19, the group who felt least close to non-gambling alters were non-problem gamblers. This result was echoed for the entire network, with low risk and problem gamblers feeling significantly more close to their alters than non-problem gamblers (with moderate risk gamblers not significantly different to any of these groups, and non-gamblers not significantly different to any groups). Furthermore, all gambler groups did not differ in how close they felt towards their alters who gambled compared to those who did not gamble. In contrast, non-gamblers felt closer to their alters who did not gamble, compared to their alters who did. This may reflect stigma towards gamblers from non-gamblers (Hing et al., 2015), also be suggested by the finding that non-gamblers thought that a relatively large proportion of their alters who gambled had experienced harm. That the egos from the gambler groups felt similarly close to their alters who did and did not gamble may reflect that they have found non-gamblers who are not aware of their gambling, or for whom the ego's gambling behaviour is not relevant in terms of their relationship. Alternatively, the alters may have a different perspective on how close they are to the ego, and the egos who gamble may be unaware of this. Capturing this information from alters would mean interviewing many alters per ego, and would

greatly expand the complexity of the study. However, interviewing a subsample of alters could provide some evidence either way.

The other possible scenario is that, as the ego engaged with more alters who partake in gambling (and smoking and drinking), their own behaviour increased; i.e., normative social influence. This is a crucial question to ask, and it can only be addressed by longitudinal research. However, it is likely that a combination of social influence and social selection is at play. Additionally, the influence is likely to flow both ways, from the alters to the ego, and from the ego to their alters. This is discussed in more detail below.

Being surrounded by gamblers is likely to influence a person's gambling through passive influences, but active influences are also likely to influence behaviour, such as if the ego and alters engage in the gambling together (see e.g., Cullum, O'Grady, Armeli, & Tennen, 2012). The, low risk and moderate risk gamblers gambled with 50% and 57% (respectively) of the gamblers in their networks during the previous 12 months, compared to 39% for non-problem and 80% for problem gamblers. Furthermore, 37% and 45% (low risk and moderate risk egos respectively) of these alters had experienced harm because of their gambling. Thus, not only are these egos surrounded by alters gambling at harmful levels, they gamble with about half of them, including those who have experienced harm. That gamblers associate with gamblers is not particularly surprising, but socialising with gamblers who experience harm raises concerns about gambling-related harm being normalised. However, this may be, in part, because those with less exposure to and less personal involvement with gambling are significantly more likely to stigmatise those experiencing problems (Hing et al., 2015). Thus, these social circles of gamblers, particularly more involved gamblers and those experiencing harms, are places where these gamblers feel more accepted, supporting social selection theories.

5.5 Network structure

The previous sections have discussed the ego, the alters, and the relationships between the ego and the alters. Relationships between alters were used to calculate structural measures, with the key finding that network density differs by risk group. Density is a measure of how many of the possible alter-alter relationships actually exist. If all alters in a network know all other alters, density will be 1. Density for moderate risk and problem gamblers was significantly higher than for non-problem gamblers, and low risk gamblers were not significantly different to either non-problem or moderate risk gamblers. This means that, on average, there is a higher degree of interconnectivity amongst alters for moderate risk and problem gamblers, and their networks are therefore less likely to be separated into distinct social circles or cliques.

No significant difference in density was observed in the previous gambling study that used egocentric social network analysis (Meisel et al., 2013), but this is likely due to its small sample with limited power to detect significant differences. However, our finding of differences in network density is consistent with patterns of other health behaviours within social networks such as smoking (Christakis & Fowler, 2008; Cutler & Glaeser, 2007; Ennett et al., 2008; Etcheverry & Agnew, 2008), alcohol consumption (Abar & Maggs, 2010; Ali & Dwyer, 2010; Knecht et al., 2011; Meisel et al., 2015; Mundt, 2011; Rosenquist et al., 2010; Stock et al., 2014), substance use (Ennett et al., 2006; Pearson et al., 2006), and dietary patterns (Christakis & Fowler, 2007; Pachucki, Jacques, & Christakis, 2011). For the gambler, their social

environment is saturated with both active and passive influences sustaining or potentially increasing their engagement with gambling, and associated harms. This saturation, expressed through network density, is an important finding because it widens our lens beyond just the peer group influence, to understand the complexity of entwined connections between the most influential people in a gambler's life. Whilst these shared attitudes and behaviour can be shaped by processes of both social influence and social selection (Bullers et al., 2001; Rosenquist et al., 2010), when they are shared between different groups within a network (ie. familial and peer influences), there is an interactive or amplifying effect (Epstein et al., 2008; Mrug & McCay, 2013).

Two recent studies illuminate the influences on the formation and strength of these connections. These studies have broadened the examination of peer influences on gambling in young males, moving the analytic focus away from the individual, by examining gambling as a social process within a peer group (Gordon et al., 2015; Raymen & Smith, 2017). Using the emerging concept of lifestyle consumption community (LCC), Gordon et al. (2015) identified the importance of shared cultural values of competition and loyalty in binding groups. Raymen and Smith's (2017) study, using a powerful longitudinal, emic[11] perspective, also identified the role of shared gambling harms such as indebtedness, relationship breakdown, and mental health issues in further strengthening connections within a social network. Whilst both these studies were limited to male peer relationships, they suggest that the shared values and experiences extending between social groups within a network, may contribute to increased network density. These connections between different groups within an individual's social network can be facilitated in part through interaction on social media platforms where shared experiences and values are easily identified.

