Using Misconceptions to Improve Engagement and Preventative Effects Within Gambling Education.

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Statement of Originality

This is to certify that to the best of my knowledge, the content of this thesis is my own work. This thesis has not been submitted for any degree or other purposes. I certify that the intellectual content of this thesis is the product of my own work and that all the assistance received in preparing this thesis and sources have been acknowledged. Ethics approval for the three experimental studies reported in this thesis was approved from the University of Sydney's Human Research Ethics Committee and the Sydney Catholic Schools Research Office (Appendix A).

______________________________	27 / 06 / 2019
Brittany Keen	Date

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Thesis Abstract

Educational programs that aim to prevent gambling problems typically focus on promoting gambling as a risky behaviour with harmful consequences. However, young people tend not to engage with fear-based messaging as they cannot personally relate to the individuals described. Gambling-related misconceptions play a key role in the development and maintenance of gambling problems and learning important gambling mathematics concepts may reduce the likelihood of misconception development. Incorporating gambling misconceptions into education may improve youth engagement by providing a developmental account of gambling problems, which is more relevant to young audiences. Additionally, the pedagogical literature suggests misconceptions are important in learning complex new material like probabilities and statistics. This research aimed to test if educating young people about gaming machine misconceptions improved their engagement with educational content and understanding of gambling mathematics; and if it might reduce existing misconceptions in adult gaming machine gamblers. Three educational animations were developed: risk awareness, information only, and cognitive misconceptions. Results indicated that the Misconceptions video was not more engaging than the other videos amongst young audiences who largely did not gamble, but did result in significant reductions in misconceptions and improved understanding of gambling mathematics amongst regular gaming machine players. The current results suggest that young people who are not heavily involved in gambling may prefer reductive information about gaming machines, however, this type of information is the least likely to produce preventive effects. Gambling education is best delivered by stratifying complexity of information over time, in line with people's development and relative gambling experiences. Incorporating gambling education into the mathematics curriculum may be one such way to ensure crucial information about mathematical game design is conveyed but may require a blended approach with multi-media and a trained facilitator.

Future research should aim to develop a foundational understanding of adolescent gambling harm as most adolescents in the current research did not gamble and those who did wagered very small amounts.

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List of Publications and Authorship Attribution Statements

Chapters 2 and 3 has been published in peer-reviewed journals. Publications are presented in their respective chapters in text format with the appropriate citation. Chapters that include published material are replicate versions of the published material, except for minor changes that were made to enhance the readability and overall flow of the thesis as a whole.

Chapter 2: Keen, B., Blaszczynski, A., & Anjoul, F. (2017). Systematic review of empirically evaluated school-based gambling education programs. *Journal of Gambling Studies, 33*(1), 301-325. https://doi.org/10.1007/s10899-016-9641-7

Contribution: I was responsible for designing the methodology and carrying out the systematic review and contributing to the bulk of the interpretation and write-up.

Chapter 3: Keen, B., Anjoul, F., & Blaszczynski, A. (2019). How learning misconceptions can improve outcomes and youth engagement with gambling education programs. *Journal of Behavioral Addictions*, 1–12. doi: 10.1556/2006.8.2019.56

Contribution: I was responsible for designing the overall structure of the review and conducting a majority of the literature review and writing.

In addition to the statements above, in cases where I am not the corresponding author of a published item, permission to include the published material has been granted by the corresponding author.

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As supervisor for the candidature upon which this thesis is based, I can confirm that the authorship attribution statements above are correct.

26 / 06 / 2019

Prof Alex Blaszczynski Date

1 Chapter One: Introduction

1.1 Gambling

Nearly two-thirds (64%) of Australians gamble each year, and 39% do so on a regular basis (Armstrong & Carroll, 2017; Dowling et al., 2016; Gainsbury et al., 2015). Although most people gamble without problems, a small minority exhibit difficulty limiting the amount of time and money they spend gambling and suffer significant harm as a result. Problem gambling is a recognised public health issue in Australia which can result in significant psychological and social implications, as well as health care cost burdens (Browne et al., 2017; Gainsbury et al., 2014; Productivity Commission, 2010; Splevins, Mireskandari, Clayton, & Blaszczynski, 2010). Recent population estimates suggest that between 0.4% and 1.1% of Australians meet criteria for problem gambling (Armstrong & Carroll, 2017; Dowling et al., 2016; Markham, Young, Doran, & Sugden, 2017). International problem gambling prevalence rates vary considerably between countries and jurisdictions due to methodological, cultural, and legislative differences; with a recent systematic review finding the lowest rates in Switzerland (0.12%) and the highest rates in Hong Kong (5.8%)(Calado & Griffiths, 2016). Other meta-analyses have suggested similar findings with low rates in Denmark, the Netherlands, and Germany, intermediate rates in Australia, and high rates in Asia (Williams, Volberg, & Stevens, 2012).

Although more Australians gamble on forms associated with low problem prevalence, such as lotteries and scratch cards (Dowling et al., 2016; Gainsbury et al., 2015) the vast majority of gambling expenditure is spent on electronic gaming machines (EGMs) (Queensland Treasury and Trade, 2018). Accordingly, EGMs are over-represented among treatment-seeking gamblers and constitute the bulk of the burden of gambling-related harm (Productivity Commission, 2010).

What constitutes gambling – as well as the varying levels of harm experienced by gamblers – is denoted by several different terms throughout the academic literature and over the course of history. For the purpose of this thesis, we accept that gambling harm occurs on a continuum, and adopt and adapt the terms and definitions outlined by Blaszczynski et al., (2016):

Gambling: The voluntary staking of something of value (usually money) by a party, on an outcome determined wholly or partially by chance that can result in monetary loss or gain for the party.

Gambling-related Harm: Any negative consequence associated with gambling that can be considered as having a significant detrimental effect on an individual or societal domain.

Problem Gambling: Excessive expenditure of money and/or time on gambling that leads to adverse consequences for the gambler, others, or for the community. This may be an appropriate term for those who meet criteria for a Gambling Disorder as well as those who score in the sub-clinical ranges on problem gambling screening tools.

Gambling Disorder: This is the term used in the latest edition of the American Psychiatric Association (APA) Diagnostic and Statistical Manual of Mental Disorders-fifth edition (DSM-5; APA, 2013) in classifying individuals meeting criteria for a diagnosis of a Gambling Disorder within the Non-Substance-Related Behaviour subcategory of the group of Substance Related and Addictive Disorders.

1.1.1 **Adolescent Gambling**

Most Australians' first gambling experiences happen during adolescence (Delfabbro, Lahn, & Grabosky, 2005; Delfabbro, Lambos, King, & Puglies, 2009; Delfabbro, Winefield, & Anderson, 2009; Purdie, Matters, Hillman, Ozolins, & Millwood, 2011; Splevins et al., 2010). Several research studies report problem gambling rates amongst adolescents to be 3-10 times higher than those found in adults (Derevensky & Gupta, 2000; Gupta et al., 2013;

Purdie et al., 2011; Splevins et al., 2010; Welte, Barnes, Tidwell, & Hoffman, 2008). This would suggest that adolescents represent a subpopulation of great interest to those tasked with the objective of preventing or reducing gambling-related harm in the community.

1.1.2 Gambling Harm Prevention

Prevention initiatives for gambling-related harm take many forms, often targeting young people, and can be broad, state- or nation-wide campaigns involving advertisements, public service announcements, and educational programs, or targeted initiatives with captive audiences such as at-risk youth (Ladouceur, Goulet, & Vitaro, 2013; Messerlian, Derevensky, & Gupta, 2005). However, the particular method of delivery and target audience depend on what stage of intervention the initiative falls into.

Historically, community prevention efforts referred to preventing or delaying the onset of potential risky behaviours such as alcohol and drug use. However, health professionals and experts have become increasingly concerned about the effectiveness of abstinence-based approaches in preventing harm, and most initiatives now incorporate a *harm-reduction* approach. The harm reduction framework was borne from a public health perspective as an alternative to the disease model of addiction and risky behaviour (Marlatt, 1996). The central tenets focus on reducing harm whilst assuming that the behaviour continues. Examples of harm reduction approaches in other fields include clean needle and syringe programs for injecting drug users, pill-testing services, medical benefits schemes for oral contraception medication, and methadone clinics for heroin users. The shift from abstinence to harm reduction in gambling has been reflected by commensurate policy changes, for example a cap on the number of available EGMs as opposed to prohibition of gambling.

The Victorian Responsible Gambling Foundation (VRGF) has provided a public health framework to reduce gambling-related harm which refers to three stages of prevention;

primary, secondary, and tertiary prevention of gambling harm (VRGF, 2015). We extend this conceptualisation in this thesis, and propose alternative terms to encompass three broad *opportunities for intervention*: 1) preventing the occurrence of gambling-related harm, 2) minimising gambling-related harm, and 3) treating gambling-related harm.

1.1.2.1 Preventing occurrence.

For the purposes of this thesis, we describe the aim of primary prevention interventions as preventing gambling-related harm before it occurs. In order to do so, such programs must target non-gamblers and non-problem gamblers, and may be appropriate for young people early in their gambling experiences. Examples of primary prevention interventions include advertising campaigns on television and in print, public service announcements, and educational initiatives including those delivered in school settings.

1.1.2.2 Minimising harm.

We describe the aim of second-tier interventions as minimising any harm already experienced by gamblers while assuming the behaviour continues. This definition is drawn from the harm reduction literature around drug use (i.e. needle and syringe programs; Marlatt, 1996). Second-tier programs may be appropriate for gamblers who exhibit at-risk behaviours or are already experiencing early stages of harm and aim to prevent gamblers from progressing to the Gambling Disorder stage. Such initiatives may focus on reducing the amount of money people spend when they gamble by altering gambling environments and encouraging responsible gambling practices (thus reducing harm but not behaviour). For example, removing ATMs from gambling areas and encouraging account holders to set limits on online betting platforms.

1.1.2.3 Treatment.

The primary aim of treatment interventions is defined here as providing therapeutic aid for those with gambling problems who are experiencing a more severe level of harm.

They may include medical, psychological, emotional, social and financial interventions. Treatment interventions may be appropriate for gamblers already experiencing harm and seeking help, and those who meet criteria for a Gambling Disorder.

1.1.3 Gambling Education

Gambling education may be categorised as either a primary harm prevention measure or secondary harm-minimisation measure depending on the target audience and content (Ladouceur et al., 2013).

1.1.3.1 Primary prevention: Children and non-problem gamblers

Typically, educational strategies designed to prevent gambling-related harm are aimed at adolescents or young adults who have not yet gambled or are in the early stages of gambling experiences. Examples of preventative strategies include public awareness campaigns, school programs, and television advertisements which may aim to provide information to delay or prevent the onset of gambling, or raise awareness of the harms associated with gambling problems. Preventative educational programs for adolescents are often implemented in school settings, because they represent appropriate sites for dissemination of information to young people in society (Monaghan, 2008). However, few school-based educational programs have demonstrated success in preventing young people from developing gambling problems (Keen et al., 2016; Ladouceur et al., 2013; Oh et al., 2017, Productivity Commission 2010).

1.1.3.2 Targeted harm reduction education: Gamblers

Educational initiatives may also be considered as second-tier harm minimisation when targeted at at-risk groups or frequent gamblers (e.g. educational pamphlets in gambling venues, help websites, etc.). In these instances educational content may be focused on providing information around awareness of gambling problems and help services in order to provide early intervention and reduce the likelihood that an individual would progress from the at-risk to problem gambling stage.

Similar to adolescents, university (or ‘college’) students represent a high-risk group for gambling problems (Nowak & Aloe, 2014) and so several education programs have also been implemented and evaluated in university (college) settings amongst young adults. Education for regular gamblers generally includes government websites, print pamphlets, and television advertisements for treatment services.

Consistent with efforts to prevent harm associated with other risky behaviours such as alcohol and substance use, sexual activity, and recklessly operating a motor vehicle (Bachman et al., 2008; Noar, Palmgreen, Chabot, Dobransky, & Zimmerman, 2009; Vivancos, Abubakar, Phillips-Howard, & Hunter, 2013), education initiatives have been developed to warn people of the risks and consequences and to encourage good decision making when gambling (see Keen, Blaszczynski, & Anjoul, 2016; Ladouceur et al., 2013 for reviews). However, of the small proportion of gambling education programs that have been empirically evaluated, their ability to prevent gambling problems remains questionable (Keen et al., 2016; Ladouceur et al., 2013; Oh, Ong, & Loo, 2017; Productivity Commission, 2010). Educational programs that have focused on a ‘just-say-no’ messaging surrounding alcohol and drug use in schools have shown to be ineffective despite billion dollar budgets (Ennett, Tobler, Ringwalt, & Flewelling, 1994; McNeal & Hansen, 1995; West & O’Neal, 2004). Similarly, messages about harmful consequences of gambling may not resonate with young people (Hastings, Stead, & Webb, 2004) reducing personal relecance and engagement with edcational messages which reduces relevance and personal engagement with the message (Goldberg, Bents, Bosworth, Trevisan, & Elliot, 1991; Higbee, 1969; Martin & Kamins, 2010).

Gambling education has the potential to represent an effective method of preventing and reducing harm amongst various target populations (i.e. non-gamblers and at-risk gamblers, respectively), however current evidence suggests adjustments may need to be made to the messaging content in order to achieve these aims.

1.2 Aims of the Thesis

The overall aims of the current thesis were to review, develop, and test new methods to improve engagement with educational programs that aim to prevent gambling problems. Specifically, this research aimed to:

1) Systematically review the current standard of empirically evaluated school-based gambling education programs with adolescents.
2) Determine gaps in the current state of programs identified in Aim 1 and develop recommendations for improvements to such programs through a comprehensive review of etiological perspectives of problem gambling and pedagogical insights.
3) Develop and test educational material based on the rationale identified in Aim 2 via a series of experimental studies comparing educational material amongst developmentally progressive samples: adolescents, young adults, and adult gamblers.

1.3 Thesis Structure

The current thesis focuses specifically on the role of education in gambling harm prevention and reduction. Examples in this thesis are drawn primarily from electronic gaming machines (EGMs) as approximately half (51%) of gambling expenditure in Australia is derived from EGMs (Queensland Treasury and Trade, 2018), and gaming machines are over-represented as the preferred form among treatment seeking problem gamblers (Productivity Commission, 2010). Throughout the thesis, the terms EGMs, gaming machines, poker machines, and the more colloquial term ‘pokies’ are used to refer to Electronic Gaming Machines in Australia.

The second chapter of this thesis describes the findings of a systematic review of empirically evaluated gambling education programs delivered in school settings. The third chapter provides an account of some of the issues of current education programs, including problems with youth engagement as well as robust preventive effects. Chapter 3 also provides a rationale for including gambling misconceptions in education strategies to enhance youth engagement and improve understanding of gambling education material. Chapter 4 constitutes a common methodology, which includes descriptions of the design, measures, and procedures of each of the three studies that form the basis of this thesis. Following this, are the three corresponding experimental results chapters which aimed to test the rationale outlined in Chapter 3. Chapters 5, 6, and 7 describe the analyses and results of each of the three studies, grouped by the samples used; adolescents, first-year university students, and adult regular electronic gaming machine gamblers. The final section of this thesis, Chapter 8 provides a common discussion that incorporates and synthesises results from all three experimental studies drawing on references to previous literature. The discussion chapter also details some of the limitations and implications of the current research, as well as general conclusions and suggestions for future research. Each chapter is prefaced with a brief preamble and ends with a chapter summary. Figure 1.1 provides an illustration of the overview of this thesis.

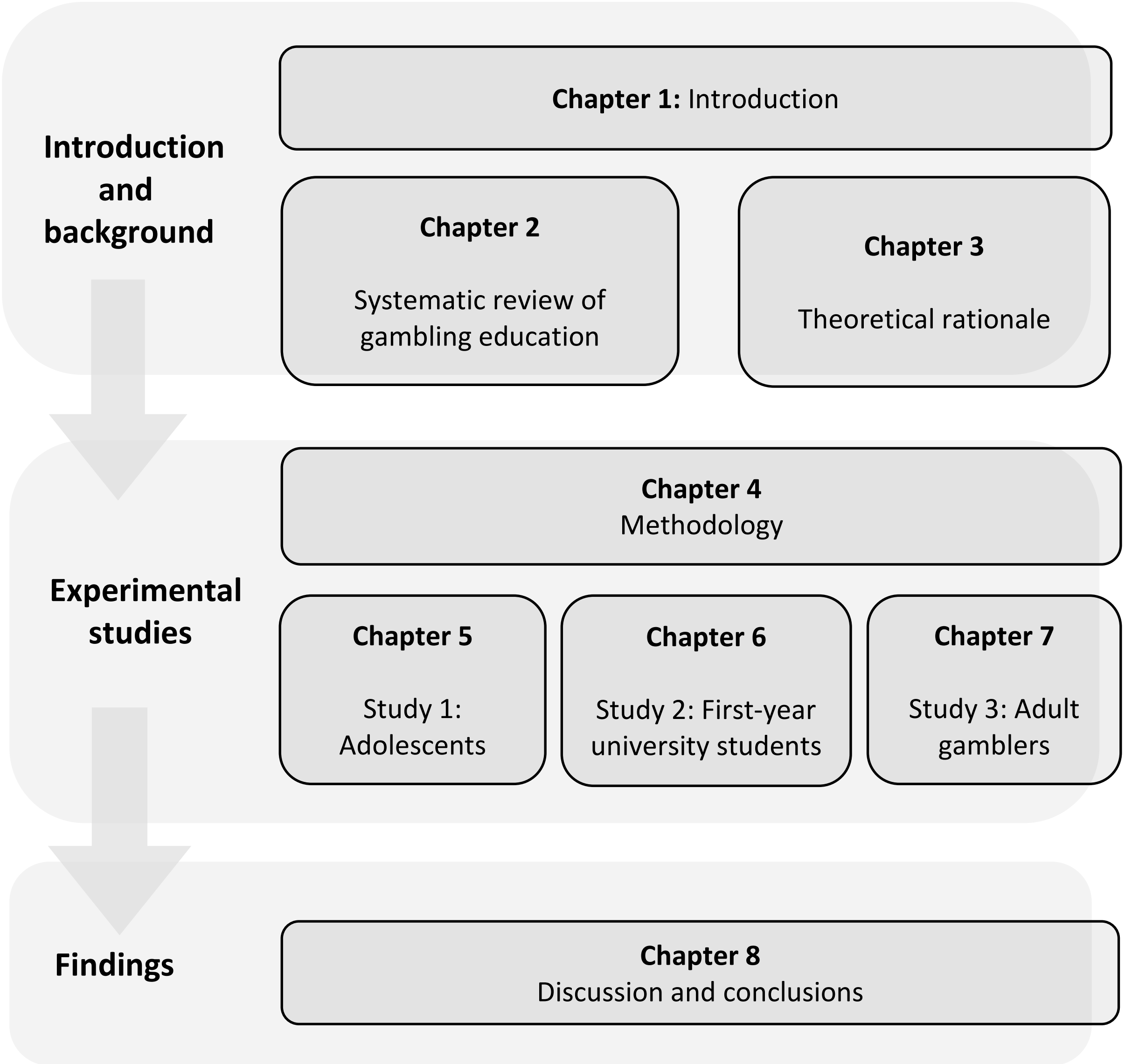

Figure 1.1 Overview of thesis

1.4 Chapter Summary

This chapter provided a broad introduction to gambling, adolescent gambling, and efforts to prevent and reduce harm including education. It described the overall aims of the thesis and the structure of how each objective will be met. The following chapter includes a published paper that systematically reviewed the literature on empirically evaluated school-based gambling education programs. It provides detailed background information on current empirical evaluations of gambling education and serves as a suitable foundation for the current research.