In addition to the saturation and density of the networks of those in higher risk groups, we also found that the networks were not hierarchical, that is, there is not a key person of influence or connection that forms a critical path connecting the ego to gambling. This helps to explain not only the potential for normalisation and reinforcement of any gambling behaviours, but also the challenges for anyone wishing to reduce or cease gambling. If gambling was clustered around a particular group, or through a key person within the social network, it would be easier to reduce or avoid contact with other gamblers. However, gambling is entrenched within the social network through shared leisure choices that permeate the network. And since the ties in the social networks of those in higher risk groups, particularly problem gamblers, are stronger than those amongst lower risk groups, breaking the influence of these social networks is likely to be particularly difficult, especially in cases where the other gamblers in the network cannot easily be avoided, such as family.

While the biopsychosocial model of gambling has long been accepted, the social component of the model has received relatively little attention. Overall, the key findings from the present study are that gamblers in higher risk groups are surrounded by other gamblers, including more gamblers who experience harm, in networks characterised by more bonds and stronger bonds. These networks either form based on shared interests, or existing social connections influence the ego to engage in, or escalate, their gambling. The multivariate analyses indicate that the density of these networks is not due solely to problem gambling status, but also to other factors typically related to gambling problems, such as being younger and/or

[11] Emic means from within the social group, or from the perspective of the subject (i.e., an insider's perspective). It is contrasted with etic, from outside (i.e., from the perspective of the observer).

male. That these networks are so tightly connected presents both opportunities and challenges in terms of public health responses to reducing gambling related harm.

5.6 How these findings inform approaches to harm minimisation

The density and saturation of gamblers within social networks of people who gamble presents both challenges and opportunities for harm minimisation strategies. For those already experiencing problems with gambling, it mostly creates challenges. Identifying people within their network to whom they can disclose their gambling-related concerns or desire to seek assistance or treatment will be difficult, as that information is likely to flow through much of the rest of the densely connected network. Additionally, when the most influential and closest gamblers to an ego attempt to reduce or cease gambling, there may be some level of weakening or separation from those connections. In some cases, these bonds may be formed based on engagement in otherwise-beneficial activities, such as team sports, or work, and thus the weakening or separation of these bonds may have adverse effects.

This highlights the importance of strengths based approaches to harm minimisation rather than trying to rely on abstinence and avoidance techniques. People experiencing problems with gambling need to be supported to develop the capacity to navigate these saturated social networks and environments. At a broader level, strategies to increase social support and normalisation of efforts to limit or abstain from gambling should also be investigated. Lessons can be drawn from strategies to address alcohol consumption, particularly settings approaches to manage harm minimisation. Settings approaches are based on the premise that health is determined through environmental, economic, social, organisational and cultural circumstances, and these influences operate both at a societal level and through the settings of everyday lives (Dooris, Dowding, Thompson, & Wynne, 1998). Settings approaches have been successfully adopted across a number of sectors, including cities, universities, prisons, workplaces, and sports clubs (Dooris, 2009, 2013). Using settings approaches, sports clubs have successfully integrated strategies to reduce alcohol related harm (Geidne, Quennerstedt, & Eriksson, 2013; Kokko, Green, & Kannas, 2014). Our findings suggest one of the challenges to this is the density of the social networks around problem gamblers. Isolated or individual settings may not be sufficient to support behaviour change, highlighting the need for joined up settings approaches (Dooris, 2004, 2013).

The strength of the connections within a person's social network can also provide opportunities for influencing behaviour change and normalising harm minimisation strategies. This has been utilised to address entrenched social behaviours and social norms that influence these behaviours, such as eating and exercise (Sandon, 2016), bullying (Wölfer & Scheithauer, 2014), and values and behaviours relating to rape culture in college campuses (Bosson, Parrott, Swan, Kuchynka, & Schramm, 2015; Paul & Gray, 2011). The lack of hierarchy we identified in the social networks of people who gamble suggests that without a key influencer, the change of social norms within the network will be a more gradual but sustained process.

The strong connections provide a further opportunity to embed Australian cultural norms of mateship and looking after each other in efforts to normalise behaviours that will reduce harm. A recent campaign by the Royal Life Saving Society Australia to address the increased incidence of alcohol related injury and

drowning of young males is one example of this approach[12]. The campaign, titled “Don’t let your mates drink and drown”, is centred on the concept of mateship, using stories of lived experience, evidence and education by providing strategies for reducing the risk of harm. Similar campaigns, based on looking after the wellbeing of friends, have also been used for drink driving, binge drinking, and within occupational health and safety fields.

Peer groups are not the only components of social networks. Family connections, work colleagues and other relationships are also included. Similar strengths based, behavioural change strategies have been implemented for other connections such as family groups. The Victorian Aboriginal Community Controlled Health Organisation implemented a campaign, “Mob Day”, which used a strengths based approach to provide suggestions and facilitate opportunities for social interaction and family based leisure that did not involve gambling. However these strategies are often group specific, and strategies aimed at behavioural change in relation to gambling will need to be cognisant of the diversity and complexity of the entwined relationships we identified.

Peer influence can also be used to shape behaviour, such as through normative feedback. As described in Section 1.4.2, previous studies have found that personalised normative feedback (feedback designed to correct misperceptions by providing information about a person’s behaviour compared to others of similar ages, Moreira et al., 2012) can be an effective tool for reduction of gambling behaviour (Auer & Griffiths, 2015; Celio & Lisman, 2014; Neighbors et al., 2015), although other tools may also be required for sustained reduction in behaviour or problems (Cunningham et al., 2012).

In a review article, Miller and Prentice (2016) discussed various interventions aimed at changing norms, in order to change behaviour. In addition to social norms marketing (such as the Life Saving and Mob Day campaigns described above) and personalised normative feedback, they identify focus groups (where misconceptions are identified through discussion) as a further possible avenue to norm change. Miller and Prentice argue that, while changing norms can be challenging, efforts to change norms are often successful, whether this is done through marketing, personalised normative feedback or through focus group discussions. They describe situations in which norms-based approaches may be successful, such as when what is considered “normal behaviour” is exaggerated (e.g., drinking amongst college students), or when many are uncomfortable with the level of behaviour, but assume that everyone else is comfortable, and thus do not object (“pluralistic ignorance”). However, changing the norm does not necessarily mean the behaviour will change. Miller and Prentice argue that, for the behaviour to change, the targeted norm must be of significance to the person, although success has been observed with modifying either injunctive or descriptive norms. Thus, effective norm-based interventions must identify the norms that are most salient to the individual, and these may be different for different people.

The findings support an extension of the new public health education programs implemented in Victoria to reduce gambling related harm through the early detection of harms experienced by low risk and moderate risk gamblers. This could involve extending the focus from the individual to challenge families, social groups, peer groups, workplaces and communities by prompting social networks or groups to look for signs of gambling harm, not only for themselves, but for those around them. Similarly the embedding of gambling as a social process could be challenged by prompting families and social groups to think about

[12] https://www.royallifesaving.com.au/programs/dont-let-your-mates-drink-and-drown/Effects-of-alcohol

the last time they got together without gambling being part of the event, or whether they talk about the game or the gamble.

5.7 Possible clinical use of egocentric social network analysis and individual level interventions

It is crucial to note that the results presented here are aggregated results, and that the nature of the networks for individuals vary. Even within a particular risk group, one person's network may include distinct social circles of gamblers, and other groups that do not gamble; while other networks may be highly connected, with gamblers throughout their social networks.

Understanding an individual's social network can be a powerful tool in a therapeutic or self-directed (i.e., online) help seeking setting to identify strategies and opportunities for effecting behaviour change or reducing gambling harm. A simplified social network analysis tool could be utilised in both therapeutic and online settings to help individuals understand the structure and subsequent role of their social network in sustaining and supporting their gambling. The connected and saturated network can make it seem that everyone around them gambles, but practical tools such as SNA, can assist people to identify pockets of non-gambling (or reduced gambling) connections within their network. SNA also highlights the possibility of creating new social connections outside an existing network for people who are in highly connected networks of gamblers.

We discussed possible interventions in Chapter 4, but noted these approaches would require rigorous research before use as a clinical tool. Thus, a useful next step is to develop a simple online tool that can automatically create social network diagrams, and to test the efficacy of different interventions based on different types of social networks.

5.8 Limitations

It was not possible to determine the formation of the networks and the contribution of social selection and social influence or the interaction between them on the evolution of participants' social networks, because the present project was cross-sectional. Longitudinal data presents research challenges. Changes in the networks must occur between observations to be detected, and social networks may change at a relatively slow pace during much of the lifecourse. However, longitudinal research is an important next step in this research, and has been used in other health behaviours (Knecht et al., 2011; Kossinets & Watts, 2006, 2009).

Respondents were required to identify 20 alters. Because social isolation has been identified as a risk factor for problem gambling, we were concerned that some respondents, particularly those in higher risk groups, would not be able to list 20 alters and thus not complete the survey. In the instructions for this section of the survey, we asked respondents who were unable to name 20 influential people in their lives to enter names of anyone they knew, and that they would later be able to say that they were not particularly close to them. Mean closeness-to-alter was actually higher for problem gamblers than it was

for most other groups, indicating that this was not an issue for at least most of the problem gamblers surveyed. Dropouts at this point of the survey were also not related to PGSI group, and the characteristics of egos in each risk group aligned with what was expected from the literature. However, the information sheet, presented at the start of the survey, stated that they would be able to list 20 alters. As PGSI information had not been collected at this stage of the survey, it is not possible to determine if any dropouts at this point were related to gambling risk severity. Thus, while we have taken steps to reduce this as a limitation, and there is no evidence that it was a limitation in the current study, we still identify it as a potential limitation.

The egocentric social network analysis, by design, does not require information from the alters. It is possible that if alters were asked the same questions about themselves, such as their gambling behaviour or level of harm, their answers may be different. Furthermore, the strength of the relationship between egos and alters, and between pairs of alters, are also only from the ego's perspective. An ego may feel close to an alter who does not feel particularly close to them. Similarly, non-gamblers, or lower frequency gamblers, may not be aware of how many of their alters gamble, or have experienced harms from gambling, if it is not a topic for discussion. However, if the behaviour or beliefs of an alter are to influence an ego, then the ego must be aware of the alter's behaviour or beliefs. Thus, for this methodology, it is the view of the ego that is important, even if it may not be entirely correct. This is also reflected in previous studies that have measured the respondent's beliefs about social norms, and have found them to be important predictors of behaviours (e.g., Larimer and Neighbors, 2003).