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2 Chapter Two: Systematic Review

Systematic Review of Empirically Evaluated School-Based Gambling Education Programs.

Preamble: This chapter contains the findings of a systematic review of gambling education programs conducted in school settings. Studies that empirically evaluated such programs were included in the review which discusses the overall quality of the research, summarises the methodological approaches used, delivery and content of programs, and provides comments and recommendations on the development and evaluation of future gambling education programs. This systematic review focuses solely on school-based gambling education programs predominantly constituting primary prevention approaches, as this thesis work is largely concerned with primary prevention efforts and how to improve them. However, the research outlined throughout the rest of this thesis discusses the effects of educational material in developmentally progressive age groups. It was important to understand how education influences people who are at different stages of risk for gambling harms because this information helps determine which components of educational programs may have the most impact and should therefore be included in prevention initiatives.

Publication: The work in this chapter has been published as a peer-reviewed manuscript in the Journal of Gambling Studies: Keen, B., Blaszczynski, A., & Anjoul, F. © (2016). Systematic review of empirically evaluated school-based gambling education programs. *Journal of Gambling Studies*, *33*(1), 301–325. doi:10.1007/s10899-016-9641-7.

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Minor modifications have been made to the manuscript to reduce repetition and improve clarity of the thesis as a whole. I was responsible for designing the methodology and carrying out the systematic review and contributing to the bulk of the interpretation and write-up. The published manuscript can be accessed at the journal's website.

2.1 Abstract

Adolescent problem gambling prevalence rates are reportedly five times higher than in the adult population. Several school-based gambling education programs have been developed in an attempt to reduce problem gambling among adolescents; however, few have been empirically evaluated. The aim of this review was to report the outcome of studies empirically evaluating gambling education programs across international jurisdictions. A systematic review searching five academic databases, PubMed, Scopus, Medline, PsycINFO, and ERIC, was conducted following guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement. A total of 20 papers and 19 studies were included after screening and exclusion criteria were applied. All studies reported intervention effects on cognitive outcomes such as knowledge, perceptions, and beliefs. Only nine of the studies attempted to measure intervention effects on behavioural outcomes, and only five of those reported significant changes in gambling behaviour. Of these five, methodological inadequacies were commonly found including brief follow-up periods, lack of control comparison in post hoc analyses, and inconsistencies and misclassifications in the measurement of gambling behaviour, including problem gambling. Based on this review,

recommendations are offered for the future development and evaluation of school-based gambling education programs relating to both methodological and content design and delivery considerations.

2.2 Introduction

2.2.1 Prevalence of Adolescent Gambling

Despite legal age requirements, most Australians have gambled before the age of 15 (Delfabbro, Lahn, & Grabosky, 2005; Delfabbro, Lambos, King, & Puglies, 2009; Delfabbro, Winefield, & Anderson, 2009; Purdie, Matters, Hillman, Ozolins, & Millwood, 2011; Splevins, Mireskandari, Clayton, & Blaszczynski, 2010). Although the majority gamble recreationally, studies have reported the prevalence of problem gambling among adolescent subpopulations to be three to ten times higher than that of adults (Derevensky & Gupta, 2000; Gupta et al., 2013; Purdie et al., 2011; Splevins et al., 2010; Welte, Barnes, Tidwell, & Hoffman, 2008). Additionally, adolescents are more likely to gamble on the Internet (Olason et al., 2011), which may place them at risk for more severe harms compared to those who gamble on land-based forms (Griffiths & Barnes, 2008).

Such elevated rates of gambling problems have generated substantial interest in developing and implementing preventive measures among children and adolescent populations (Ladouceur, Goulet, & Vitaro, 2013). Although some measures are administered outside of schools (e.g., in youth centres, community initiatives, juvenile justice system), the majority of educational programs have been carried out in primary and secondary school settings, either incorporated into education curricula, or offered as stand-alone workshops. Despite the effort and expenditure directed toward their delivery, few programs have been assessed and evaluated (Productivity Commission, 2010).

A recent review of gambling education programs criticised the lack of long-term follow-ups and behavioural measures in program evaluations (Ladouceur et al., 2013). These authors concluded that at best, current programs are effective at reducing misconceptions and increasing knowledge about gambling in the short-term but their longitudinal impact on gambling-related harms and incidence of Gambling Disorders remain unknown (Ladouceur et al., 2013).

2.2.2 Universal prevention versus targeted intervention.

Ladouceur and colleagues (2013) argued that gambling education programs generally adopt one of two approaches: *universal* or *targeted*. Universal prevention programs are aimed at youth, regardless of risk or gambling status. In contrast, targeted programs are aimed specifically at at-risk or problem gamblers. The presumed benefit of the latter is that such interventions can be directed and specifically tailored to those needing it most. The disadvantage is the potential failure for a proportion of non-identified problem gamblers to be offered appropriate support (Ladouceur et al., 2013). Tailored programs more closely represent treatment options for at-risk groups, whereas universal programs can be seen as genuine *primary prevention* initiatives. This review focuses solely on primary prevention programs which were carried out with adolescents in school settings, and so targeted approaches are not discussed.

Although evidence suggests gambling from an early age is associated with more severe gambling problems (Jiménez-Murcia et al., 2010), longitudinal studies have reported that adolescent problem gambling does not predict adult problem gambling (Delfabbro, King, & Griffiths, 2014; Delfabbro, Winefield, et al., 2009; Slutske, Jackson, & Sher, 2003). Despite inconsistent findings that risk factors in adolescents and children predict adult gambling problems, the available evidence indicates that exposure to multiple factors and experiences in the formative stages of adolescent development can shape subsequent attitudes, cognitions and behaviours in adulthood (Sroufe, Coffino, & Carlson, 2010). Although the mechanism of impact remains unclear, there is a basis for arguments favouring the implementation of early intervention preventative educational programs in schools.

Irrespective of which approach is adopted, there are general guidelines for program development to increase potential effectiveness. Nation et al. (2003) reviewed prevention strategies in substance use, sexual health, school failure, and delinquency. These authors identified nine characteristics of effective interventions: 1) comprehensive coverage of material; 2) inclusion of varied teaching methods; 3) provision of sufficient dosage; 4) theoretical justification; 5) establishment of positive relationships; 6) appropriate timing, 7) socio-cultural relevance; 8) inclusion of outcome evaluations; and 9) well-trained staff. It is argued that although community-based initiatives and treatment centres have the ability to deliver gambling education to youth, schools appear to have the necessary resources and capacity to meet several of the above requirements.

The aim of this systematic review was to evaluate existing school-based gambling education programs and offer recommendations for improving research methodology and program effectiveness, respectively. The purpose of focusing on primary prevention initiatives was to provide an appropriate foundation for future work on gambling education as a prevention effort. It was necessary to first describe the current quality of evidence for education as a prevention initiative, including methodological and practical issues which other researchers have faced before important work on development of improved programs could begin.

2.2.3 Current Review

The current review adhered to the stringent systematic search protocols recommended in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group, 2009). It adds seven studies to those reviewed by Ladouceur et al. (2013) and provides an updated resource for the gambling education sector. This review located and critically assessed studies evaluating school-based gambling education programs among youth. Studies were sought that sampled children and adolescents attending primary or secondary school.

2.3 Methodology

2.3.1 Initial Search

The original search was conducted on the 20th January 2016; five databases were searched: PubMed, Scopus, Medline, PsycINFO, and ERIC. The search terms included: gambling, adolescent, teen, child, youth, student, program, intervention, awareness, prevention, school, evaluation, education, and curriculum, as well as all derivatives of the words. No date filter was applied, as it was important to maximise the search for all possible evidence pertaining to gambling education programs.

2.3.2 Selection Criteria

Inclusion criteria: The research was included if it:

a) Empirically evaluated a gambling education program; and
b) Evaluated a program that was administered/implemented in a school setting; and
c) Involved some form of quantitative analysis of pre-post intervention scores; and
d) Reported on primary data; and
e) Sampled youth attending primary or secondary school

Exclusion criteria: Studies were excluded if they:

a) Were not available as full text; or
b) Could not be obtained in English; or
c) Were reviews, or conceptual or opinion pieces reporting no original data; or
d) Reported on programs or interventions that were:
    i. Carried out in a therapeutic setting, or;
    ii. A media campaign or public policy; or
    iii. A public announcement; or

iv. A stand-alone website; or

e) Only reported on qualitative data; or

f) Sampled participants attending colleges or universities.

Grey literature including government reports, industry-commissioned documents, unpublished theses, and conference proceedings were included in the review to reduce the risk of publication bias.

2.4 Results

2.4.1 Study Selection

The original search yielded over 6,000 publications; however only 69 were retained for review (see Figure 2.1). Retained studies were included if they appeared relevant based on their title and abstract. Two independent reviewers assessed all 69 articles and applied the specific inclusion and exclusion criteria. A total of 54 papers were subsequently excluded for not meeting inclusion criteria, leaving 15 included articles. Following this, a snowball method was used to search the references contained in included articles to locate any further studies. Seven additional papers were located, five of which met inclusion criteria, resulting in a total sample of 20 papers (Figure 2.1). Inter-rata reliability between the two reviewers was high, with initial agreement on 95.65% of papers, $\kappa = 0.905$ (95% CI, .800 to 1.00). It should be noted that although 20 papers were included, only 19 studies were reviewed as two papers reported data from the same study. Information for the 19 reviewed studies is summarised in Table 2.1.

2.4.2 Study Characteristics

All programs reviewed were carried out in a school setting. The majority of studies were cluster randomised controlled trials and grouped students either by class or school. Participants were aged between 10 and 18 years old, and sample numbers ranged from 75 to 8,455. Nine of the 19 programs provided one intervention session (Ferland, Ladouceur, &

Vitaro, 2002; Ladouceur, Ferland, & Fournier, 2003; Ladouceur, Ferland, & Vitaro, 2004; Ladouceur, Ferland, Vitaro, & Pelletier, 2005; Lavoie & Ladouceur, 2004; Lemaire, de Lima, & Patton, 2004; Taylor & Hillyard, 2009; Turner, Macdonald, Bartoshuk, & Zangeneh, 2008; Walther, Hanewinkel, & Morgenstern, 2013), two programs provided two to three sessions (Donati, Primi, & Chiesi, 2014; Ferland, Ladouceur, & Vitaro, 2005), and eight of the programs provided more than three sessions (Canale et al., 2016; Gaboury & Ladouceur, 1993; Lupu & Lupu, 2013; Todirita & Lupu, 2013; Turner, Macdonald, & Somerset, 2008; Williams, 2002/Davis, 2003; Williams, Connolly, Wood, Currie, & Davis, 2004; Williams, Wood, & Currie, 2010). Program sessions lasted between 20-120 minutes each, between 20-500 minutes per program (M = 194.71, SD = 3.08) (based on 17 studies that reported session duration) and were delivered over one to ten sessions (M = 3.53, SD = 3.08). All studies measured cognitive outcomes such as knowledge, perceptions, or beliefs, but only nine measured behavioural outcomes (Canale et al., 2016; Donati et al., 2014; Ferland et al., 2005; Gaboury & Ladouceur, 1993; Turner, Macdonald, Bartoshuk, et al., 2008; Walther et al., 2013; Williams, 2002/Davis, 2003; Williams et al., 2004, 2010). Study characteristics are described in Table 2.1. Measures of effect size (Cohen's *d*) are presented where possible where 0.2-0.3 represents a small effect, 0.5 a medium effect, and $\geq$0.8 a large effect (Cohen, 1992).

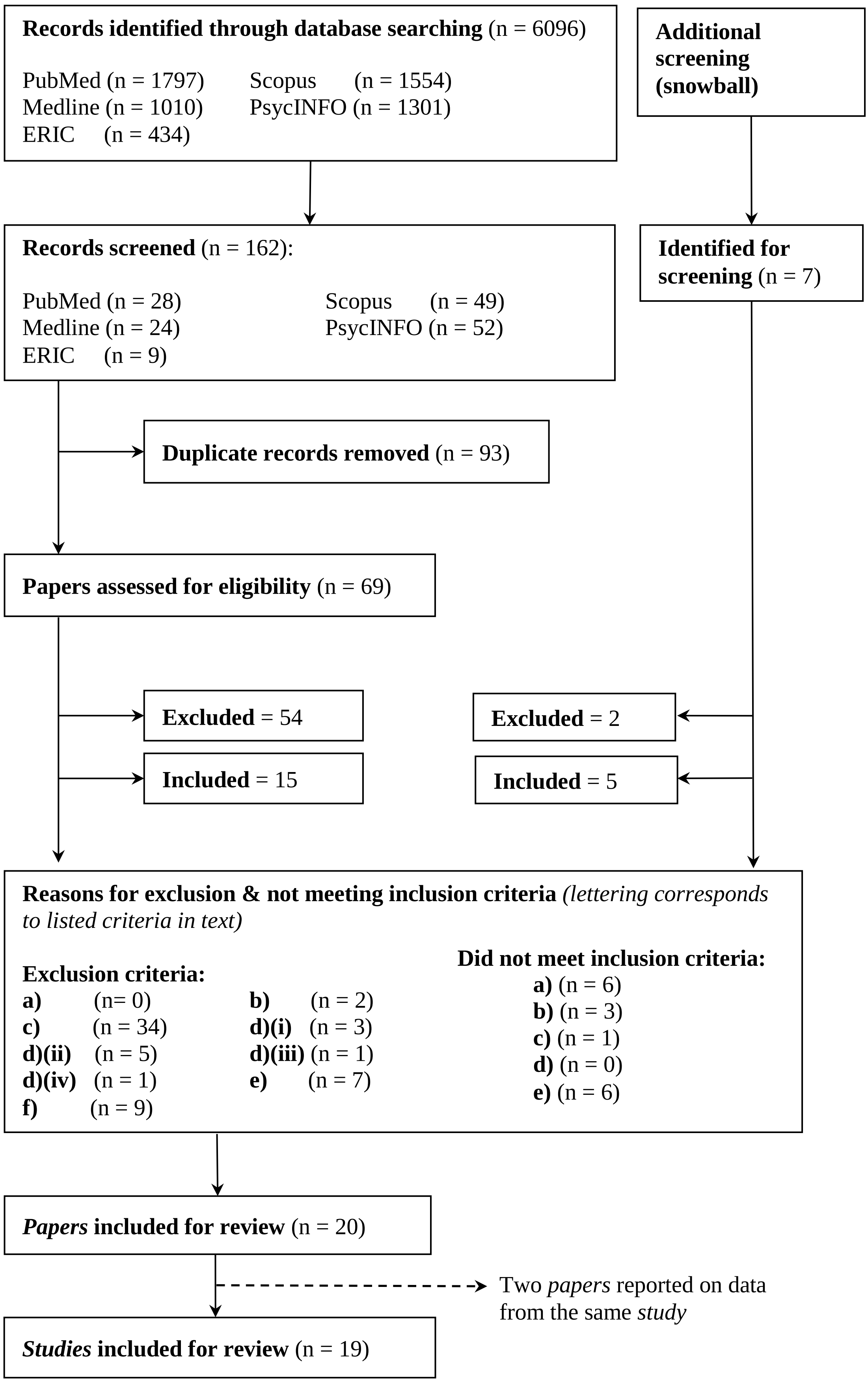

Figure 2.1: Systematic review consort diagram adapted from Zorzela et al. (2016)

Table 2.1 Systematic review study characteristics

Study	Participants[a]	Intervention	Dose	Comparison	Study design	Follow up[b]	Outcome measures (instrument)	Outcomes
Ferland et al. (2002)	N = 424 Age (*M* = 13.1)(range 11-15) 53.3% Male % PG = ns	"Lucky" video + 40min info	1	Lecture/ activities, video, control	Cluster Randomised Controlled Trial (RCT) (by class)	0	Misconceptions, Knowledge	All three experimental conditions were significantly more effective than the control at improving misconceptions and knowledge.
Ladouceur et al. (2004)	N = 371 Age (*M* = 12.8, *SD* = 0.7) 51.8% Male % PG = ns	"Lucky" video	1	Control	Cluster RCT (by school)	0	Misconceptions, Knowledge	The video condition significantly improved knowledge (d = 0.29) and misconceptions (d = 0.41) at post-test when compared to the control
Lavoie & Ladouceur (2004)	N = 273 Age (*M* = 11.53)(range 10-13) 50.2% Male % PG = ns	"Lucky" video + 20min info	1	Video, control	Cluster RCT (by class)	0	Misconceptions, Knowledge	The video + discussion and video groups significantly improved misconceptions and knowledge at post-test when compared to the control condition.
Ladouceur et al. (2005)	N = 568 Age (*M* = 15.99, *SD* = 0.79) 47% Male % PG = ns	"Gambling stories" + 20 min info	1	Control	Controlled pre-post test	1	Knowledge, Stereotypes	The video significantly increased overall knowledge of gambling, and knowledge of excessive gambling, and reduced stereotypes.
Ladouceur et al. (2003)	n = Phase 1 = 153, 56% Male n = Phase 2 = 356, 49% Male Age = grade 5 + 6 % PG = ns	"Count Me Out" exercises	1	Gambling specialist exercises	Cluster RCT (by class)	0	Misperceptions	Exercises developed by a gambling specialist were more effective at reducing misperceptions than exercises from the Count Me Out program. Interventions delivered by gambling specialists were more effective than those delivered by teachers.
Lemaire et al. (2004)	N = 894 Age = grade 7 + 8 % Male = ns % PG = ns	"It's Your Lucky Day"	1	Control	Cluster RCT (by class)	0	Knowledge	The intervention group scored significantly more correct responses than the control group on a post-test quiz.
Turner, Macdonald, & Somerset (2008)	N = 201 Age (range 15-18) 32.84% Male PG = 3.5% (SOGS-RA)	7 session curriculum	7	Control	Cluster RCT (by school)	1	Coping skills (PRI), random knowledge (REKT), awareness and self-monitoring	There was significant improvement in coping skills, random knowledge, and awareness and self-monitoring in the experimental group compared to the control group at follow up.

Taylor & Hillyard (2009)	N = 8,455 Age = Ns 48% Male PG = 10% (MSOGST)	"Don't Gamble Away our Future"	1	None	Uncontrolled pre-post trial	0	Knowledge	Knowledge of gambling and its negative effects were significantly improved after the intervention compared to baseline.
Todriita & Lupu (2013)	N = 81 Age (range 12-13) 45.7% Male % PG = ns	"The Amazing Chateau"	10	Control, REE	Cluster RCT (by class)	0	Gambling questionnaire (knowledge, misconceptions, illusion of control, attitudes, cognitive errors)	Amazing Chateau improved accuracy on gambling questionnaire significantly better than the REE and control, and REE was significantly better than the control.
Lupu & Lupu (2013)	N = 75 Age (range 12-13) 48% Male % PG = ns	"The Amazing Chateau"	10	Control, AC + REE, REE	Cluster RCT (by class)	3, 6, 9, 12	Gambling questionnaire (knowledge, misconceptions, illusion of control, attitudes, cognitive errors)	REE + AC produced significantly more correct responses at the 12 month follow up compared to REE alone and the control.
Gaboury & Ladouceur (1993)	N = 289 Age (*M* = 16) % Male = ns PG = 6.7% (DSM-III-R)	6 session program	6	Matched control	Cluster matched controlled trial (by class)	6	Gambling behaviour (frequency, forms, stake amount) peer and familial gambling attitudes, knowledge, attitude, and coping skills	The experimental group displayed significant improvements in knowledge at the six-month follow up compared to the control.
Turner, Macdonald, Bartoshuk et al. (2008)	N = 374 Age = grade 5 to 12 % Male = ns % PG = ns	1-hour intervention	1	Control	Controlled pre-post test	2	Random knowledge (REKT), problem gambling (SOGS-RA), luck and skill (luck & skill questionnaire) gambling form	The intervention group demonstrated significantly better scores on the REKT compared to the control group at the 7 week follow up.
Williams (2002); Davis (2003)	N = 282 Age Control (*M* = 15.31, *SD* = 0.52) Exp (*M* = 15.45, *SD* = 0.84) 51.5% Male PG = 2.5% (DSM-IV-MR-J)	5 session program	5	Control	Cluster RCT (by school)	3	Gambling awareness, knowledge, attitudes, cognitive errors, recognition and calculation of gambling odds, coping and problem solving, gambling behaviour (frequency, duration, expenditure)	At the three-month follow up students in the intervention group demonstrated significantly better knowledge, more negative attitudes, and fewer cognitive errors compared to the control. The intervention group was the only group to significantly reduce gambling frequency and expenditure at follow up (no control comparison).
Ferland et al. (2005)	N = 1193 Age (*M* = 13.5, *SD* = 1.1) Control = 43.9% Male Exp = 56.1% Male % PG = ns	3 session program	3	Control	Cluster RCT (by school)	3, 6	Knowledge of probabilities and pitfalls, attitudes, problem solving, gambling frequency, discussion with relatives, friends and family, attention paid to peer gambling	The experimental group demonstrated significantly better knowledge, more realistic attitudes toward gambling, an increased likelihood of discussing gambling with their parents, as well as a greater interest in and awareness of their friends and family's gambling at the six month follow up when compared to the control group.

Williams et al. (2004)	N = 578 Age (*M* = 16.2) 53% Male PG = 3.5% (DSM-IV-MR-J)	"Gambling: A stacked deck"	5	Control	Cluster RCT (by school)	3	Gambling Knowledge Scale, Gambling Fallacies Scale, Gambling Attitudes Scale, decision making and problem solving, high risk behaviour, gambling behaviour (type, duration, expenditure), and problem gambling (DSM-IV-MR-J)	The intervention group showed significant improvements on knowledge, fallacies, attitudes, and significant reductions in time and money spent gambling at the three-month follow up when compared to the control.
Williams et al. (2010)	N = 1240 Age (*M* = 16, *SD* = 1.0) 53% Male PG = 3.2% (DSM-IV-MR-J), 5.2% (Self-reported)	"Stacked Deck"	5	Matched control	Cluster RCT (by school)	4	Gambling Knowledge Scale, Gambling Fallacies Scale, Gambling Attitudes Scale, decision making and problem solving, high risk behaviour, gambling behaviour (type, frequency, expenditure), and problem gambling (DSM-IV-MR-J, self report)	There was a significant difference between groups with regards to attitudes, knowledge, fallacies, decision-making and problem solving, number of gamblers, and frequency at the three-month follow-up. Booster sessions improved scores on attitudes and knowledge compared to no booster and control.
Donati et al. (2014)	N = 181 Age (*M* = 15.95, *SD* = 0.51) 64% Male % PG = ns	2 session integrated intervention	2	Control	Cluster RCT (by class)	6	Problem gambling (SOGS-RA)(SOGS-RA broad criteria), knowledge, misconceptions, Gambler's Fallacies Task, perception of economic profitability (Gambling Attitude Scale), and superstitious thinking (Superstitious Thinking Scale)	The intervention group performed significantly better on measures of knowledge, misconceptions, economic perception, and superstitious thinking at the post-test. There was a small and medium reduction in self-reported (phi = .16) and at-risk/problem (phi = .32) gamblers, in the intervention group, respectively.
Walther et al. (2013)	N = 2109 Age (*M* = 12, *SD* = 0.85) 50.4% Male % PG = ns	**"**Vernetzte www.Welten**"**	1	Control	Cluster RCT (by school)	1.75	Gambling behaviour (lifetime, current), attitudes (Gambling Attitudes and Beliefs Scale), and knowledge	The intervention group demonstrated small but significant improvements in knowledge (d = .18) and attitudes (d = .15) at post-test. There was a small significant reduction in current gamblers in the intervention group at post-test when compared to the control group (d = .02).
Canale et al. (2016)	N = 168 Age (*M* = 15.01, *SD* = 0.6) 58% Male PG = 8.3% (SOGS-RA)	5-session web-based intervention	5	Active control (screening + feedback)	Cluster RCT (by class)	1	Gambling behaviour (SOGS-RA, frequency, & expenditure), and attitudes (Gambling Attitudes Scale)	There was a significant decrease in gambling problems in the intervention group at follow-up compared to the control (d = .23). Frequent gamblers in the intervention group reduced problem gambling (d = .41) and frequency (d = .45) compared to non-frequent gamblers.

[a] Per cent problem gamblers at baseline
[b] Determined as the time between the end of the intervention and follow up assessment (months).

2.5 Quality Assessment of Selected Studies

Studies were assessed for quality using the Quality Assessment Tool for Quantitative Studies (National Collaborating Centre for Methods and Tools, 2008). Each study was assigned a rating of weak, moderate, or strong on measures of selection bias, study design, confounding variables, blinding, data collection, withdrawals and dropouts, and given an overall global rating. Validity and reliability properties for this measure meet acceptable standards. Content validity was assessed using an iterative process with an expert panel. Test-retest reliability was calculated twice by two reviewers and was good (Cohen's Kappa = 0.74, 0.61) for both reviewers, respectively (Thomas, Ciliska, Dobbins, & Micucci, 2004). Results of quality assessment by component can be seen in Table 2.2.

2.6 General Limitations of the Adolescent Gambling Education Literature

2.6.1 Design.

The lack of a behavioural outcome measure was the most common methodological weakness found in ten out of 19 studies. These studies limited their outcome measures to cognitive changes, primarily in the short-term (Ferland et al., 2002; Ladouceur et al., 2003, 2004; Ladouceur, Ferland, Vitaro, et al., 2005; Lavoie & Ladouceur, 2004; Lemaire et al., 2004; Taylor & Hillyard, 2009; Todirita & Lupu, 2013; Turner, Macdonald, & Somerset, 2008). Two studies measured problem gambling at baseline (Taylor & Hillyard, 2009; Turner, Macdonald, & Somerset, 2008), but failed to include this in post-test assessment as a primary outcome measure.

Table .2.2: Systematic review quality assessment.

Paper	**Selection bias**	**Study design**	**Confounders**	**Blinding**	**Data collection methods**	**Withdrawal and drop-outs**	**GLOBAL RATING**
Ferland et al. (2002)	Moderate	Strong	Strong	Moderate	Weak	Weak	Weak
Ladouceur et al. (2004)	Moderate	Strong	Strong	Moderate	Strong	Moderate	Strong
Lavoie & Ladouceur (2004)	Moderate	Strong	Strong	Moderate	Weak	Weak	Weak
Ladouceur et al. (2005)	Moderate	Strong	Strong	Moderate	Weak	Weak	Weak
Ladouceur et al. (2003)	Moderate	Strong	Strong	Moderate	Weak	Weak	Weak
Lemaire et al. (2004)	Moderate	Strong	Strong	Moderate	Weak	Strong	Moderate
Turner, Macdonald, & Somerset (2008)	Moderate	Strong	Weak	Moderate	Weak	Strong	Weak
Taylor & Hillyard (2009)	Moderate	Moderate	Strong	Moderate	Strong	Weak	Moderate
Todirita & Lupu (2013)	Moderate	Strong	Strong	Moderate	Weak	Strong	Moderate
Lupu & Lupu (2013)	Moderate	Strong	Weak	Moderate	Weak	Strong	Weak
Gaboury & Ladouceur (1993)	Moderate	Strong	Weak	Moderate	Weak	Weak	Weak
Turner, Macdonald, Bartoshuk et al. (2008)	Moderate	Strong	Weak	Moderate	Weak	Weak	Weak
Williams (2002); Davis (2003)	Moderate	Strong	Strong	Moderate	Weak	Moderate	Moderate
Ferland et al. (2005)	Moderate	Strong	Strong	Moderate	Weak	Strong	Moderate
Williams et al. (2004)	Moderate	Strong	Strong	Moderate	Strong	Strong	Strong
Williams et al. (2010)	Strong	Strong	Strong	Moderate	Moderate	Moderate	Strong
Donati et al. (2014)	Moderate	Strong	Strong	Moderate	Weak	Moderate	Weak
Walther et al. (2013)	Moderate	Strong	Strong	Moderate	Moderate	Strong	Strong
Canale et al. (2016)	Weak	Strong	Strong	Moderate	Strong	Moderate	Moderate

Moreover, only four out of the 19 studies assessed follow-up outcomes at the six-month post-intervention interval, or beyond (Donati et al., 2014; Ferland et al., 2005; Gaboury & Ladouceur, 1993; Lupu & Lupu, 2013). Impressively, Lupu and Lupu (2013) assessed intervention effects over three, six, nine, and 12 months; however, they did not take the opportunity to evaluate gambling behaviour at any of these time points. Seven studies had no follow-up assessment at all (Ferland et al., 2002; Ladouceur et al., 2003, 2004; Lavoie & Ladouceur, 2004; Lemaire et al., 2004; Taylor & Hillyard, 2009; Todirita & Lupu, 2013). Although the absence of follow-up assessment is less problematic when the aim is to measure cognitive change, post-test assessment provides no indication of the permanence of such cognitive changes, or if they translate into any behavioural changes over time.

Notably, most studies used a cluster randomised control approach, randomly allocating schools (Ferland et al., 2005; Ladouceur et al., 2004; Turner, Macdonald, & Somerset, 2008; Walther et al., 2013; Williams, 2002/Davis, 2003; Williams et al., 2004, 2010) or classes (Canale et al., 2016; Donati et al., 2014; Ferland et al., 2002; Ladouceur et al., 2003; Lavoie & Ladouceur, 2004; Lemaire et al., 2004; Lupu & Lupu, 2013; Todirita & Lupu, 2013) as opposed to individual students to each condition. This is particularly important when administering and evaluating interventions among youth because adolescents' attitudes toward gambling are vastly influenced by the opinions and behaviours of their peers (Hanss, Mentzoni, Delfabbro, Myrseth, & Pallesen, 2014). Thus, when delivering interventions to an entire grade cohort, adolescents are likely to be of the same age, ensuring long-term studies are especially sensitive to crucial changes in development (Slutske, 2007).

However, class allocation can confound the observed effects. This is often because students from control classes are likely to have peers in intervention classes with whom they share thoughts, ideas, and newly acquired knowledge. No study provided information on integrity checks, so it is unclear as to whether the same intervention was applied consistently across groups. Only three studies varied from a randomised control design; Ladouceur et al. (2003) and Turner, Macdonald, Bartoshuk et al. (2008) did not randomly allocate participants to their controlled study, and Taylor and Hillyard (2009) did not use a control in their pre-post design.

2.6.2 Measurement instruments.

Of the seven studies that measured gambling problems at baseline, the majority reported reasonably high levels of problematic gambling among youth (see Table 2.1) (Canale et al., 2016; Gaboury & Ladouceur, 1993; Taylor & Hillyard, 2009; Turner, Macdonald, & Somerset, 2008; Williams, 2002/Davis, 2003; Williams et al., 2004, 2010). However, the distribution of problematic gambling did not appear to commensurate with real-world effects. Among those who did gamble, relatively small amounts of money were wagered (Canale et al., 2016; Williams, 2002; Williams et al., 2010). Although there was no breakdown of the amount of money spent by problem gamblers, the level of harm experienced by those categorised as 'problem gamblers' remains questionable. Furthermore, low baseline amounts of money wagered were reported on average. This makes it difficult to detect and interpret reductions in average expenditure over time. For example, Canale et al. (2016) reported that on average, gambling expenditure was less than 10 Euros per month. Similarly, Williams (2002) reported a median loss of just CAN$10 over three months, and only 4% of Williams et al.'s (2010) sample reported losing more than CAN$51 in the past month on gambling.

Additionally, of the five studies that administered the DSM-IV-J/MR-J (Fisher, 1992, 2000) or SOGS-RA (Winters, Stinchfield, & Fulkerson, 1993), three did not take into consideration the 12-month timeframe of these measures, which may not be appropriate for re-test intervals of six months or less (Turner, Macdonald, Bartoshuk, et al., 2008; Williams et al., 2004, 2010). With a lapse of less than six months, one would not expect to see changes in such problem gambling measures from baseline to follow-up. Notably, Donati et al. (2014) and Canale et al. (2016) modified the SOGS-RA to reflect the brevity in their follow-up (6 months and 1 month, respectively). However, given that both measures assess gambling problems over a 12-month timeframe, it is questionable if the instruments are sensitive to detect significant differences between baseline and follow-up scores over shorter periods, even by modifying its timeframe.

There were also issues with the classification of participants' gambling status. In addition to the straightforward numerical scoring of the SOGS-RA, known as the *narrow criteria*, the SOGS-RA is commonly used in conjunction with gambling frequency to produce an overall level of gambling 'severity', referred to as the *broad criteria* (Winters et al., 1993; Winters, Stinchfield, & Kim, 1995). Donati et al., (2014) applied broad criteria to their sample in order to categorise them into two groups; *non-problem gamblers*, and *at-risk and problem gamblers (ARPGs)*. However, in this study, ARPGs included adolescents who gambled less than weekly and obtained a SOGS-RA score of *one or more*; but the original scale criteria requires a SOGS-RA score of *at least two*, not one, resulting in a large overrepresentation of ARPGs.

Similarly, both Donati et al. (2014) and Canale et al. (2016) classified non-gamblers as *non-problem* or *non-frequent* gamblers, respectively. Although it is unclear how many participants were similarly classified in Canale et al.'s study, nearly one-quarter (23.18%) of the *non-problem gambling* group in Donati et al.'s study were in fact non-gamblers. Consequently, one must cautiously interpret any results that indicate differences between gambling groups in these studies as such groups are not fully representative of recreational gamblers.

The range of challenges and confounds related to the evaluation of programs includes reliance on self-reported expenditure data. There are two issues. The first pertains to the way in which questions are phrased, as gamblers tend to differ in the way they calculate their expenditure (Blaszczynski, Dumlao, & Lange, 1997; Blaszczynski, Ladouceur, Goulet, & Savard, 2006, 2008; Wood & Williams, 2007). The second relates to the fidelity of responses. Adolescents (and adults) tend to overestimate wins and underestimate losses (Braverman, Tom, & Shaffer, 2014; Wood & Williams, 2007). For example, the data reported by Davis (2003) and Williams et al. (2010), suggested students won more often than they lost. Given the significant house edge inherent in commercial gambling, it is doubtful that student responses were valid and reliable.

Of the nine studies that evaluated gambling behaviour, only four of those explicitly operationalised gambling behaviour as involving the wagering of money (Ferland et al., 2005; Walther et al., 2013; Williams, 2002; Williams et al., 2010). Without wagering money, adolescents may be inclined to positively report 'betting' on various activities, such as games of skill, sport, and cards, without ever having risked any actual money (e.g., "I bet you can't make this shot"). Further, it is possible that adolescents, having such low disposable income (if any), wagered items of value such as food, clothing, or jewellery, rather than money. None of the studies asked if youth were gambling items of value instead of money.