Egocentric social network analysis is, by definition, a study of the network around an individual person, and aims to identify influences on that person only. A broader sociocentric social network analysis would be more useful in terms of identifying clusters of behaviour within the population as a whole (whether that population is Australia, a state, or something like a sports club). As discussed in Section 2.2.2, sociocentric social network analysis is only possible in situations where data are public, or where the network is small enough to be able to capture information from all people within the network. Even then, it is subject to issues around anonymity, and missing data. Furthermore, any sociocentric network needs to have some kind of boundary, and the present results suggest that a network limited to a workplace, or particular social group, would miss important influences from other groups of friends, or family.

As always, surveys are self report and are thus subject to the usual limitations around self report data, such as exaggeration or social desirability bias.

5.9 Future research

SNA offers substantial value to understanding health behaviours, as well as the values and influences that underpin them. Further valuable information can be obtained if such a study is conducted longitudinally. Longitudinal data will allow the identification of processes of change and influences on attitudes and behaviours as well as the structure and evolution of social networks. This understanding is essential to properly exploit opportunities to influence attitude and behaviour change through social connection. Longitudinal analysis also allows the opportunity to prospectively examine potential interventions to change behaviours across a network.

Because the networks of those in higher risk groups include more gamblers, and more gamblers who have experienced harm, and because the social networks of moderate risk and problem gamblers in particular are more interconnected than those in lower risk groups, we believe that both strengths-based approaches, and approaches that change norms, are likely to be most successful in reducing these social influences. While Miller and Prentice (2016) found that most approaches to changing norms have been successful, research is required to determine which norms are most salient for particular groups of people, as gamblers are not a homogenous group.

Furthermore, Dobbie, Reith, and McConville (2017) have identified the use of certain aspects of social network analysis as a particularly useful tool for qualitative research. In their study, gamblers were asked to draw a sociogram (a chart of interrelationships within a group, similar to social network diagrams) of people who were currently close to them. They found the visual mapping exercise provided advantages such as gaining a deeper insight into the social networks of gamblers, both in terms of social influences on the gambler, and on those around them. While the focus was not on the quantitative aspects of the social network (number and strength of ties, network density, etc.), their approach shows a clear use for designs based on social network analysis.

5.10 Conclusions by objective

Objective 1: Capture and map the nature of the social networks (i.e., social context) for low risk and moderate risk gamblers, in terms of the gambling and other potentially risky behaviours (e.g. alcohol consumption) of the most influential people around them; AND

Objective 2: Determine whether the social networks around low risk and moderate risk gamblers differ to those around non-gamblers, non-problem gamblers and problem gamblers, and how they differ;

Low risk and moderate risk gamblers are surrounded by gamblers (as well as smokers and drinkers), more so than non-gamblers and non-problem gamblers, but less so than problem gamblers. Approximately 50% of the most influential people in their lives are gamblers. Low risk and moderate risk gamblers are also surrounded by, and gamble with, more people who experience gambling-related harm compared to non-gamblers and non-problem gamblers, but less so than problem gamblers.

Moderate risk (and problem) gamblers in particular feel closer to those in their networks, although this does not appear to depend on whether those people are gamblers or not. Low risk gamblers are not significantly different to either moderate risk or non-problem gamblers in this regard.

The social networks of moderate risk gamblers in particular are more interconnected (dense) compared to those of non-problem gamblers, but less so than problem gamblers, indicating more social opportunities to gamble with their alters who gamble. The density of the social networks of low risk gamblers is not significantly different to those of moderate risk or non-problem gamblers, although they are closer to moderate risk gamblers. The network density of those at higher risk presents challenges for reducing social influence.

Objective 3: Consider the potential role of social networks on the normalisation of gambling behaviour.

Because we are influenced by the behaviour of those around us (as well as influencing their behaviour), the results from the present study indicate that the social networks of gamblers, particularly those in higher risk groups, are influential on their gambling based on the number of gamblers in their networks, as well as on the number of gamblers with whom they gamble.

This extends to gambling-related harm. Those who have experienced more harm are also surrounded by more gamblers who have experienced harm, and are more likely to gamble with them despite experiencing harm. Thus, not only is gambling-related behaviour normalised through these social networks, so too is gambling-related harm.

5.11 Conclusion

For at least some forms of gambling, particularly sports and race betting, gambling can represent an important part of the social bond between people. These social influences, then, can shape the behaviour of a person, by normalising the behaviour, and by providing prompts. Social networks for higher risk gamblers include more gamblers, and more gamblers who experience gambling-related harm (homophily). These networks are particularly dense and interconnected, particularly for moderate risk and problem gamblers, and gambling does not appear to be the only shared activity, with smoking and drinking also important socialisation behaviours.

The density of the networks and abundance of gamblers within the networks of moderate risk and problem gamblers present challenges for changing behaviour, and indicate that attempts to cease or reduce the behaviour are less likely to be successful if the social influences are not also addressed. The dense nature of the networks of moderate risk and problem gamblers in particular, as well as the fact that there do not appear to be key influential individuals within these networks, indicates that approaches for addressing these social influences are more likely to be successful if they focus on overcoming or reducing the influence, rather than avoiding the influence completely. Similarly, approaches that change norms, rather than behaviour in the individual, should also be considered. However, we note that these approaches have not been tested, and that assessing these approaches is an important next step in this research area.