2.6.3 Statistical analyses and interpretation of results.

There were concerns over the method of analyses and interpretation of results regarding statistically significant intervention effects. Williams (2002) reported reductions in gambling frequency and expenditure in the intervention group; however this occurred *within* the intervention group *only* from baseline to follow-up, and not relative to the control group. Similarly, Williams et al. (2010) reported significantly fewer *self-reported* problem gamblers in the intervention and booster groups compared to the control group at follow-up assessment. However, there was no change in self-reported problem gambling *within* any of the groups over time, thus such a between-groups comparison is an unreliable marker of true intervention effects. The lack of a statistically significant interaction may be due to the small numbers of problem gamblers in each group (between 7 and 35) leading to low statistical power. Indeed, the standard and booster intervention groups resulted in a 77% and 50% reduction in self-reported problem gamblers from baseline to follow-up, respectively, while the control group saw a 150% *increase* in self-reported problem gambling.

Williams et al.'s (2004) reporting of results were inconsistent with their interpretation of such results in their discussion. The results section of the paper reports an increase in gamblers in the intervention group, however this is interpreted as a reduction in the discussion section. Such contradictory claims confound interpretation of the intervention's effectiveness.

Donati et al. (2014) did not compare follow-up data to baseline data when determining the long-term efficacy of their intervention. The authors argued that because there were significant improvements in the intervention group from baseline (Time 1) to post-test (Time 2), and no significant deterioration between post-test (Time 2) and follow-up (Time 3), that this indicates permanence of the intervention's effects. However, without verifying that follow-up (Time 3) scores were significantly different from baseline (Time 1) scores, such conclusions are questionable. Indeed, subsequent non-significant deteriorations were observed between post-test and follow-up in this intervention group. Further, although the authors reported a significant decrease in the number of gamblers and problem gamblers from baseline to follow-up in the intervention group, there was no statistical comparison to the control group. Without taking into consideration any between-group effects, it is difficult to detect if this decrease was truly due to the intervention in question.

2.7 Program Effects

2.7.1 Knowledge, misconceptions, and attitudes.

Drawing conclusions about program effectiveness is difficult given challenges that are not easily controlled in research design. Nonetheless, the main indicator of program effectiveness is long-term behavioural change. However, ten studies did not measure the effects of interventions in terms of behavioural indicators capable of identifying reduced problem gambling among adolescents.

Overall, the effectiveness of a program is generally suggested by observed measurement changes in cognitive variables. Programs were effective in reducing common misconceptions and fallacies about gambling, increasing knowledge of gambling forms, odds, highlighting differences between chance and skill, and creating more negative attitudes toward gambling.

Six studies also demonstrated improvements in more specific skills such as coping, awareness and self-monitoring, attitudes toward and dialogue about peer and familial gambling, problem solving and decision-making. However, from these results it is not possible to determine if such cognitive improvements prevent the development of future gambling problems. Additionally, any improvements if present, may deteriorate in the long term (Donati et al., 2014; Ferland et al., 2005; Lupu & Lupu, 2013). Given only one study measured outcomes at 12 months, it is difficult to determine if such deterioration effects are unique to these programs or if they are likely to be observed in all preventive efforts.

2.7.2 Gambling behaviour.

Behavioural outcomes were less clear. Presumably, the justification for including cognitive measures in program evaluations is that such changes in cognition are expected to produce, or at least highly correlate with, changes in behavioural outcomes. Thus, one would assume that if an intervention were effective in producing cognitive improvements, it would also be effective in producing behavioural improvements. Although four studies that measured behavioural outcomes observed improvements in knowledge, attitudes, and cognitive errors (Ferland et al., 2005; Gaboury & Ladouceur, 1993; Turner, Macdonald, Bartoshuk, et al., 2008; Williams, 2002/Davis, 2003), they did not detect consequent behavioural changes. It is possible that significant improvements on measures such as the Random Events Knowledge Test (Turner & Liu, 1999), and measures of gambling knowledge may be due to rehearsal effects, rather than genuine cognitive development. Additionally, cognitive changes observed at post-test have been shown to decrease over time, further suggesting immediate improvements may be a result of recency effects (Donati et al., 2014; Ferland et al., 2005; Lupu & Lupu, 2013). It is also possible that the structural constraints pre-empted the observation of behaviour change within a short study period.

Theoretical conceptualisations for mechanisms of change were also unclear. Canale et al. (2016) attributed much of the success of their intervention to *personalised feedback.* However, both control and intervention groups were administered personalised feedback, while the intervention group also completed additional online training modules. Thus, it is more appropriate to attribute any success to the online modules, which tended to focus more on randomness, fallacies, and negative mathematical expectation. Indeed, as described by the authors, personalised feedback may have had a detrimental effect on students who gambled regularly, as those in the control condition reported significantly more unrealistic attitudes at the follow-up compared to their baseline assessment. Similarly, the Romanian studies (Lupu & Lupu, 2013; Todirita & Lupu, 2013) compared Rational Emotive Education (REE) combined with the Amazing Chateau software developed by the International Centre for Youth Gambling Problems and High-Risk Behaviours (ICYGPHRB, 2004). The software combined with REE was more effective than REE alone and a control. However, it is not known what component of this combination is effective, i.e., if the software alone is more effective than REE and a control, thus rendering the REE an unnecessary component.

Measures of problem gambling were primarily used as proxies for harm. Five studies used problem gambling measures (DSM-IV-MR-J, SOGS-RA) as their primary outcome variable (Canale et al., 2016; Donati et al., 2014; Turner, Macdonald, Bartoshuk, et al., 2008; Williams et al., 2004, 2010); however many used other behavioural variables to measure intervention outcomes such as frequency, duration, and expenditure or bet size (Canale et al., 2016; Ferland et al., 2005; Gaboury & Ladouceur, 1993; Walther et al., 2013; Williams, 2002/Davis, 2003; Williams et al., 2004, 2010). Given gambling expenditure is considerably low among adolescents, and abstinence is not necessarily an adequate or realistic outcome, such measures by themselves may not be appropriate indicators of efficacy. Thus, it is important that measures of gambling-related harm are developed and used as markers of efficacy in future harm reduction and prevention programs.

2.8 Program Content and Delivery

2.8.1 Content.

All programs targeted known cognitive aspects of problem gambling, including gambling fallacies and misconceptions. Thirteen programs attempted to teach students about the unprofitability of gambling (house edge, odds)(Canale et al., 2016; Donati et al., 2014; Ferland et al., 2002; Gaboury & Ladouceur, 1993; Ladouceur et al., 2004; Lavoie & Ladouceur, 2004; Lemaire et al., 2004; Lupu & Lupu, 2013; Todirita & Lupu, 2013; Walther et al., 2013; Williams, 2002/Davis, 2003; Williams et al., 2004, 2010), and 11 covered components on randomness in gambling (Canale et al., 2016; Donati et al., 2014; Ferland et al., 2002, 2005; Ladouceur et al., 2003, 2004; Lavoie & Ladouceur, 2004; Lupu & Lupu, 2013; Todirita & Lupu, 2013; Turner, Macdonald, Bartoshuk, et al., 2008; Turner, Macdonald, & Somerset, 2008). Raising awareness of the signs, symptoms, and consequences of problem gambling was also commonly found (11 out of 19) (Canale et al., 2016; Ferland et al., 2005; Gaboury & Ladouceur, 1993; Ladouceur, Ferland, Poulin, Vitaro, & Wiebe, 2005; Lemaire et al., 2004; Taylor & Hillyard, 2009; Turner, Macdonald, & Somerset, 2008; Walther et al., 2013; Williams, 2002/Davis, 2003; Williams et al., 2004, 2010), however, more specific skills such as coping, problem-solving and decision-making were less common (6 out of 19)(Ferland et al., 2005; Gaboury & Ladouceur, 1993; Turner, Macdonald, & Somerset, 2008; Williams, 2002/Davis, 2003; Williams et al., 2004, 2010).

Most studies did not provide a rationale for developing the intervention program, or used programs already developed by third parties. Williams (2002) and

Williams et al. (2010) explicitly stated that their program development followed a comprehensive and systematic process that was informed by a thorough review of the educational literature. This was to ensure that their content would be engaging and relevant to youth.

2.8.2 Dosage.

Programs varied considerably in dosage (how many sessions) and total exposure (20-500 minutes per program). Generally, studies that evaluated behavioural outcomes tended to implement more comprehensive programs and evaluate them over a longer period of time than those that did not measure behavioural outcomes. Of the ten studies that did not measure behavioural outcomes, only three programs were delivered over more than one session, or integrated into the school curriculum (Lupu & Lupu, 2013; Todirita & Lupu, 2013; Turner, Macdonald, & Somerset, 2008). On the other hand, seven out of the nine studies that measured behavioural outcomes involved programs that lasted more than one session (Canale et al., 2016; Donati et al., 2014; Ferland et al., 2005; Gaboury & Ladouceur, 1993; Williams, 2002/Davis, 2003; Williams et al., 2004, 2010).

More comprehensive programs, and those with booster sessions, tended to perform better than their brief counterparts on cognitive and behavioural measures (Ferland et al., 2002; Williams et al., 2010, respectively). Brief interventions on their own may not be sufficient to produce lasting changes, and larger dosages may assist youth to fully understand complex concepts such as randomness and negative expectation. However, the absence of long-term follow-up precludes assessment of a dose-responsive relationship between the duration of programs and their outcomes and longevity of effects.

2.8.3 **Delivery mode.**

Most programs comprised a combination of multi-media tools (videos, online modules) and classroom discussions and activities. Only three programs did not involve some form of multi-media (Ladouceur et al., 2003; Turner, Macdonald, Bartoshuk, et al., 2008; Walther et al., 2013), and only five were solely multi-media programs (no teacher intervention) (Canale et al., 2016; Ladouceur et al., 2004; Lemaire et al., 2004; Lupu & Lupu, 2013; Todirita & Lupu, 2013). Video-based and online programs provide an appropriate alternative to teacher-based education programs. Internet-based interventions for gambling are cost-effective, convenient, and especially suited to empirical evaluation (Gainsbury & Blaszczynski, 2011). Moreover, and in line with Nation et al.'s (2003) recommendations, they are relevant and engaging for youth (Monaghan & Wood, 2010).

Almost all programs were delivered to class cohorts (Canale et al., 2016; Donati et al., 2014; Ferland et al., 2002; Gaboury & Ladouceur, 1993; Ladouceur et al., 2003; Lavoie & Ladouceur, 2004; Lemaire et al., 2004; Lupu & Lupu, 2013; Todirita & Lupu, 2013) or school cohorts (Ferland et al., 2005; Ladouceur et al., 2004; Turner, Macdonald, & Somerset, 2008; Walther et al., 2013; Williams, 2002/Davis, 2003; Williams et al., 2004, 2010). School-wide distribution is preferable, with two primary advantages; 1) student peer groups are targeted simultaneously, and 2) control groups are distinct from intervention groups. In the case where allocation is carried out by *class*, control and intervention participants are likely to engage and share information, confounding true control conditions.

Only one study assessed the impact of educators on outcome variables, finding that exercises delivered by a gambling specialist were more effective in reducing erroneous perceptions than those delivered by a teacher (Ladouceur et al., 2003).

Perhaps counter-intuitively, this suggests teachers may not be the most appropriate people to deliver such programs.

2.9 Discussion

2.9.1 Methodological Considerations

One of the difficulties in measuring behavioural change in adolescent gambling is that relatively small numbers of youth gamble at problematic levels, and therefore, large sample sizes are needed to detect small but significant reductions in gambling problems. Additionally, many programs are not designed to promote abstinence, so large reductions in gambling frequency are not necessarily anticipated.

Importantly, many of the studies demonstrated that changes in knowledge, beliefs and attitudes do not necessarily translate into changes in behaviour (e.g., Ferland et al., 2005; Gaboury & Ladouceur, 1993; Turner, Macdonald, Bartoshuk, et al., 2008). This is likely the result of two factors: inaccurate measurement of problematic gambling in adolescence, and/or a lack of theoretical conceptualisation in program design. Firstly, it is important that studies do not use cognitive measures as proxies for harm because these may represent mechanisms for problematic behaviour (process) but are not conceptually the same as the consequences of negative impacts (harm). For example, the fallacy that machines run in cycles is a mechanism by which gamblers may be persuaded to spend beyond their affordable means (process), but it is not the consequent harm (money lost). As previously mentioned, adolescent measures of problem gambling have come under considerable criticism (Derevensky, Gupta, & Winters, 2003; Jacques & Ladouceur, 2003; Stinchfield, 2010), and similar to the adult gambling literature, there is a suggested need to move away from diagnostic criteria of gambling pathology and toward measures of gambling-related harm (Blaszczynski, Ladouceur, & Moodie, 2008; Currie, Miller, Hodgins, & Wang, 2009; Langham et al., 2016; Neal, Delfabbro, & O'Neill, 2005). Second, even with improvements in measurement instruments, a program that is designed from sound theory increases the likelihood of observing behavioural change. In the absence of a theoretical conceptualisation regarding mechanisms for change, designing preventive interventions proceeds by trial and error.

The confidence in observed program evaluations increases with longer follow-up periods. It is preferable for studies to evaluate behavioural outcomes over a period of six months or more, because there appears to be evidence of deteriorating effects over time (Donati et al., 2014; Ferland et al., 2005; Lupu & Lupu, 2013). Observed changes at brief follow-up intervals do not necessarily indicate lasting positive effects on future gambling behaviour. Additionally, problem gambling measures (and measures of harm) should reflect follow-up periods. The SOGS-RA and DSM-IV were developed as measures of gambling problems over the last 12-months, as such it is not adequate to simply adjust the timeframe of these measures to suit shorter assessment timeframes.

2.9.2 Program Content and Delivery

Second to the methodological issues faced in the evaluation of gambling education programs, specific attention must be paid to their content and mode of delivery. In practise, it would be more economical for existing teachers to adapt and deliver programs to their students via some form of program manual or teaching kit. Ladouceur et al. (2003) demonstrated that gambling initiatives delivered by gambling specialists were significantly more effective at reducing cognitive errors among students compared to those delivered by their teachers. Nevertheless, it does not seem feasible that schools enlist gambling psychologists to deliver education programs, especially those that span multiple sessions. Online programs or modules may provide a promising compromise. Canale et al. (2016) demonstrated some efficacy in reducing gambling problems among secondary school students using a web-based intervention, despite its methodological flaws, and the Amazing Chateau computer program and Lucky video produced encouraging cognitive improvements (Ladouceur et al., 2004; Lupu & Lupu, 2013; Todirita & Lupu, 2013). The benefits are many; web-based interventions are cost effective, consistent, unbiased, and socio-culturally relevant to youth (Gainsbury & Blaszczynski, 2011; Monaghan & Wood, 2010).

To date, many of the programs implemented in schools and reviewed in this paper focus on raising awareness of problem gambling, its signs, symptoms and consequences, available treatment services, fallacies and cognitive errors, and superficial explanations of terms such as probability, odds, and house edge. Few programs emphasised learning complex mathematical concepts such as randomness and expected value. Only four of the nine studies that evaluated behavioural outcomes sought to teach students about randomness. There may be hesitation toward including complex mathematical concepts in gambling education programs so as not to overwhelm students. Nevertheless, such important concepts are crucial to understanding the unprofitability and unpredictability of commercial gambling products. Promoting a negative viewpoint of gambling and its associated consequences are not sufficient to prevent gambling problems.

2.9.3 Limitations

The current systematic review was limited foremost by the lack of meta-analyses. Due to the variation in outcome measures, samples, and analyses, it was not feasible to calculate comparable measures of effect size. Two studies were excluded despite meeting all other eligibility criteria because they were not available in English. This may have limited the representativeness of the reported findings.

Further, there was a genuine risk of publication bias in the reviewed studies. Given the large number of programs currently available in schools, it is likely that others have been evaluated and not published due to non-significant findings. That said, this review followed a rigorous search procedure in an attempt to mitigate such biases, and every effort was made to include all possible relevant studies. In light of the broad scope of this review, we were able to provide recommendations for the design and evaluation of future programs, based on the available evidence.

2.9.4 Recommendations

To prevent gambling problems, programs should be implemented universally, as early as possible (age 10 onward) to prevent misconceptions from developing. It is logical that programs orient their efforts toward preventing gambling problems from occurring, rather than preventing gambling, or treating adolescents identified as 'problem gamblers'. Programs may be improved by focusing primarily on teaching mathematical principles that account for the long-term unprofitability experienced by users, such as expected value. Where possible, programs that are staggered over several sessions will be better suited to the needs of complex content. It is important programs are relevant to youth in terms of delivery and content; that is, multi-media platforms may be preferable, and examples within the program should help to connect new knowledge with existing knowledge and familiar experiences (most adolescents have not gambled inside a casino, but may be familiar with footy tipping). Evaluations should measure reductions in harm, not frequency or expenditure (because these are typically very low), and conduct follow-up assessments into adulthood (or time of legal age).

2.10 Conclusion

Given the prevalence of gambling among adolescents, few gambling education programs for adolescents have been evaluated. No doubt the number of programs currently implemented in schools far exceeds those reviewed in this paper. There is a discord between current practice, and evidence-based practice. The strength of the efficacy of the reviewed programs remains unclear due to notable methodological flaws including measurement issues, small numbers of problem gamblers, and brief follow-up assessments. Further, improvements could be made to the content and design of programs so that they have a greater likelihood of producing behavioural outcomes. Strong theoretical conceptualisation in designing programs is essential to boost intervention effects and meet the objective of reducing or preventing gambling problems among adolescents.

2.11 Chapter Summary

This chapter detailed the findings of a systematic review of empirically evaluated school-based gambling education programs. The results suggest that most gambling education programs for young people tend to focus on risks and harmful consequences and few have had impact on actual gambling behaviour. The following chapter aims to explain where some of the issues of current gambling education programs may have originated from, and how we may go about addressing these in the future.

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3 Chapter Three: Theoretical Rationale

Using Misconceptions to Boost Outcomes and Engagement with Educational Programs that Aim to Prevent Gambling Problems.

Preamble: This chapter discusses some of the theoretical and practical limitations of current gambling education strategies, many of which relate to broader conceptual issues in the field. It suggests improvements may be made to make gambling education more engaging for young people, as well as improve overall preventive effects. Specifically, it reviews cognitive and developmental accounts of problem gambling etiology and provides a rationale for focusing on misconceptions about gambling mathematical game design in education programs.

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Minor modifications have been made to the manuscript to reduce repetition and improve clarity of the thesis as a whole. I was responsible for designing the overall structure of the review and conducting a majority of the literature review and writing.