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Appendices

Appendix A. Survey instrument

Social network analysis study

Project Team: Dr Alex Russell (Chief Investigator), Ms Erika Langham, Professor Nerilee Hing, and Mr Vijay Rawat.

INFORMATION SHEET

Thanks for your interest in this project examining the social networks of individuals who gamble. It is funded by the Victorian Responsible Gambling Foundation (VRGF) and is being conducted by Central Queensland University.

What you will be asked to do

Participation requires completing an online survey which should take about 20 minutes.

We will ask you socio-demographic questions and questions about gambling (such as your attitudes towards gambling, any harms you might have experienced, and the types of gambling you engage in). There will also be some brief questions about alcohol and tobacco use.

The second part of the survey will require you to reflect on the **20 adults** you consider closest in your life in the last 12 months (for example - friends, family, romantic partners, and colleagues). Questions will relate to your relationship with each of these people, and their gambling, drinking and smoking behaviour.

The last part of the survey will require you to rate the closeness of the relationships of these 20 adults with each other.

How your confidentiality will be protected

We will protect the confidentiality of your responses to the fullest possible extent, within the limits of the law. Your name will not appear in the research report or any associated publications or presentations. We will also remove any references to personal information that might allow someone to guess your identity. The data will be kept securely by CQUniversity. In accordance with the Productivity Commission's recommendations to improve research into gambling, the de-identified data (the data collected without any way of identifying you) will be data warehoused and may be used by other researchers in the future. These researchers would need to supply an appropriate research proposal and have obtained approval from the Human Research Ethics Committee before access to the de-identified data would be given.

Participation will not prejudice you in any way

Please be advised that your participation in this study is completely voluntary. Should you wish to withdraw at any stage you are free to do so without prejudice or penalty.

How you will receive feedback

This research is being conducted for the Victorian Responsible Gambling Foundation. The final report will

be publicly available on their website at the end of the project (www.responsiblegambling.vic.gov.au).

Where you can get further information

Should you require any further information or have some questions about participation please contact Vijay Rawat on v.rawat@cqu.edu.au. If you have broader queries or concerns about the research, please do not hesitate to contact the Chief Investigator (Alex Russell) on a.m.russell@cqu.edu.au. You are also welcome to contact the Ethics and Compliance Officer at the Office of Research on 07 4923 2603.

Some of the questions we ask will be about your gambling behaviour. If you experience discomfort at any point during the surveys, you can contact **Gambler's Help on 1800 858 858 or www.gamblinghelponline.org.au**. These are free and confidential telephone/online help services that operate 24 hours a day, 7 days a week.

Taking part

To participate you must be:

- 18 years or over,
- Currently live in Victoria, and
- Be able to reflect on the 20 people you consider closest in your life over the last 12 months.

If you would like to participate CLICK NEXT. You will be asked to indicate that you are 18 years of age or over, and have read and understood this information by checking the acknowledgement accompanying the consent form. You can then complete the online survey.

Consent

I consent to participation in this research project and agree that:

1. I have read and understood the Information Sheet that describes this study

2. Any questions I had about the project were answered by either the Information Sheet or the researchers

3. I understand I have the right to withdraw from the project at any time without penalty

4. The research findings will be included in the researchers' publication(s) on the project; and this may include conference presentations and research articles as well as other media described in the Information Sheet

5. To protect my privacy, my name will not be used in publication(s)

6. I am providing informed consent to participate in this project

7. I am 18 years of age or over

- I consent to the above
- I do not consent to the above

We care about the quality of our data.

In order for us to get the most accurate measures of your opinions, it is important that you thoughtfully provide your best answers to each question in this survey.

Do you commit to thoughtfully provide your best answers to each question in this survey?

- I will provide my best answers
- I will not provide my best answers
- I can't promise either way

In **the last 12 months**, how often did you engage in the following activities?

	Not in the past year	Less than once a month	About once a month	About once a fortnight	About once a week	Multiple times a week	Daily
Instant scratch tickets (scratchies)	O	O	O	O	O	O	O
Bingo	O	O	O	O	O	O	O
Lotto / lottery games like Powerball	O	O	O	O	O	O	O
Keno	O	O	O	O	O	O	O
Poker	O	O	O	O	O	O	O
Poker machines (pokies)	O	O	O	O	O	O	O
Sports betting	O	O	O	O	O	O	O
Race betting	O	O	O	O	O	O	O
Other casino table games (such as roulette, but not poker)	O	O	O	O	O	O	O

Thinking about **the last 12 months**, how often:

	Never	Sometimes	Most of the time	Almost always
Have you bet more than you could really afford to lose?	O	O	O	O
Have you needed to gamble with larger amounts of money to get the same feeling of excitement?	O	O	O	O
When you gambled, did you go back another day to try to win back the money you lost?	O	O	O	O
Have you borrowed money or sold anything to get money to gamble?	O	O	O	O
Have you felt that you might have a problem with gambling?	O	O	O	O
Has gambling caused you any health problems, including stress or anxiety?	O	O	O	O
Have people criticized your betting or told you that you had a gambling problem, regardless of whether or not you thought it was true?	O	O	O	O
Has your gambling caused any financial problems for you or your household?	O	O	O	O
Have you felt guilty about the way you gamble or what happens when you gamble?	O	O	O	O

What is your gender?