Abstract

Gambling education programs typically focus on promoting gambling as a high-risk activity and highlight its potential harmful effects. However, research has demonstrated limited program efficacy in preventing development of gambling problems, perhaps because youth tend not to engage with these messages. The purpose of the current review was to investigate some of the issues with existing efforts in problem gambling education, and to provide fruitful new avenues for innovation. Based on this review, several recommendations are made for the development of future problem gambling education programs. Specifically, we suggest that employing a developmental framework of problem gambling may improve youth engagement with educational programs by increasing personal relevance. The cognitive model of problem gambling suggests that misconceptions about the profitability of gambling games (e.g., the gambler's fallacy) play an important role in the development of problems and should be a key target for gambling education. However, exposing such misconceptions requires teaching the mathematical principles that underpin them, which can be challenging. Fortunately, the pedagogical field provides insights for teaching complex concepts. Research that has applied the conceptual change model to science education suggests misconceptions also play an important role in learning new complex information; like gambling-related mathematical concepts (i.e., randomness, statistics). Additionally, improvements in computer-assisted teaching methods provide opportunities to use simulations and visualisations to help teach abstract concepts and correct such misconceptions.

3.1 Introduction

Most individuals are first exposed to gambling experiences during adolescence (Delfabbro, Lahn, & Grabosky, 2005a; Delfabbro, Lambos, King, & Puglies, 2009; Delfabbro, Winefield, & Anderson, 2009; Purdie, Matters, Hillman, Ozolins, & Millwood, 2011; Splevins, Mireskandari, Clayton, & Blaszczynski, 2010). Several research studies report problem gambling rates amongst adolescents to be 3-10 times higher than those found in adults (Derevensky & Gupta, 2000; Gupta et al., 2013; Purdie et al., 2011; Splevins et al., 2010; Welte, Barnes, Tidwell, & Hoffman, 2008). Although researchers have suggested that the current rates may be inflated due to nomenclature issues and psychometric problems with measurement instruments (Derevensky, Gupta, & Winters, 2003; Stinchfield, 2010); adolescents represent a subpopulation of great interest to those tasked with the objective of preventing development of future gambling problems.

Consistent with efforts to prevent harm from other risky behaviours such as alcohol and substance use, sexual activity, and recklessly operating a motor vehicle (Bachman et al., 2008; Noar, Palmgreen, Chabot, Dobransky, & Zimmerman, 2009; Vivancos, Abubakar, Phillips-Howard, & Hunter, 2013), education initiatives have been developed to encourage good decision making when gambling (see Keen, Blaszczynski, & Anjoul, 2016; Ladouceur, Goulet, & Vitaro, 2013 for reviews).

Typically, educational strategies designed to prevent gambling-related harm are aimed at adolescents or young adults who have not yet gambled or are in the early stages of gambling experiences. Educational programs for adolescents are often implemented in school settings, because they represent appropriate sites for dissemination of information to young people in society (Monaghan, 2008). Several programs have also been implemented and evaluated in university (college) settings amongst young adults. These are more common in countries such as the United States where the legal age to gamble is slightly higher (21 years old) and coincides with admittance to college. In Australia, many young people have access to commercial gambling opportunities while they are still in secondary school (18 years old).

Two recent reviews of the content, design, evaluation and efficacy of educational gambling programs for adolescents and young adults suggest that improvements in gambling knowledge, attitudes, and reductions in misconceptions are common; however, the impact of these outcomes is rarely translated into changes in behaviour (Keen et al., 2016; Oh, Ong, & Loo, 2017). The reasons for this are not clear, but possible suggestions are that a) these variables are not important in predicting gambling behaviour, b) the impact of the educational effects are not strong enough to translate into behavioural outcomes, or c) measures of gambling knowledge, attitudes, and misconceptions lack validity, real effect sizes are smaller than those reported, and intervention effects need boosting in order to affect behaviour.

The primary purpose of educational strategies is to disseminate accurate information with the aim of fostering informed choice and responsible gambling among future gamblers (Keen et al., 2016; Ladouceur et al., 2013; Monaghan, 2008). The nature of the information contained in these educational programs vary. Most generally raise awareness of gambling as a risky behaviour and detail the dangers of excessive gambling. Some focus on teaching young people about the unfair nature of gambling games, including information about how outcomes are determined randomly and the low probability of winning. Others include strategies for gambling within financial limits, budget management, and myths and misconceptions related to gambling games (Keen et al., 2016; Ladouceur et al., 2013; Monaghan, 2008).

Although the purpose of educating young people about gambling appears consistent, it is not clear exactly what kind of information should be taught to have the most impact. The vast majority of school-based education programs with adolescents tend to focus on raising awareness of the potential risks and harmful outcomes that may eventuate from gambling

(Keen et al., 2016); and so these will henceforth be referred to as 'risk-awareness' programs. Such approaches can be described as encapsulating fear-based messaging designed to deter recipients from engaging in the described behaviour to avoid potential harmful consequences.

Despite relative efforts in prevention, the small number of empirical studies available that measure gambling behaviour suggest that educational programs have had limited success in preventing young people from developing gambling problems (Keen et al., 2016; Ladouceur et al., 2013; Oh et al., 2017). The Productivity Commission (2010) indicated that the efficacy of current educational programs was limited due to their inability to produce behavioural change among participants. The report went so far as to say, "…school-based information programs could be having perverse effects and should not be extended without review" (2010, p. 3).

As stated, exactly why these strategies have not been effective in reducing the incidence of gambling problems has not been evaluated in depth. The apparent lack of effectiveness may relate to either delivery approach or content. Many current programs are perhaps delivered in a way that falls short or could be improved upon by using more innovative and technologically advanced strategies (Borovcnik, 2007; Chandra & Watters, 2012a; McKagan et al., 2008). Another explanation may be that the general content focusing on raising awareness about the dangers of excessive gambling may not resonate with young audiences. Previous research has demonstrated that improvements in knowledge do not always translate into behavioural effects (Wiefferink et al., 2006), and prevention programs that rely on delivering information alone have generally been ineffective (Durlak, 1997).

Currently, most risk-awareness programs depict a person (usually an adult) suffering a range of severe gambling-related harms (divorce, mortgage repayments, job loss, bankruptcy, etc.) and needing professional help. Given that prevention, by its nature, targets non-gamblers and non-problem gamblers, it would seem that these messages describe a situation that inherently does not relate to the target audience. As a consequence, the audience are then more likely to attribute such problems to someone unlike themselves (Hastings, Stead, & Webb, 2004), which reduces relevance and personal engagement with the message (Goldberg, Bents, Bosworth, Trevisan, & Elliot, 1991; Higbee, 1969; Martin & Kamins, 2010). It is likely that the promotion of harmful consequences in current educational programs has been informed by the categorisation of Gambling Disorder as a behavioural addiction and by proxy, a brain-disease (Leshner, 2003; U.S. Department of Health and Human Services [HHS], 2016). Despite the expectation that medicalising addiction would reduce stigma, research suggests this has not necessarily eventuated. Such biological explanations of addiction have been associated with increased public stigma and doubt surrounding one's prospects for recovery (Satel & Lilienfeld, 2013). Such implications may have encouraged development of abstinence-based gambling education, similar to the 'just say no' drug campaigns of the late 80s and early 90s introduced by Nancy Reagan. The Drug Abuse Resistance Education (D.A.R.E.) program in use until 2009 in the US represents one such program, and despite being one of the most widely implemented and well-funded school-based drug education programs in the country (nearly $1b annually), meta-analyses demonstrated it was ineffective (Ennett, Tobler, Ringwalt, & Flewelling, 1994; McNeal & Hansen, 1995; West & O'Neal, 2004). This suggests that alternatives to fear-based approaches and 'just say no' messaging are essential if we are to engage youth and reduce harm.

The purpose of this paper is to provide new insights into improving engagement with gambling education amongst young people, and to detail some of the conceptual and practical barriers in pursuing new directions to prevent gambling problems. This paper justifies the need for more theory-driven and evidenced-based content in gambling education programs to enhance their efficacy in reducing gambling-related harm.

It proposes that the cognitive model of problem gambling represents a conceptually justifiable theoretical framework to inform the content and delivery of gambling education initiatives. It then brings together psychological research and theory to inform how educational content may be developed and implemented using this framework. We explore some of the reported and anticipated issues of applying such a framework in practice and draw upon the pedagogical literature for solutions to common problems.

Specifically, this paper articulates the dual-purpose for incorporating misconceptions into gambling education – both conceptually and practically. From a conceptual perspective, misconceptions contribute to the development of gambling problems progressively by motivating further bets after losses. This developmental framework of problem progression may encourage young people to better identify themselves as someone who may be vulnerable to developing the disorder (enhancing engagement and relevance).

From a practical perspective, there are two main benefits of incorporating misconceptions into gambling education. The first as stated above, is that misconceptions are known risk factors for gambling problems, so it is important to address and correct unhelpful thinking patterns early so that we may reduce their impact on motivating current and future gambling play. A strong understanding of key mathematical concepts that pertain to gambling games may assist in addressing such misconceptions and act as a protective factor for their development.

Finally, the pedagogical literature states that misconceptions in many different fields of science education serve as important didactic teaching tools. When young people learn about how others have misinterpreted new concepts, they are less likely to make these mistakes themselves and are better able to learn complex material like gambling mathematics more accurately. The multiple advantages to incorporating misconceptions into gambling education are presented in Figure 3.1.

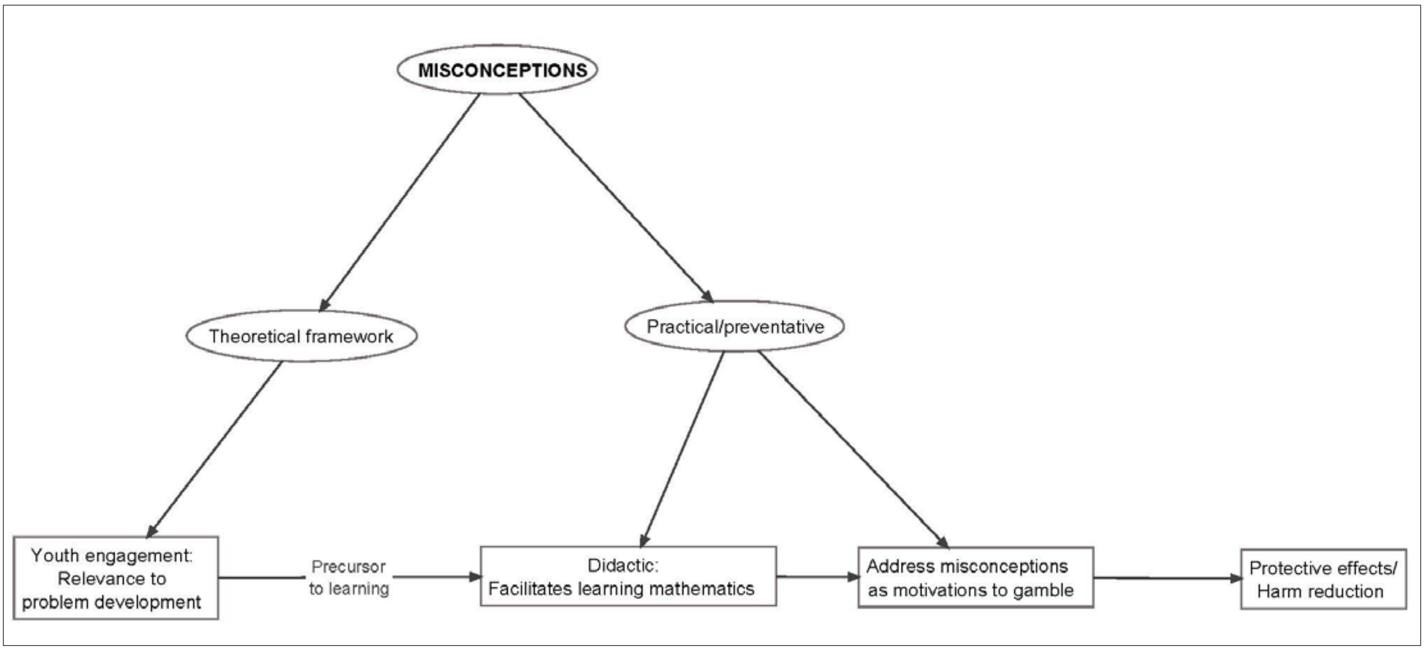

Figure 3.1: The proposed rationale for emphasising misconceptions in gambling education

The paper is separated into four sections, each of which constitute recommended changes to the theoretical approach, content, and delivery of gambling education: 1) Emphasising the harms of excessive gambling may not be relevant to youth and should be avoided, 2) Adopting a cognitive-developmental framework that focuses on the importance of gambling misconceptions may be a more engaging approach for young people; 3) Teaching gambling-related mathematics may act as a protective factor for gambling problem development and pedagogical research suggests explanations of misconceptions also play a didactic role and may improve this learning process; and 4) Technology can help promote a deeper understanding of complex gambling mathematics by use of data visualisations and simulations. These recommendations and the theoretical and scientific literature which supports them is provided below.

3.2 Recommendation 1: Shift the focus away from harms to increase youth engagement

Current risk-awareness programs for gambling may be less engaging for young people because they generally omit mechanistic explanations of the disorder which link the target audience to development of the disorder and associated consequences. These types of programs educate learners about the negative consequences of gambling problems, but do not provide an explanation of the factors that influence how or why problems emerge. This has likely been influenced by the considerable ambiguity in the gambling field around how problems develop (McIntosh, 2017; Rickwood, Blaszczynski, Delfabbro, Dowling, & Heading, 2010). The lack of a clear and unified theoretical model for problem gambling has likely hindered the standardised inclusion of a detailed description of problem formation in educational programs, as well as a clear mechanistic target for prevention.

Based on this reasoning, it is possible that the inclusion of a developmental account of gambling problem formation may enhance personal relevance and engagement for young people. Instead of encouraging concern for harmful consequences, a developmental account places emphasis on transitional processes that may occur between progressive stages of gambling. The information presented would educate about how someone progresses from initial exposure, to recreational gambling, to problem gambling. The target audience, who are either non-gamblers or non-problem gamblers, may find information relating to problem development has more personal relevance; a key to increase learner engagement and understanding of new educational material (Heddy & Sinatra, 2013; Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003; Taylor & Parsons, 2011).

It appears then, that programs aiming to promote messages about the harmful consequences of gambling have limited effectiveness in preventing future gambling problems, possibly because adolescents dismiss such messaging as lacking personal relevance or because they are not applicable to them. So, it is proposed programs that account for how someone much like themselves (presumably a non-gambler) may engage in gambling activities, and perhaps develop future problems, may increase personal relevance, engagement and impact on adolescents.

3.3 Recommendation 2: Applying a Cognitive-Developmental Approach to Gambling Education

One theoretical model that provides a developmental account of problem gambling is the cognitive model. Cognitive theories of problem gambling predominantly focus on the role that misguided belief systems play in driving gambling behaviour (Ladouceur & Walker, 1996). Cognitive therapeutic techniques typically involve challenging and replacing unhealthy cognitions with more accurate and helpful ones, in line with client goals (Chretien, Giroux, Goulet, Jacques, & Bouchard, 2017). Within the literature, gambling cognitions have been referred to using various terminologies; cognitive distortions, erroneous cognitions, irrational or distorted beliefs, and misconceptions, to name a few (see Chretien et al., 2017 for a systematic review). Attempts to measure such cognitions have also been varied and inconsistent (see Barrault & Varescon, 2012 for a comprehensive list of gambling cognition measures). A specific advantage of applying a cognitive-developmental model of problem gambling to educational efforts over and above other developmental models (neuro-developmental, behavioural, etc.) is that it suggests modification of thoughts and beliefs via didactic strategies may act as protective factors for gambling problems. It has also been suggested that focusing on cognitive mechanisms of change in public health may be more appropriate than focusing on behavioural solutions as the former better predicts gambling behaviour (Yakovenko et al., 2016). Results from this same longitudinal research indicated that gambling-related misconceptions may be the earliest robust predictors of change from social to problematic gambling, and thus should be the target for prevention initiatives (Yakovenko et al., 2016).

In the late 1980s, Gaboury and Ladouceur (1989) utilised the ‘talk-aloud’ approach which involved asking gamblers to verbalise their thought processes as they engaged in gambling tasks or activities. Research using this method established that gamblers consistently demonstrate systematic thinking errors (misconceptions) while gambling

(Baboushkin, Hardoon, Derevensky, & Gupta, 2001; Delfabbro & Winefield, 2000; Gaboury & Ladouceur, 1989; Griffiths, 1994; Walker, 1992a).

For the purposes of this paper, we will use the term ‘misconception’ to refer to a situation where someone holds a faulty ‘mental model’ of real-world phenomena without realising as much. An important distinction from dichotomous evaluations of a person’s thinking (correct vs. incorrect), misconceptions represent systematic and predictable errors in thinking that make initial conceptual sense when attempting to understand new phenomena (Smith III, diSessa, & Roschelle, 1994).

Importantly, cognitive distortions about gambling appear to constitute a convincing predictor of gambling problems in adults (Barrault & Varescon, 2012; Devynck, Giroux, & Jacques, 2012; Fortune & Goodie, 2012; Joukhador, Blaszczynski, & Maccallum, 2004; Lévesque, Sévigny, Giroux, & Jacques, 2018; Mathieu, Barrault, Brunault, & Varescon, 2018; Miller & Currie, 2008; Oei, Lin, & Raylu, 2008; Toneatto, 1999; Toneatto, Blitz-Miller, Calderwood, Dragonetti, & Tsanos, 1997; Toplak, Liu, Macpherson, Toneatto, & Stanovich, 2007), and amongst adolescents (Cosenza & Nigro, 2015; Donati et al., 2018). This research suggests that gambling-related misconceptions serve an important developmental role in the learning process gamblers undergo during some of their early gambling experiences, and may provide a fruitful avenue for early intervention or prevention of gambling problems.

Although gamblers with and without problems possess misconceptions, those with problems express such cognitions more frequently and more intensely than those without problems (Baboushkin et al., 2001; Joukhador et al., 2004; Raylu & Oei, 2004). Interestingly, recent research has suggested that gambling misconceptions may moderate or mediate the effects of other risk factors on gambling problems (Lévesque et al., 2018; Miller & Currie, 2008; Wong, Zhuang, Jackson, Dowling, & Lo, 2018). Additionally, Mathieu et al. (2018)

studied gambling motives of male poker players and determined that the data was consistent with a process model of gambling where gambling motives led to practice, which increased risk of developing misconceptions, which predicted problems.