- Male
- Female
- Other (please specify) _____

What is your age (years)? _____

What is the postcode of your primary residence? _____

Are you of Aboriginal or Torres Strait Islander origin?

- No
- Yes, Aboriginal
- Yes, Torres Strait Islander
- Yes, Aboriginal and Torres Strait Islander

What is the main language that you speak at home?

- English
- Other (please specify) _____

In which country were you born?

- Australia
- Other (please specify) _____

What is the highest level of education you have achieved?

- Year 10 or below
- Year 11 or equivalent
- Year 12 or equivalent
- A trade, technical certificate or diploma
- A university or college degree
- Postgraduate qualifications

What sort of living arrangement best describes your household?

- Live alone
- Couple (no dependents)
- Couple with at least one dependent child
- Couple living with independent child(ren)
- Single parent living with at least one dependent child
- Single parent living with independent child(ren)
- Share house with other adults
- Live with parents
- Other (please specify) _____

How many dependent children are living with you?

- 1
- 2
- 3
- 4
- 5 or more

What is their age?

	Age (years)
Child 1	
Child 2	
Child 3	
Child 4	
Child 5	

Which of the following best describes what you mainly do?

- Work full-time
- Work part-time or casual
- Student (you may also be working part time to support your study)
- Unemployed and looking for work
- Full-time home duties
- Retired
- Sick or on a disability pension
- Other (please specify) _____

What do you estimate your weekly (or annual) **personal** income was last year, before taxes?

- Negative income
- Nil income
- $1-$199 ($1-$10,399)
- $200-$299 ($10,400-$15,599)
- $300-$399 ($15,600-$20,799)
- $400-$599 ($20,800-$31,199)
- $600-$799 ($31,200-$41,599)
- $800-$999 ($41,600-$51,999)
- $1,000-$1,249 ($52,000-$64,999)
- $1,250-$1,499 ($65,000-$77,999)
- $1,500-$1,999 ($78,000-$103,999)
- $2,000-$2,499 ($104,000-$129,999)
- $2,500-$2,999 ($130,000-$155,999)
- $3,000-$3,499 ($156,000-$181,999)
- $3,500-$3,999 ($182,000-$207,999)
- $4,000 or more ($208,000 or more)
- Don't know
- Prefer not to say

During a normal week how much money do you have per week for recreational activities? (That is, after you've paid your bills, rent/mortgage and groceries, along with other expenses). If you are unsure, please take your best guess.

- $0
- $1-$25
- $26-$50
- $51-$75
- $76-$100
- $101-$150
- $151-$200
- $201-$250
- $251-$300
- $301-$400
- $401-$500
- $501-$750
- $751-$1,000
- More than $1000
- Prefer not to say
- Don't know

In the last 12 months, roughly how much money did you place on each of the following activities **in a typical month?**

This means money that you have invested and does not count recycling wins. So if you deposited $20, then won $50, your answer would be $20.

Please enter your response in Australian dollars, using whole numbers only. If you are unsure, please take your best guess.

	$
Instant scratch tickets (scratchies)	
Bingo	
Lotto / lottery games like Powerball	
Keno	
Poker	
Poker machines (pokies)	
Sports betting	
Race betting	
Other casino table games (such as roulette, but not poker)	

In terms of your gambling over the last 12 months, which of the following statements is most accurate for you?

Note: online gambling refers to gambling via websites, including smartphone, tablet and smart television apps. Offline refers to bets placed via telephone calls, or in land-based venues.

- I have only gambled online in the last 12 months
- I have mostly gambled online, but I have sometimes gambled offline
- About half of my gambling has been online and half has been offline
- I have mostly gambled offline, but I have sometimes gambled online
- I have only gambled offline in the last 12 months

Considering **the last 12 months**, did you experience any of the following as a result of your gambling?

	No	Yes
Reduction of my available spending money	O	O
Reduction of my savings	O	O
Less spending on recreational expenses such as eating out, going to the movies or other entertainment	O	O
Had regrets that made me feel sorry about my gambling	O	O
Felt ashamed of my gambling	O	O
Sold personal items	O	O
Increased credit card debt	O	O
Spent less time with people I care about	O	O
Felt distressed about my gambling	O	O
Felt like a failure	O	O

Please indicate on a scale from 1 (never) to 7 (always) how often you engaged in the following behaviours

	1 (Never)	2	3	4	5	6	7 (Always)
I considered the amount of TIME I was willing to spend BEFORE I gambled	O	O	O	O	O	O	O
I considered the amount of MONEY I was willing to lose BEFORE I gambled	O	O	O	O	O	O	O
I only spent TIME gambling that I could afford to spend	O	O	O	O	O	O	O
I only gambled with MONEY that I could afford to lose	O	O	O	O	O	O	O
I was honest with my family and/or friends about the amount of TIME I spent gambling	O	O	O	O	O	O	O
I was honest with my family and/or friends about the amount of MONEY I spent gambling	O	O	O	O	O	O	O
I felt in control of my gambling behavior	O	O	O	O	O	O	O

Please indicate on a scale from 1 to 7 how much you disagree or agree with the following statements.

	1 (Strongly Disagree)	2	3	4	5	6	7 (Strongly Agree)
It's my responsibility to spend only money that I can afford to lose	O	O	O	O	O	O	O
I should be aware of how much MONEY I spend when I gamble	O	O	O	O	O	O	O
I should only gamble when I have enough money to cover all my bills first	O	O	O	O	O	O	O
I should be able to walk away from gambling at any time	O	O	O	O	O	O	O
If I gamble more often, it will help me to win more than I lose	O	O	O	O	O	O	O
My chances of winning get better after I have lost	O	O	O	O	O	O	O

Gambling is a good way to make money	O	O	O	O	O	O	O

Below is a list of things that some people have said about gambling. Please select one box for each statement to show how much you agree or disagree with each one.

	Strongly Disagree	Disgree	Neither agree nor disagree	Agree	Strongly Agree
There are too many opportunities for gambling nowadays	O	O	O	O	O
People should have the right to gamble whenever they want	O	O	O	O	O
Gambling should be discouraged	O	O	O	O	O
Most people who gamble do so sensibly	O	O	O	O	O
Gambling is a fool's game	O	O	O	O	O
Gambling is dangerous for family life	O	O	O	O	O
Gambling is a harmless form of entertainment	O	O	O	O	O
Gambling is an important part of cultural life	O	O	O	O	O
Gambling is a waste of time	O	O	O	O	O
On balance, gambling is good for society	O	O	O	O	O
Gambling livens up life	O	O	O	O	O
It would be better if gambling was banned all together	O	O	O	O	O
Gambling is like a drug	O	O	O	O	O
Gambling is good for communities	O	O	O	O	O

How frequently do you:

	Not in the past year	Less that once a month	Once a month	Once a fortnight	Once a week	Multiple times a week	Daily
Smoke cigarettes	O	O	O	O	O	O	O
Drink alcohol	O	O	O	O	O	O	O

Who are the most influential people in your life?

- This differs for everyone. They could be:

Your mum

Your friends

Your colleagues

- Or anyone! Neighbours, partners, etc.
- We want to know about these people in your life.

What will we ask?

- We want to know about the **20 people who were most influential in your life over the last 12 months.**
- For each of the 20 people, we'll ask some short questions about them, like:
  - Who they are to you (family, friend, colleague, etc)
  - Some basic demographics
  - Some of their behaviours

- **<u>These 20 people must all be adults, i.e., aged 18+</u>**

- If you're unsure about anything, please take your best guess.

Relationships between people

- For each of the 20 people, we'll also ask you to rate how close you are to each of them.
- Finally, we'll ask how close each of them are to each other. For example, some of your friends might be close to each other, but not very close with your family. We want to understand your networks.

We'll ask for their names

- The only reason we're doing this is to make the survey easy to answer. So a question might ask "How close is James to Peter?"
- You don't have to use real names. You can use nicknames if you like. They're just there in the survey to make life easier for you.
- The first thing we do when we analyse your data will be to delete these names. Your anonymity, and the anonymity of those around you, is crucial to us.

We would now like to ask you about the adults who you considered the most important in your life **within the last 12 months**.

These people must be over the age of 18.

Please complete the following questions about the 20 most influential adults in your life **within the last 12 months**; and indicate how close you are with each of them, from "not particularly close" to "extremely close".

If you're struggling to think of 20 adults who have been influential in your life **in the last 12 months**, think of your immediate and extended family, friends from various social circles, romantic partners, work colleagues, neighbours and so on.

If you still have not made it to 20 adults who have been particularly influential in your life **in the last 12 months**, fill the remaining names with those of adults around you who are not particularly influential, and indicate that they are "not particularly close" to you.

It's very important that you put the correct names here, because the rest of the survey is based around these names. If you don't put the correct names in, the rest of the survey will not work properly. We care about your anonymity and will delete these names when we analyse the data.

	What is their first name or nickname?
Person 1[13]	
Person 2	
…	
Person 20	

[13] For the purpose of this report we simplified the copy of the survey instrument. For example, rather than presenting all 20 rows we add a row of ellipses to indicate the table contained 20 rows for person 1 to person 20.

Please complete the following questions about the 20 most influential adults in your life **within the last 12 months.**

	How close are you with each of these people?	What is your relationship with each of these people?	What is their gender?	How many years have you known them?
Person 1	• Not particularly close • Somewhat close • Very close • Extremely close	• Mother • Brother • Sister • Father • Other family member • Friend • Colleague • Spouse • Romantic partner (other than spouse) • Housemate	• Male • Female	_____
Person 2	• Not particularly close • Somewhat close • Very close • Extremely close	• Mother • Brother • Sister • Father • Other family member • Friend • Colleague • Spouse • Romantic partner (other than spouse) • Housemate	• Male • Female	_____
…				
Person 20	• Not particularly close • Somewhat close • Very close • Extremely close	• Mother • Brother • Sister • Father • Other family member • Friend • Colleague • Spouse • Romantic partner (other than spouse) • Housemate	• Male • Female	_____

What is the age (years) of these people?

	What is their age (years)?
Person 1	
Person 2	
…	
Person 20	

For each of these 20 people please indicate how often you think they smoked cigarettes in the last 12 months.

	Not in the past year	Less than once a month	Once a month	Once a fortnight	Once a week	Multiple times a week	Daily
Person 1							
Person 2							
…							
Person 20							

For each of these people please indicate how often you smoked cigarettes WITH them in the last 12 months.