3.3.1 What do gambling-related misconceptions look like?

Three recent reviews provide an overview of gambling-related misconceptions (Ejova & Ohtsuka, 2019; Fortune & Goodie, 2012; Leonard, Williams, & Vokey, 2015). Although there are several different and nuanced gambling misconceptions, there appears to be three broad categories of misconceptions which appear to influence gambling behaviour, each of which may manifest in different ways depending on the individual, the gambling environment, and the type of gambling game (Lévesque, Sévigny, Giroux, & Jacques, 2017). The following broad categories of misconceptions are described below, and their origins and manifestations are discussed later in this section.

The Gambler's fallacy. Also known as the Monte Carlo Fallacy, refers to the mistaken belief that after a series of losses a win is more likely (e.g., in electronic gaming machine (EGM) play "I have lost $500 on this machine, therefore a win is due soon"), or after a series of one particular outcome, the alternate outcome is more likely (e.g., in roulette: "it's landed on red the last ten spins! It's got to be black next"). This has also been associated with more broad decision-making biases, such as representativeness (see Fortune & Goodie, 2012 for an explanation of how this relates to the gambler's fallacy).

The Hot Hand fallacy. This fallacy refers to the belief that a winning streak is an indication of more winning. That is, an EGM may be considered to be "hot" or a player "on a roll" when incurring several wins in a row, which inclines players to persist playing while the 'winning streak' is occurring.

Illusion of control. This refers to the propensity to believe that the player has some level of control over chance outcomes, and that their personal level of success is higher than objective probability would suggest. For example, that choosing your own lottery numbers or rolling your own dice (as opposed to having them chosen randomly or thrown for you) will improve your likelihood of winning.

Although this is not an extensive list of the kinds of misconceptions problem gamblers may have, these three broad categories of cognitions can be considered umbrella terms for some more specific misconceptions gamblers may hold. For example, a gambler's specific thought "I'm on a roll" pertains to the hot hand fallacy, while the thought "I'm getting good at this" may be a manifestation of the illusion of control. Exactly where these misconceptions come from is of key importance to understanding how they may influence behaviour, and how we may go about preventing them.

Although misconceptions appear to play an early developmental role in gambling problems, cognitive models tend to lack a compelling account of the origins of these misconceptions. Without knowing exactly where gambling misconceptions come from, a gap still exists between non- or non-problem gamblers and problem gamblers who struggle with such misconceptions. Accounting for the origins of gambling misconceptions has the potential to increase young people's engagement with prevention by accounting for some early developmental stages that occur between non-gambling and problem gambling. It is possible that identifying with the early stages of non-problem gambling may increase message relevance from young people who may then be more receptive to subsequent educational material. It is also important to determine temporally when gamblers are likely to develop these misconceptions so that we can determine an appropriate strategy for prevention.

3.3.2 Where do gambling-related misconceptions come from?

There are several known cognitive biases and heuristics which broadly affect our decision-making and likely play a role in the development of gambling-related misconceptions (see Kahneman & Tversky, 1972; Tversky & Kahneman, 1973, 1974). However, more specifically, as misconceptions develop from attempts to learn new phenomena, gambling-related misconceptions appear to be derived directly from ineffective attempts to understand gambling outcomes.

Ejova and Ohtsuka (2019) contended that gambling misconceptions emerge from misapplying conventional heuristics when attempting to problem-solve how to win money gambling. The authors suggest that gamblers bring their preconceived belief systems to this problem-solving process which can relate to the natural world, supernatural phenomena, and understanding of random processes. Combined with work in reinforcement learning, the authors provided an account for why the gambler's fallacy is often present but does not lead to gambling problems for most gamblers. Experimental work carried out by Redish et al., (2007) determined that significant wins represent a large salient 'strike' to the gamblers' learning process which is largely impervious to extinction effects. One possible conclusion from this research suggests that winning may facilitate the misapplication of the gambler's fallacy to future gambling decisions encouraging continued gambling despite losses and eventually leading to problems.

3.3.2.1 Early wins.

Early positive gambling experiences such as a big win have been associated with an increased risk of developing gambling misconceptions and problems (Cummins, Nadorff, & Kelly, 2009; Delfabbro, Lahn, & Grabosky, 2005b; Delfabbro & Thrupp, 2003; Lambos, Delfabbro, & Puglies, 2007; Langer & Roth, 1975; Lesieur, 1984; Moran, 1970; Turner, Jain, Spence, & Zangeneh, 2008). It is possible that positive early gambling experiences may lead gamblers to develop a strong association between gambling and winning, and this may promote or strengthen biases toward decisions to gamble beyond affordable limits. Although this notion has not been tested in detail, there is some evidence that this is the case; problem gamblers are more likely to report being motivated to gamble to win money (Lee, Chae, Lee, & Kim, 2007), and gamblers motivated to win money are more likely to engage in loss chasing behaviour (Lister, Nower, & Wohl, 2016). This emphasises the need to intervene early, prior to gambling experiences to prevent misconceptions from developing.

3.3.2.2 Underlying game mathematics.

Extensive research carried out by educators and cognitive psychologists indicates that young people possess numerous misconceptions about scientific phenomena. Such misconceptions have been demonstrated in samples of students studying physics (Clement, 1982; Loverude, Kautz, & Heron, 2003; Zeineddin & Abd-El-Khalick, 2010), mechanical and electrical engineering (Chen, Pan, Sung, & Chang, 2013; Nelson et al., 2017; Wettergren, 2002), evolutionary biology (Chi, Kristensen, & Roscoe, 2012; Evans, 2008; Heddy & Sinatra, 2013) and most important to gambling, mathematics (Confrey, 1990; Garfield & Ahlgren, 1988; Gürbüz & Birgin, 2012; Shaughnessy, 1977).

The root of these misconceptions has been described as stemming from a lack of understanding of key concepts related to the subject matter. For example, students' misconceptions about buoyancy have been described as arising from an insufficient understanding of central concepts in physics such as weight, density, force, liquid pressure and displacement, and objects in equilibrium (Loverude et al., 2003; Zeineddin & Abd-El-Khalick, 2010). In the same way, gambling misconceptions can be described as resulting from a knowledge deficit of specific concepts in mathematics, including randomness, probabilities, and negative expected return or the unprofitability of gambling games (Blaszczynski & Nower, 2002; Gaboury & Ladouceur, 1989; Hardoon, Baboushkin, Derevensky, & Gupta, 2001; Ladouceur & Walker, 1996; Sharpe, 2002; Toplak et al., 2007; Walker, 1992b). Improving understanding of the mathematical underpinnings of commercial gambling products has been described as an important strategy to promote responsible attitudes toward gambling and prevent harm (Blaszczynski et al., 2015; Lowe & Money, 2017; Peard, 2008). Indeed, even outside the gambling literature, educators have suggested that necessary prerequisites to remediation of misconceptions like the gambler's fallacy involve education around concepts of independence and mathematical expectation (Peard, 2008).

3.4 Recommendation 3: Educate About Gambling Mathematics to Prevent Harm

A number of empirical studies have concluded that misunderstanding gambling-related mathematics concepts plays an important role in the development and maintenance of gambling problems, and that better understanding these may help prevent the onset of problems (Donati et al., 2018; Ferland, Ladouceur, & Vitaro, 2002; Ladouceur, Ferland, & Vitaro, 2004; Ladouceur, Ferland, Vitaro, & Pelletier, 2005; Lavoie & Ladouceur, 2004). However, not all findings have been positive. For example, Lambos and Delfabbro (2007) found no difference in numeric reasoning and ability between pathological, recreational, and non-gamblers; and concluded that educating about odds was unlikely to be effective in minimising gambling-related harm. Similarly, Williams and Connolly (2006) found that educating about mathematical knowledge relating to gambling did not result in predicted behaviour change.

Researchers have argued that part of the difficulty in impacting behaviour by altering gambling cognitions is that gamblers seem to have a rational understanding of the unprofitability of gambling outside of gambling sessions, but due to emotional investment in the game 'switch' back to unhelpful belief systems during a gambling session (Sevigny & Ladouceur, 2003). Australian researchers Delfabbro and colleagues (2006, 2009) referred to this concept in two studies of adolescent gamblers and demonstrated that despite adolescent problem gamblers' erroneous perceptions of randomness, they did not differ from non-problem gamblers in terms of their objective understanding of gambling odds. Educational programs for adolescents and young adults have attempted to address the role of emotions by incorporating emotion-skills training. For example, Romanian researchers (Lupu & Lupu, 2013; Todirita & Lupu, 2013) incorporated Rational Emotive Education with gambling education which resulted in improvements to gambling knowledge, misconceptions, and attitudes. However, it is not known what component of the education was most effective (emotion skills, game design knowledge, or some combination of both).

These challenges are consistent with studies in the pedagogical literature which suggest that when teaching abstract and complex scientific concepts, information about the concept is often insufficient to challenge previously held misconceptions. Loverude and colleagues (2003) investigated physics student's understanding of Archimedes' principle and determined that standard instruction on hydrostatics was insufficient to combat prior misconceptions and often left students confused about the new information. Similarly, Zeineddin and Abd-El-Khalick (2010) concluded that even amongst college students, prior knowledge played an important and potentially damaging role in their scientific reasoning skills. The authors explained that even after providing students with the correct information, students did not revise or change their original misconceptions. Importantly, we echo the arguments put forward by gambling researchers Wohl et al. (2010), who suggest that presenting factual information alone may not be sufficient for teaching complex ideas, particularly when that information does not sit within an existing knowledgebase (i.e., is not personally relevant).

It appears then, that the challenging task is to teach young people difficult mathematics concepts specific to gambling, so that they do not develop problematic misconceptions which place them at risk for gambling problems. However, it is not clear how we should go about doing so in a way that will maximise learning outcomes for young people. What is more, it appears that merely presenting factual information may be insufficient to combat misconceptions. Fortunately, the pedagogical literature constitutes a largely untapped resource providing a wealth of recommendations for how best to teach young people complex material that is prone to misconceptions.

3.5 Early Learning Processes and Conceptual Change

Emphasising the importance of prior knowledge, Posner et al. (1982) adapted Thomas Kuhn's (1962) original work on theory change in science to describe the application of *conceptual change* in science education. This model provides an account for how learners shift from an initial set of concepts to a new set that are incompatible with the first. Posner et al. (1982) suggested four specific criteria necessary for a learner to forego their prior conceptual knowledge and adopt new incompatible ideas. The authors suggest that before new concepts can be adopted, there must be (1) dissatisfaction with the current conception, and the new conception must be (2) intelligible, (3) plausible, and (4) able to resolve the problems of the original one (Posner et al., 1982).

More recently, Chi et al., (2012) adapted Posner at al.'s (1982) work in conceptual change and provided a concordant account for why many scientific phenomena are difficult to learn, and how misconceptions develop. The authors suggest that as children, we construct our worldview using examples from experiences in our everyday life. They term this internal structure a 'Direct Causal Schema' because it refers to processes that are sequential in nature, where one event builds upon another, and is directly causally related to the other. Examples of sequential processes learned in school include those that refer to cyclical or stage-like phenomena, such as learning the phases of the moon, stages of human development, and the various stages of photosynthesis (Chi et al., 2012). The authors suggest that we attempt to assimilate new information into this existing schema when learning new phenomena, and that for the above examples, this is mostly appropriate. However, many concepts in science entail *non-sequential* processes. Similar to the misapplication of conventional heuristics described by Ejova and Ohtsuka (2019), Chi et al. (2012) explain how misconceptions can develop from attempts to apply a direct causal schema to non-sequential processes.

In Heddy and Sinatra's (2013) study of undergraduate students' misconceptions about evolutionary biology, the authors described how evolutionary concepts often conflict with our intuitive feelings of agency and purposiveness. The researchers argued that such intuitions usually help construct meaning in the face of complex information, however when learning new concepts related to evolution, they impeded student's ability to understand the content fully.

Comparisons can be drawn here with gambling education. Complex and abstract mathematical concepts that underpin the operation of gambling games can be considered non-sequential, and indeed the process of how an EGM produces a winning outcome for a player is a non-sequential process. Using Chi et al.'s (2012) framework, we can describe how novice gamblers may apply a direct causal schema when attempting to understand how and when EGMs produce winning outcomes. For example, the gambler's fallacy can be described as resulting from an attempt to apply a direct causal schema (processes occur in a cumulative/cyclic fashion) to a non-sequential process (machines operate randomly, and every spin is independent of the last).

3.5.1 Using misconceptions as a didactic technique to enhance learning gambling mathematics.

Importantly, such applications of the conceptual change framework suggest that misconceptions play an important role in learning new and complex information. In particular, educating about misconceptions represents an important opportunity for learners to consider the failures of that concept, and prepares them to better accurately accept new complex information (Chi & Roscoe, 2002; Chi, Slotta, & De Leeuw, 1994; Posner et al., 1982; Strike & Posner, 1982). However, this must be done strategically; it is best to first specify misconceptions, encourage dissatisfaction with those ideas, and then provide information which remediates them and provides more fruitful outcomes (Posner et al., 1982; Strike & Posner, 1982).

Of note, there is increasing evidence that targeting misconceptions in gambling education may be effective. Donati at al. (2018) reported on two studies; the first of which determined that misconceptions were a significant predictor of gambling problems amongst adolescents. Following this finding, the authors designed an education program which instructed adolescents to reflect on the irrationality of probabilistic reasoning errors and superstitious thinking. The results of this education program indicated a successful reduction in misconceptions and gambling frequency compared to adolescents who did not receive the program (Donati et al., 2018).

3.6 Recommendation 4: Leveraging Technology to Teach Complex Concepts

Teaching such key mathematical concepts at the level of depth required for comprehension is difficult, and educators are already required to teach outside their scope of knowledge (Batanero & Diaz, 2012; Garfield & Ahlgren, 1988). This means that educators often provide only superficial explanations of what are reasonably complex concepts, and this likely impedes uptake of new information (Schwartz, Varma, & Martin, 2008). This may explain why some researchers have concluded that teaching such concepts is unlikely to reduce gambling-related harm (e.g., Lambos & Delfabbro, 2007). That is, it is not clear if teaching such concepts is ineffective in preventing harm, or if the concepts, because of their inherent difficulty, are not being adequately taught.

Most evaluated gambling prevention programs provide superficial explanations of the mathematical concepts that underlie problematic misconceptions about commercial gambling (Keen et al., 2016a). Educators have stressed that a more comprehensive understanding of these concepts is needed to reinforce responsible attitudes toward gambling, and that such concepts can be readily learnt by those with little prior success in mathematics (Peard, 2008). Superficial explanations of new concepts are likely to raise scepticism among learners, and unless new concepts are explained in sufficient and compelling detail, learners will likely reject them and hold on to any previously held convictions, regardless of their accuracy (Posner et al., 1982; Smith III et al., 1994; Strike & Posner, 1982). For example, telling a problem gambler who holds the misconception that gaming machines operate in winning and losing cycles that machines are actually random may not adequately compel them to accept that notion without sufficient explanation.

Pedagogical researchers have suggested that teaching complex mathematical concepts can be enhanced by using newly available technologies (Borovcnik, 2007; Chandra & Watters, 2012b; McKagan et al., 2008). For example, computer-generated visualisations and animations are powerful tools that can be leveraged to help explain complex abstract concepts necessary for inclusion in problem gambling education; and students now have access to point-and-click software to perform data simulations that allow them to visualise and understand abstract statistical problems (Borovcnik, 2007). Previous research has demonstrated that computer simulations and visualisations facilitate learning of complex and abstract concepts in science, such as those in electronics, engineering, quantum mechanics, physics, and mathematics including remediation of misconceptions about probabilities (Borovcnik, 2007; Chandra & Watters, 2012b; Gürbüz & Birgin, 2012; Mayer & Moreno, 2002; McKagan et al., 2008; Nelson et al., 2017; Özyurt, Özyurt, Güven, & Baki, 2014; Pilli & Aksu, 2013). Such simulations can also be displayed in graph format for visual impact. One further benefit of utilising computer-assisted technologies in problem gambling education is that it helps control for educator effects. That is, computer-based programs represent standardised instruction. This is a compelling advantage, given the low mathematical literacy among some teachers, the difficulty inherent in teaching these concepts, and the already overflowing curriculum schools are expected to deliver (Batanero & Diaz, 2012; Garfield & Ahlgren, 1988).

3.7 Conclusions and Recommendations for Gambling Education

A potentially important barrier to youth engagement with current programs is the lack of a detailed description of problem gambling development, which ultimately prevents audiences from relating to the disorder. From a cognitive perspective, problem gambling development arises in part from misconceptions and the inclusion of misconceptions in educational programs could enhance learning engagement and outcomes. Such inclusion however, raises further challenges as misconceptions relate to abstract mathematical concepts that underpin commercial gambling products but are complex and difficult to teach.

The pedagogical literature provides helpful avenues to teaching complex and abstract concepts which are prone to misconceptions. It suggests exposing misconceptions represents a didactic technique whereby learners are able to consider their problematic nature, and ultimately prepares them to adopt new complex corrective information. Moreover, the pedagogical literature further suggests that several technologies may be leveraged to assist in the delivery of complex and abstract concepts in problem gambling education. Based on the above review, several guidelines for the development of future gambling education programs can be made.

First and foremost, preventive information should place less emphasis on raising awareness of severe consequences associated with gambling problems. Fear-based approaches to problem gambling education do not resonate with young audiences and do little to effectively reduce development of gambling problems. Second, initiatives directed to adolescents should aim to include a description of problem formation that fits within a developmental framework and affords opportunities for prevention. The cognitive account of problem gambling is one such description but must include information on the aetiology of gambling misconceptions.

Following this, preventative content should focus on gambling-related mathematical concepts that are often misunderstood and lead to misconceptions about the profitability of commercial gambling games. For example, for EGMs these concepts and their related misconceptions may include independence of events and the long-term negative expected payoff of the return-to-player per cent and how these relate to the gambler's fallacy. Moreover, when attempting to teach these mathematical concepts, problem gambling education should teach young audiences about common misconceptions first, before presenting new complex and abstract mathematical information. A conceptual change framework suggests that misconceptions represent an opportunity for learners to consider the failures of an idea, which increases dissatisfaction with initial concepts and better prepares them to adopt new complex information.

Finally, new technologies including computer simulations and visualisations should be leveraged to help young learners comprehend new abstract mathematical concepts. Statistical simulations of gambling games over time may help to clarify how gamblers may win in the short-term but ensure overall long-term losses with repeated plays. Taken together, the findings of this review have the potential to inform substantial improvements to gambling education programs that aim to prevent problems. It is important however, that these suggestions are tested empirically using robust experimental and longitudinal research methodologies.

3.8 Chapter Summary

The above review provided a rationale for incorporating and appraising misconceptions in gambling education in an effort to improve program relevance and effectiveness amongst young audiences. Such an approach bears several challenges, as misconceptions are robust, and only amenable to change through comprehension of more complex or abstract information. In the following chapter, a detailed methodology is outlined for the three studies described later in Chapters 5, 6, and 7. Using theories drawn from this literature review, an educational video about electronic gaming machine (EGM) gambling was created and evaluated amongst a sample of adolescents, first-year university students, and regular EGM gamblers. The next chapter describes the video in detail, along with two comparison videos, and the outcome measures used to evaluate it.

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4 Chapter Four: Study Design and Methods

Preamble: In Chapter 3, several features were recommended to improve the development of gambling education programs. From these recommendations, an educational video was developed so that it could be empirically tested against existing gambling education information. This chapter provides an overview of the research thesis' aims, hypotheses, and broad methodology. It also details a comprehensive description of the materials used in each experimental study including the educational videos and the main outcome measures. Specific aims, hypotheses, and procedures are described at the beginning of each of the respective results sections in Chapters 5, 6, and 7.

4.1 Introduction

The recommendations outlined in Chapter 3 were based on a thorough review of theoretical and practical considerations for the development of problem gambling education. However, it is essential that such recommendations are evaluated for their ecological validity and overall efficacy. Chapters 5, 6, and 7 describe the results of three studies that were conducted to empirically test several of the aforementioned recommendations. There were several commonalities in the materials, methods, and analytical approaches across the three studies. The purpose of this chapter is to provide a comprehensive description and justification of the materials and methods that are common to the studies reported in Chapters 5, 6, and 7.

The three studies used developmentally progressive samples and aimed to test the unique impact of critically appraising misconceptions in gambling education amongst those cohorts. In order to test this approach, an educational animated video was developed that incorporated many of the recommendations outlined in the previous chapter. Two more educational videos were developed based on existing gambling education to compare the experimental video. All three videos are explained in further detail below.

4.2 Research Aims and Hypotheses

The theoretical review provided in Chapter 3 suggested that gambling misconceptions play various roles in the way different people think about and engage with gambling games. Although somewhat related, gambling misconceptions can be conceived as having three distinct roles:

Didactic tool: Pedagogical research suggests that when teaching novice learners complex concepts – like important gambling mathematics – it can be helpful to first explain commonly held misconceptions. In this context, misconceptions provide initial representations that act as mental scaffolding to prepare the learner for the new complex information.

Developmental risk factor: For those who have had prior gambling experiences, misconceptions may act as a catalyst for future gambling. That is, some gambling experiences, like winning, may lead people to mistakenly believe that gambling is more profitable than is objectively true.

Motivational factor: For those who are experiencing gambling harm, misconceptions can be explained as maintaining and perpetuating excessive gambling behaviour, despite considerable financial and personal consequences.

Each of these functions of misconceptions can be leveraged in gambling education, depending on the audiences' developmental stage. Primary prevention efforts aimed at educating young audiences may benefit from didactic techniques which help in conveying complex ideas like gambling mathematics. Whereas, using misconceptions in an attempt to explain gambling motivations in problem gambling populations may be an effective method to help gamblers understand their behaviour and reduce harm.

The aim of this research was to test the various functions of educating about misconceptions in different developmental cohorts. Specifically, does critically appraising misconceptions in gambling education:

1) improve young people's engagement with gambling education,

2) improve people's knowledge of important mathematical concepts related to gambling, and

3) reduce misconceptions amongst those who have them.

Three separate studies aimed to test the following broad hypotheses (more specific hypotheses will be described at the beginning of each experimental study's chapter):

H_1 = Critically appraising gambling misconceptions will improve engagement with gambling education among adolescents and young adults compared to teaching about harmful consequences.

H_2 = Critically appraising gambling misconceptions will promote a better understanding of key mathematical concepts related to gambling compared to teaching about harmful consequences.

H_3 = Critically appraising gambling misconceptions will help to reduce misconceptions held by regular gamblers.

Three studies were designed which, together, provide cross-sectional insight into the lifespan of Australian gamblers. In particular, the first and second studies aimed to determine if, as has been seen in broader science education, misconceptions in gambling education increases engagement among adolescents and young adults. The first and third studies aimed to determine if critically appraising misconceptions improves learning complex gambling mathematics. Although the third study aimed to determine if critically appraising misconceptions was effective in reducing misconceptions amongst regular gamblers.

Each of the three studies aimed to address some of the limitations of previously evaluated gambling education programs discussed in Chapter 2. Namely, they incorporated a measure of self-reported gambling behaviour including frequency and expenditure, and potential problems, over and above important cognitive measures. In addition, it was important to incorporate collection of follow-up data into the research methodology and measure outcomes at longer term intervals; up to six months after the intervention. Integrity of delivery of the intervention was also considered, and the use of animated videos were advantageous in overcoming issues of inconsistent and unstandardised delivery of educational information.

4.3 Study Designs

The following research involved three studies that employed mixed factorial and repeated measures research designs. The first study was conducted with adolescents and administered measures before and after random allocation to one of three educational video conditions. The second study was conducted with first-year psychology students and employed a repeated measures design where each participant viewed all three videos and completed measures before and after each video. The third study was carried out with adult gaming machine gamblers and employed a random allocation factorial design where measures were administered before and after watching one of the videos.

The primary independent variable across the three studies was education type. Education type comprised three levels which were represented in animated videos aimed to educate viewers about electronic gaming machines (EGMs). Each of the three educational videos were used in all three experimental studies and their details can be found below.

4.4 Educational Videos

In line with the rationale proposed in Chapter 3, an educational video was created that focused on breaking down two common misconceptions about electronic gaming machines (EGMs). It did this by following the recommendations in Chapter 3, which suggested first providing a detailed explanation of people's misinterpretation, followed by information about the underlying game mathematics which combats these misconceptions. In addition, two comparison videos were developed from current publicly available educational material about EGMs. In total, three different kinds of educational videos were developed:

- One that does not focus on the consequences of problem gambling but on teaching underlying game mathematics and related misconceptions (cognitive misconceptions);

- One that focuses on the consequences associated with problem gambling and does not provide detailed information about misconceptions or underlying game design (risk awareness); and
- One that does not focus on the consequences of problem gambling, has minimal content on misconceptions, but does aim to promote a better understanding of underlying game mathematics (operator information).

Table 4.1: Content focus by educational video

	Content		
Educational video	Risks and consequences	Game mathematics	Misconceptions
Cognitive misconceptions	✗	✓	✓
Risk awareness	✓	●	✗
Operator information	✗	✓	●

Legend: ✓ *Focus = content is based on this content;* ● *Not focus = some information may appear, but this is not the primary focus or is not explained in detail;* ✗ *Not explained = not included in the content.*

It was important to use ecologically valid information about EGMs, so the two comparison videos were created from existing publicly available information. It was also important that the three videos differed in their content, but not appearance, so that possible differences between them could be attributed to content and not delivery/graphic appeal. All three videos were created by the same animation developer, who operated externally to the research team and had no prior experience with gambling research. Each of the videos had similar images, animations, and all videos had the same narrator. The content of each of the videos is described below.

4.4.1 Cognitive Misconceptions video (CM).

Drawing on the reviewed literature and suggested rationale provided in Chapter 3, an animated educational video was developed based on a cognitive developmental framework of problem gambling etiology. The CM video presented gambling misconceptions about the design of electronic gaming machines as a risk factor that may lead to problematic levels of gambling and focused on explaining two key concepts of EGM play that, when misunderstood, contribute to the gambler's fallacy. These two concepts were the return-to-player per cent (or negative payoff of long-term play), and independence of events (randomness). Table 4.2 provides an overview of the content of the video, which focused on explaining these two misunderstood concepts and the associated corrective information about the game mathematics that underpin them. This video ran for approximately 20 minutes.

Table 4.2: CM video content focus

Content		**Level of explanation**
Risks and consequences	✗	Not explained
Game mathematics	✓	Focus
Misconceptions	✓	Focus

The content in the video was designed and adapted from Dr. Fadi Anjoul's Cognitive Deconstructional Therapy treatment manual for problem gambling with EGMs (Anjoul, 2015). This therapeutic method identifies, targets, and deconstructs the specific cognitions that maintain and drive problem gambling.

The concepts of return to player per cent (RTP%) and randomness were considered crucial information because they are central to understanding how EGMs operate at a loss to the player. Researchers have demonstrated that many EGM players (and lay people) have the erroneous belief that gaming machines operate in predictable winning and losing cycles, and that this misconception can drive loss chasing behaviour (Delfabbro & Winefield, 1999; Ejova & Ohtsuka, 2019; Fortune & Goodie, 2012). Thus, facilitating understanding of these two concepts is hypothesised to increase understanding of the long-term unprofitability of EGMs and reduce related misconceptions in those who have them. These concepts are intertwined and understanding how they each relate to the long-term unprofitability of EGMs is dependent on and complements the other.

This work aligns with the research conducted by Wohl et al. (2010) which aimed to challenge two key misconceptions related to gaming machines using a brief animation; independence of events, and sampling replacement. The authors determined that gamblers who watched the animated video were more likely to endorse responsible gambling strategies and intention to use them. The current educational video extends on this work to explain how the two seemingly opposing concepts of randomness and return-to-player per cent work together to produce overall losses for players with repeated play. Specifically, this video targets two misunderstood concepts:

Misconception 1: That EGMs run in winning and losing cycles. This can be conceptualised as a manifestation of the gambler's fallacy, whereby gamblers mistakenly believe that after a continued series of one particular outcome, the probability of the alternative outcome increases. For example, after a series of many losses, that a win is 'due'. This misconception is underpinned by a misunderstanding of the mathematical principle of independence of events.

Misconception 2: The second misconception is that machines are 'set' to return a certain percentage of money to players. Although on face value this statement appears true, it is poorly understood and further encourages the misconception that machines run in winning and losing cycles to maintain a 'record' and 'balance' of wins and losses. This is borne from a misunderstanding of the mathematical concept of expected value, which relates to statistics and probabilities.

Both misconceptions feed into one another and explanation of one without the other may not fully resolve the gambler's fallacy. For example, the reason many gamblers believe Misconceptions 1 is because they are told (often through educational material) that gaming machines are programmed to return a percentage of monies put in them. This creates an understanding that if this is to be true, machines must ‘pay out’ soon after losing streaks to operate within this programmed return per cent. In reality, this explanation fails to consider that expected pay out amounts are a) a theoretical projection based on the games’ parameters (number of winning combinations and pay out amounts), b) this per cent refers to credits, not cash, and c) the projected expectation is not likely to be met within the several hours of a gambling session, or even the following days, weeks, or months.

In line with the conceptual change model of science education, misconceptions were presented before mathematical information, to create dissatisfaction with the misconception and increase likelihood of accommodating new complex information (Chi, Kristensen, & Roscoe, 2012; Posner, Strike, Hewson, & Gertzog, 1982; Strike & Posner, 1982). In addition, the video incorporated visualisations of abstract mathematical concepts to promote improved learning of complex ideas, as well as computer simulations of EGM play to provide context-specific information (Chen, Pan, Sung, & Chang, 2013; Kelly & Jones, 2007).

An outline of the structure and content of the video is as follows:

1. Introduction
    a. Purpose
2. Three stages of gambling
    a. Non-gambling stage
    b. Recreational stage
        i. Early wins
    c. Problem gambling stage
3. Misconception 1: Predictable Cycles
4. Random selection
    a. The game’s range

    b. Random number-reel-position selection
    c. Unequal number of symbols
    d. Number of symbols never change
5. Misconception 2: Adjust to Percentage
6. House Edge and Expected Payoff
    a. Expected Payoff and Return to Player Percentage
    b. Symbol-Probability and Prize Level
7. Summary

A detailed script of the video can be found in Appendix B, as well as screenshots of this video in Appendix C.

4.4.2 Risk Awareness video (RA).

The content in the risk-awareness video represented the content of most publicly available problem gambling education programs, as identified in the systematic review in Chapter 2. That is, it predominantly depicted the harmful consequences of gambling and focused on promoting an awareness that gambling was a high-risk behaviour. The risk-awareness video contained very minimal or no content pertaining to game mathematics, with concepts such as probabilities and randomness mentioned, but not explained in depth. Details of gambling-related misconceptions were not explained. The RA video ran for approximately 15 minutes.

Table 4.3: RA video content focus

Content	Level of explanation
Risks and consequences	✓ Focus
Game mathematics	● Mentioned but not explained
Misconceptions	✗ Not explained

In order to maintain ecological validity, the script and some of the images in the animation were adapted from the Victorian Government's Responsible Gambling Guide (VRGF, 2013). The content of the script was taken verbatim from the Guide where possible, except in cases where it was necessary to modify the language slightly so that it was grammatically correct or more understandable to the audience. Copyright permissions were obtained from the VRGF to adapt the content of the Guide to the animation for the purposes of the current research (see Appendix D). This video also contained publicly available video footage of a young man discussing his experience with gambling, made available by Gambling Help NSW (2013) via YouTube. The video was not altered in any way, except for reducing its length to fit the educational video.

The Risk Awareness video content adhered to the following structure:

1. Introduction
    a. Purpose
2. Types of gambling
    a. Games of pure chance
    b. Games involving skill
3. Risk Factors for Problem Gambling
    a. Why do people gamble?
    b. Pokies
    c. Winning and losing on the pokies
4. Consequences
    a. James' story
5. Signs and Symptoms
    a. How does problem gambling start?
    b. Warning signs

6. Where to Get Help

The full script for the RA video as well as screenshots can be found in Appendix E and F, respectively.

4.4.3 **Operator Information video (OI).**

The operator information video was based on the Gaming Technologies Association's (GTA) Australian Gaming Machines Player Information Booklet (2018). This video aimed to promote a better understanding of the game design of EGMs, including a broad overview of game mathematics and features such as the random number generator and RTP%. It did not contain messages about the harms and consequences of gambling and had little description of gambling-related misconceptions and why these place people at a higher risk for Gambling Disorder (Table 4.4).

Table 4.4: OI video content focus

Content	**Level of explanation**	
Risks and consequences	✗	Not explained
Game mathematics	✓	Focus
Misconceptions	●	Mentioned but not focus

The script was taken verbatim from the Player Information Booklet, except where amendments needed to be made to the language so that it was grammatically correct and understandable to its audience. Copyright permissions were obtained from the GTA to adapt this information into an animation for research purposes (see Appendix G). This video ran for approximately 18 minutes. The OI video content and structure was as follows:

1. Introduction
2. Winning and Losing on the Machines

  a. Table 1: Win-Lose
  b. Table 2: The TIME Factor
3. How the Machines Work
  a. Chance
  b. Randomness
    i. Random number generator (RNG)
  c. Return to player per cent (RTP)
4. Where to Get Help

Screenshots of this video and a full script can be found in Appendix H and I, respectively.

4.5 Outcome Measures

Many of the measures described below were 1) common to all three experimental studies, 2) novel and purpose-made for this research, and 3) require a complete description of their items and psychometrics properties. Novel measures are described in full and the complete scale is provided in this chapter. Full versions of validated measures can be found in their respective cited publications. In addition to the outcome measures listed in this chapter, participants were asked questions about their gambling behaviour, simulated gambling experiences, and demographic situation. The specifics of these questions differed slightly across studies and so are reported in full in each of the following experimental results chapters.

4.5.1 EGM cognitions scale (ECS).

Frequency and intensity of gambling misconceptions can effectively discriminate between those with and without gambling problems (Mathieu, Barrault, Brunault, & Varescon, 2018). However, there is no consensus on the best approach to measuring gambling misconceptions and current instruments suffer problems with content validity, limiting their efficacy in experimental research (Leonard, Williams, & Vokey, 2015). Further, the vast majority of gambling cognition scales do not differentiate between gambling forms, despite recognition that cognitions likely differ depending on the type of gambling activity (e.g., EGMs vs. sports betting) (Barrault & Varescon, 2012; Lévesque, Sévigny, Giroux, & Jacques, 2017). As such, for the purposes of this research, the decision was made to focus solely on measuring misconceptions arising from EGM play.

To the authors' knowledge, only one other scale has been developed that measures gambling related cognitions specific to gaming machines. Jefferson and Nicki (2003) developed a self-report measure named the Informational Biases Scale (IBS), which measures cognitive distortions amongst video lottery terminal (VLT) players. However, the decision was made to use the EGM Cognitions Scale (ECS) as it was briefer and referred specifically to EGMs (Australian machines) as opposed to VLTs (which are gaming machines found in the United Kingdom, Canada, etc.).

The ECS was developed by Dr Fadi Anjoul at the University of Sydney and is based on his extensive experience as a clinical psychologist treating people with gambling problems, as well as his interactions supervising and training psychologists at the University's Gambling Treatment and Research Clinic. The scale has 16 items that each represent cognitions or statements about EGMs; 12 items endorse misconceptions or unhealthy cognitions and four items represent accurate or healthy cognitions (reversed items). Responses included 1 = 'Strongly disagree', 2 = 'Disagree', 3 = 'Agree', 4 = 'Strongly agree'. Four positively framed items on the scale were reversed and responses totalled. Possible scores ranged from 16 to 64 with lower scores indicating fewer misconceptions. The scale demonstrated an acceptable level of internal consistency (Chronbach's α =.71) (DeVellis, 2003; Kline, 2005) in a sample of 73 regular EGM players. The full scale is provided in Table 4.5.

Table 4.5: Items in the EGM Cognitions Scale (ECS).