	Not in the past year	Less than once a month	Once a month	Once a fortnight	Once a week	Multiple times a week	Daily
Person 1							
Person 2							
…							
Person 20							

For each of these 20 people please indicate how often you think they drank alcohol in the last 12 months.

	Not in the past year	Less than once a month	Once a month	Once a fortnight	Once a week	Multiple times a week	Daily
Person 1							
Person 2							
…							
Person 20							

For each of these people please indicate how often you drank alcohol WITH them in the last 12 months.

	Not in the past year	Less than once a month	Once a month	Once a fortnight	Once a week	Multiple times a week	Daily
Person 1							
Person 2							
…							
Person 20							

For each of these 20 people please indicate how often you think they gambled in the last 12 months.

Only think about gambling forms **other than lottery games (such as powerball), scratchies and bingo**. That is, focus **only** on pokies, sports betting, race betting, keno, casino-type games and playing cards for money.

	Not in the past year	Less than once a month	Once a month	Once a fortnight	Once a week	Multiple times a week	Daily
Person 1							
Person 2							
…							
Person 20							

For each of these people please indicate how often you gambled WITH them in the last 12 months.

Only think about gambling forms **other than lottery games (such as powerball), scratchies and bingo**. That is, focus **only** on pokies, sports betting, race betting, keno, casino-type games and playing cards for money.

	Not in the past year	Less than once a month	Once a month	Once a fortnight	Once a week	Multiple times a week	Daily
Person 1							
Person 2							
…							
Person 20							

Now we will ask you what form of gambling each gambler in your network most engaged in over the last 12 months.

Please also indicate how many harms you think their gambling caused them over the last 12 months, from no harm, to minor harm, to moderate harm, to severe harm.

	Level of harm due to gambling experienced over the last 12 months	Form of gambling they most engaged in over the last 12 months
Person 1	• No harm • Minor harm • Moderate harm • Severe harm	• Keno • Poker • Poker machines (pokies) • Sports betting • Racebetting • Other casino table games (such as roulette, but not poker)
Person 2	• No harm • Minor harm • Moderate harm • Severe harm	• Keno • Poker • Poker machines (pokies) • Sports betting • Racebetting • Other casino table games (such as roulette, but not poker)
…		
Person 20	• No harm • Minor harm • Moderate harm • Severe harm	• Keno • Poker • Poker machines (pokies) • Sports betting • Racebetting • Other casino table games (such as roulette, but not poker)

Thanks for your participation so far.

Now we're onto the last section. Here we're going to ask you about the relationships between the people closest in your life. This is where we build your social network.

Please indicate the closeness of the relationship between ${PERSON 1} and the following people.

	Not particularly close	Somewhat close	Very close	Extremely close
${PERSON 2}	O	O	O	O
${PERSON 3}	O	O	O	O
…	O	O	O	O
${PERSON 20}	O	O	O	O

How about between ${PERSON 2} and the following? [14]

	Not particularly close	Somewhat close	Very close	Extremely close
${PERSON 3}	O	O	O	O
${PERSON 4}	O	O	O	O
…	O	O	O	O
${PERSON 20}	O	O	O	O

Thank you for your participation so far. We're now on to the last few questions.

[14] Additional questions were asked for each person (from person 3 to person 20) to indicate the respective persons closeness to all other alters. For simplicity we have not presented the questions here, however they followed the same structure and format as the two tables presented above. See section 5.3.4 of the report for further details.

How many other people are there in your network who are influential to your gambling, and who you haven't already listed?

- 0
- 1
- 2
- 3
- 4
- 5 or more

Please complete the following information about these individuals who are influential to your gambling, but weren't listed here. Only include people here who are over the age of 18.

	What is your relationship with each of these people?	What is their gender?
Person 1	• Mother • Brother • Sister • Father • Other family member • Friend • Colleague • Spouse • Romantic partner (other than spouse) • Housemate	• Male • Female
Person 2	• Mother • Brother • Sister • Father • Other family member • Friend • Colleague • Spouse • Romantic partner (other than spouse) • Housemate	• Male • Female
…		
Person 5	• Mother • Brother • Sister • Father • Other family member • Friend • Colleague • Spouse • Romantic partner (other than spouse) • Housemate	• Male • Female

And what is their age?

	Age (years)
Person 1	
Person 2	
Person 3	
Person 4	
Person 5	

Thank you so much!

- We really appreciate you taking the time to help us with our research.
- We cannot provide individual results, but aggregated results will be available on the website for the Victorian Responsible Gambling Foundation early next year:
- https://www.responsiblegambling.vic.gov.au
- Please click through to the next page to finish the survey.

That brings us to the end of the survey. Thank for you taking the time to participate.

If you are experiencing discomfort you can contact Gambler's Help on 1800858858 or www.gamblinghelponline.org.au.

These are free and confidential telephone/online help services that operate 24 hours a day, 7 days a week

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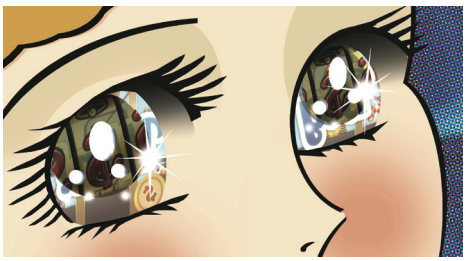

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Let us know what you'd like to read

If you have ideas for themes or stories for *Inside gambling*, we would love to hear from you. Go to: **insidegambling.com.au/contact-us**

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