ECS items
1. A machine is more likely to pay when you change the total number of credits bet per spin.
2. Playing different machines over time helps you work out which ones are likely to pay more.
3. Players who know what they are doing have a better chance of winning on the poker machines in the long run.
4. Machines are less likely to pay after a short series of wins.
5. Playing the machines is pointless (R).
6. After a long series of wins, there is less chance that a machine will pay in future spins.
7. Your chances of winning or losing on a machine never change (R).
8. There is nothing you can do to trick or confuse a machine into producing winning outcomes (R).
9. A machine is less likely to pay after a player has cashed out a large sum of money.
10. The machines are set to return a certain percentage of money put in them back to players.
11. There are certain times when a machine is more likely to pay.
12. After a long series of losses, machines are more likely to pay in future spins.
13. It is a mathematical impossibility to win back all your losses in the long run (R).
14. Machines are more likely to pay after a short series of losses.
15. A machine is more likely to pay when you change the number of lines played.
16. A few big wins every so often will ensure you come out ahead in the long run.

(R) = Reversed items

4.5.2 Engagement

Engagement has been defined as a meta-construct comprising at the very least behavioural, cognitive, and emotional elements (see Appleton, Christenson, & Furlong, 2008 for a conceptual review). In educational studies, cognitive and behavioural engagement has been referred to as the particular strategies one may employ to become more involved in the learning process. For example, a learner may get to school early and complete homework (behavioural), or mentally rehearse the information they have been taught (cognitive); whereas emotional engagement refers more to students' affective response to education (positive/negative reactions)(Appleton et al., 2008; Fredricks, Blumenfeld, & Paris, 2004; Fredricks & McColskey, 2012).

For the purposes of this research, it was appropriate to focus on emotional engagement, given that it was most important to measure adolescents and young adults' response to a static piece of educational information, as opposed to ongoing education. That is, how much did young people 'like' the educational videos? The current measure of emotional engagement was informed by the items in Shernoff et al. (2003) and Park et al's (2012) studies on student engagement. Shernoff et al. (2003) used a measure of emotional engagement which comprised the central components of *flow* theory; interest, concentration and enjoyment. Park et al. (2012) later adapted these items to use as a measure of emotional engagement in their longitudinal study on senior students' engagement in learning. As such, emotional engagement with the educational videos was conceptualised as a composite measure of self-reported interest, concentration, and enjoyment. Participants were asked to rate their level of interest, concentration, and enjoyment on a five-point Likert scale (1 = 'Not at all', 2 = 'Not very', 3 = 'Neutral', 4 = 'Somewhat', 5 = 'Very'). Each response on the three items were summed (range = 3 to 15), with lower scores indicating lower engagement. The scale had good internal consistency amongst adolescents (Cronbach's α =.89) and young adults (Cronbach's α = .82) in this research. The items and response options for this scale can be found in Table 4.6 below.

Table 4.6: Emotional Engagement Scale

Item	**Response options**				
	1	2	3	4	5
Did you find the video interesting?	Not at all interesting	Not very interesting	Neutral	Somewhat interesting	Very interesting
Were you concentrating on the video?	Not concentrating at all	Not really concentrating	Neutral	Somewhat concentrating	Concentrating hard
Did you enjoy watching the video?	Did not enjoy it at all	Did not really enjoy it	Neutral	Somewhat enjoyed it	Really enjoyed it

4.5.3 Likelihood of Accommodating New Information (LANI)

Research in conceptual change suggests that misconceptions play a key role in helping learners take on new complex information (Posner et al., 1982). The principles provided by this framework suggest that new information must be intelligible, plausible, and fruitful before it can be fully accommodated (Posner et al., 1982; Strike & Posner, 1982). Furthermore, researchers who have adopted the conceptual change framework and integrated it with educational models have suggested that *transformative* learning promotes better conceptual change. That is, when information is personally relevant to young people, they are more likely to accommodate it (Heddy & Sinatra, 2013). In order to determine if accommodation of new information was likely, a self-report measure was developed that incorporated the above research. The items used to measure intelligibility, plausibility, fruitfulness, and relevance were informed from pre-testing research for anti-smoking campaigns in Australia (Wakefield, Durkin, Murphy, & Cotter, 2007). The scale consists of four items asking participants to rate how much they 1) understood the information; found it 2) believable, 3) useful, and 4) relevant, on a five-point Likert scale (1 = 'Strongly disagree', 2 = 'Disagree', 3 = 'Neutral', 4 = 'Agree', 5 = 'Strongly agree'). Responses to each item were summed to give participants a total score (range = 4 to 20), with lower scores indicating low likelihood of accommodating new information. The scale had reasonable internal consistency for a new measure (Gudergan, Ringle, Wende, & Will, 2008) (Cronbach's α =.69) amongst a sample of adolescents and fair consistency amongst a sample of first-year psychology students (Cronbach's α =.70). Items for this scale are presented in Table 4.7.

Table 4.7: Items in the Likelihood of accommodating new information (LANI) scale

LANI Items
1. I understood the information in the video.
2. The information in the video was believable.
3. I found the information in the video useful.
4. The information in the video was relevant to me.

4.5.4 Perceived Effectiveness

Participants in the adolescent and university student samples were asked to rate how effective they thought each video was on a scale from one to five (1 = 'Not at all effective', 2 = 'Not very effective', 3 = 'Neutral', 4 = 'Somewhat effective', 5 = 'Very effective'). Participants were asked "how effective would this video be in the following ways…" 1) "preventing young people from developing gambling problems with the pokies in the future" and 2) "reducing the amount of money young people spend on the pokies in the future". Responses to each item were summed to give participants a total score (range = 2 to 10) where lower scores indicated lower perceptions of effectiveness.

Self-reported measures of perceived effectiveness are commonly used throughout the public health and marketing research fields to provide an overall perception of intervention impact (e.g., see Adebiyi, Uchendu, Bamgboye, Ibitoye, & Omotola, 2016; Sinclair & Whitford, 2015; Taylor, 2017; Wakefield et al., 2007; Wang, Egelandsdal, Amdam, Almli, & Oostindjer, 2016).

4.5.5 Canadian Adolescent Gambling Inventory (CAGI) Gambling Problem Severity Subscale (GPSS).

The Canadian Adolescent Gambling Inventory Gambling Problem Severity Subscale (CAGI-GPSS; Tremblay, Stinchfield, Wiebe, & Wynne, 2010) was used to measure adolescents' level of gambling problem severity. The CAGI is a validated scale which is divided into two sections; the first section asks participants about the different forms of gambling they have engaged in over the past three months, as well as the frequency and duration of that activity. This part of the CAGI is designed to gather information and no scoring is carried out. The second part of the CAGI is comprised of five subscales that detail the consequences of one's gambling. Three of these pertain to psychological, social and financial harms experienced by adolescents, the fourth relates to loss of control and the fifth refers to the global severity of gambling problems experienced (gambling problem severity subscale; GPSS) (Tremblay et al., 2010). For parsimony, only the fifth subscale, the GPSS, was used in this study. It consists of nine questions which are scattered throughout the four consequences subscales (2-3 questions in each of psychological, social, and financial consequences, and loss of control). Participants were asked to indicate the frequency with which they endorsed the items on the GPSS in the past three months on a four-point scale (0 = 'Never', 1 = 'Sometimes', 2 = 'Most of the time', 3 = 'Almost Always'). Scores were summed (range = 0 to 18) and a traffic-light system approach was applied where scores of 0-1 = No problem (green light), 2-5 = Low to moderate severity (yellow light), and 6+ = high severity (red light).

The subscale has good convergent validity, with all measures of gambling behaviour (no. games played, frequency, duration, losses, debt, peer gambling) significantly correlating with scores on the GPSS (p <.001, r >.30) (Tremblay et al., 2010). The authors of the scale also conducted Receiver Operating Characteristic (ROC) curve analysis and confirmed the GPSS had good classification accuracy, as demonstrated by large area under the curve values when compared to gold standard measures of gambling problems (CRAGS = 0.97, DSM-IV-CR = 0.96, DSM-IV-SR) (Tremblay et al., 2010). The GPSS had good internal consistency in the adolescent sample described in Chapter 5 (Cronbach's α = 0.91).

4.5.6 Canadian Problem Gambling Index (CPGI) Problem Gambling Severity Index (PGSI)

In order to measure problem gambling severity amongst adults, gamblers in Study 3 were administered the Problem Gambling Severity Index (PGSI) of the Canadian Problem Gambling Index (CPGI) (Ferris & Wynne, 2001). Participants were asked to respond to each on the nine items on a four-point Likert scale where 0 = 'Never', 1 = 'Sometimes', 2 = 'Most of the time', 3 = 'Almost always', producing a range of possible scores from 0 to 27.

Respondents' scores were totalled and were categorised as having no problem (score = 0), low-risk (1-3), moderate-risk (4-7), and problem gambling (8+). More recently, researchers have provided revised thresholds for PGSI risk categories (Currie, Hodgins, & Casey, 2013), however, the original authors' scoring system was used in the current research to be consistent with the majority of the literature in the field using this scale. Previous research has demonstrated the subscale has good internal reliability (Cronbach's $\alpha = 0.84$) and has superior classification validity compared to other problem gambling screens such as the South Oaks Gambling Screen and the Victorian Gambling Screen (Mcmillen & Wenzel, 2006).

4.5.7 Understanding Important Gambling Mathematics Concepts

The rationale described in Chapter 3 suggested that problematic misconceptions are underpinned by a lack of understanding (or misunderstanding) of important mathematical concepts related to EGM play. Because these concepts are often abstract and complex in nature, it is difficult to measure how well people understand them. Consequently, scenario-based questions that allowed for more complexity in responses were developed in order to determine if participants understood two important concepts related to EGM play. Although the following two concepts are intertwined and overlap is expected, the first question aimed to gauge participants' understanding that each spin on an EGM is independent of the last (i.e., random), the second aimed to measure understanding of how EGMs have a negative long-term payoff with repeated plays (due to a return to player per cent <100%; RTP%). Both of these concepts underpin the aforementioned misconceptions that 1) gaming machines run in predictable winning and losing cycles, and that 2) the machines keep record of and adjust their outcomes to maintain a balanced RTP% in the short and long term.

4.5.8 Independence of events (IE).

Participants were provided with a scenario which described a person who is deciding to play an EGM. Participants were provided information about various different EGMs, in terms of their previous recent outcomes (pay-outs and takings) and were asked to choose which machine the character should decide to play. Response options included a statement to choose each of the available machines, with a nine-point Likert scale indicating their agreement to choose that machine (1 = 'Strongly disagree', 5 = 'Neutral', and 9 = 'Strongly agree').

Participants were asked how likely they were to choose each machine. These scores were summed and the standard deviation (SD) from the mean value was used as a measure of consistency between items, where lower standard deviations were indicative of better understanding of independence of events. That is, a participant who presumed that each of the available machines were equally likely to produce winning outcomes, regardless of their previous outcomes, may respond that they 'strongly agree' (9) they would choose each machine A, B, C, and D, and would receive a SD score of 0 (M = 9). Whereas a participant who may perceive one particular machine (D) to be more profitable than the others may respond accordingly: A=1, B=1, C=1, D=9, and receive a SD score of 4 (M = 3). Thus, more correct responses were not determined by responses on the Likert scale *within* each of the responses, rather they were determined by the level of consistency *between* each of the responses. Lower SD scores (consistency between machines) were indicative of better understanding of the concept of independence of events in EGM play, whereas higher SD scores (variability between machines) indicated poorer understanding or misconceptions. Previous research studies have also utilised SD as a measure of intra-individual consistency/variability (see Baird, Le, & Lucas, 2006; Biderman & Reddock, 2012; Khan & Biderman, 2013; Reddock, Biderman, & Nguyen, 2011).

Due to age-appropriate considerations, the phrasing of this question differed slightly between the experimental studies depending on the sample. For those in the adolescent sample, the scenario involved a third-party character (e.g., “Which machine should Tim choose?”), and for those in the adult EGM gambler sample, the question was phrased as if they were the main character (e.g., “Which machine should you choose?”). Both versions of this question can be found in Appendix J and the version used in the adolescent sample can be found below:

> Tim is on a night out with a group of friends. Although he has money to spend, he would feel more comfortable if he had a bit more. His group arrives at a venue that has electronic gaming machines (pokies).
>
> He decides he is going to play the machines in the hope of winning some money. Now he must decide which machine to play.
>
> Suppose machines A, B, C, and D are vacant and Tim knows the following:
>
> Machine A: Someone just lost $800
> Machine B: Someone just won $800
> Machine C: He has won big on this machine before.
> Machine D: He has lost big on this machine before.
>
> Tim has already decided that he is going to play one of the machines; he just needs to decide which one.
>
> Using the scale below, please indicate how much you agree with the following statements.

	Strongly Disagree				Neutral				Strongly Agree
Tim should choose machine A	1	2	3	4	5	6	7	8	9
Tim should choose machine B	1	2	3	4	5	6	7	8	9
Tim should choose machine C	1	2	3	4	5	6	7	8	9
Tim should choose machine D	1	2	3	4	5	6	7	8	9

4.5.9 Negative long-term payoff (NP).

A second scenario-based question was developed in order to determine how well participants understood the negative long-term payoff of EGMs. Participants were provided with a scenario where two friends were described playing EGMs; “Tina has won $1000 whereas Ben has lost $200”. Ben was described as in need of money, and participants were asked to rate how likely they would be to recommend that he continues playing in the hope of winning money like his friend. Response options ranged from 1 = ‘Highly Unlikely (stop playing!)’, 5 = ‘Neutral’, 9 = ‘Highly Likely (keep going!)’. A second set of response options was given for the adult gambler sample in Study 3 that included a reversed question “How likely would you be to recommend Ben *stops* playing?”. This second question was later removed for use in the adolescent study based on participant feedback that it confused respondents. Response options were also revised to include nine options instead of the original six. Both versions of this question can be found in Appendix K, and the version used in the adolescent sample can be found below. Scores on the first question were used for analyses, with lower scores indicating better understanding of negative long-term payoff.

> Tina and her friend Ben are at the pub playing the electronic gaming machines. They have both been playing for one hour. Tina is really excited because she just won $1000 on her machine. Ben has not had much luck and has lost $200 on his machine.
>
> Ben has been going through a tough time lately, he lost his job, and could really use some extra cash. He is deciding whether or not he should stop playing, or continue playing in the hope of winning some money like his friend.

	Highly Unlikely (stop playing!)				Neutral				Highly Likely (keep going!)
How likely would you be to recommend Ben keeps playing?	1	2	3	4	5	6	7	8	9

4.5.10 Gambling Harm

Gamblers in Study 3 were administered a measure of gambling-related harm developed by Shannon, Anjoul, and Blaszczynski (2017). It was important to measure harm in addition to gambling problem severity as between 7-22% of non-problem gamblers are likely to experience some level of gambling-related harm (Shannon et al., 2017). The scale measured harm in seven domains: financial, health, disengagement from leisure activities, social and relationships, employment and education, psychological, and critical events. Each set of questions in the seven domains was asked using a two-step approach; first about the presence and severity of harm, and second about its relationship with gambling (Figure 4.1).

During the past 6 months, drugs (including street drugs and prescription drugs) have:

○ Not been problem in my life (go to Q3)	○ Been a minor problem in my life	○ Been a moderate problem in my life	○ Been a major problem in my life	○ Been a very serious problem in my life

My problem with drugs was:

○ Not related to my gambling	○ Slightly related to my gambling	○ Moderately related to my gambling	○ Strongly related to my gambling	○ Totally related to my gambling

Figure 4.1: Item example from harm measure sourced from Shannon et al., (2017).

A composite score of gambling-related harm was created using a scoring rubric which considered participants' severity of harm and its relationship to their gambling (Figure 4.2). Participants' composite scores for each item across the six domains (excluding critical events) were averaged resulting in an overall mean gambling-related harm score for each participant ranging from 0-7.

		Problem/harm presence				
Due to gambling		Not	Minor	Moderate	Major	Serious
	Not	0	0	0	0	0
	Slightly	0	1	2	3	4
	Moderately	0	2	3	4	5
	Strongly	0	3	4	5	6
	Completely	0	4	5	6	7

Figure 4.2: Scoring rubric for the harm measure developed by Shannon et al., (2017)

4.6 Statistical Approaches

Many of the dependent variables were non-normally distributed and the studies experienced a high level of drop-out at the one/three- and six-month follow-ups. These factors, among others, influenced the decision to use multiple Generalized Estimating Equations (GEE) to determine the effect of intervention type on the dependent variables over time. The GEE method can be considered as an extension of the generalized linear mixed models approach which produces parameter estimates for correlated data (after fitting a correlation structure). Benefits of using GEEs over more traditional methods such as a mixed two-way ANOVA include the flexibility to specify and apply a non-normal distribution and different working correlational structures between data, as well as retaining cases that demonstrate drop out at follow-ups (Hubbard et al., 2010). Consideration was given to using a generalized linear mixed models (GLMM) approach which also meets the needs of the current dataset, however a GLMM approach models the data on the subject-specific level (e.g., how likely a patient is to respond to a drug given patient-specific variables), whereas GEEs estimate parameters at a population level to provide information about the overall intervention effects (e.g., how likely patients are to respond to a drug overall). Specifically, GLMM provide more useful inferences for subjects, such as patients in a drug trial, whereas the inferences drawn from a GEE may be more useful to someone wanting to see the population effects of an intervention, such as policy makers, or those wishing to optimise or improve intervention effects. As most educational programs are distributed to populations in a ‘universal’ fashion (Ladouceur, Goulet, & Vitaro, 2013), the GEE model was deemed a more appropriate method to answer questions about population effects. It would be of value in future endeavours to use a GLMM approach to investigate subject-specific factors that affect the outcome of the intervention. For example, this approach may be used to determine if certain intervention types are more or less effective for people with a high or low level of existing misconceptions, however, that was not the intention of the current study.

All data was analysed using SPSS v24 statistical package. For each GEE analyses testing effects of the three educational videos, the method was run three times using each educational video as the reference category. In order to keep the Time variable in descending order (Time 1 always remaining first, and thus the reference comparison) SPSS required the treatment variable (video condition) also remain fixed in descending order (1=Risk Awareness video, 2=Operator Information video, 3=Cognitive Misconceptions video, with 1 the reference category). To account for this, and to produce statistics for each video condition, the treatment variable (video condition) was recoded three ways to allow separate models where each treatment could be considered the reference category keeping a descending Time order in the model. Recoding occurred via the following rotation:

Table 4.8: Treatment variable rotation for GEE analyses.

Treatment variable	**Coded as**		
	1	**2**	**3**
Condition 1	RA	OI	CM
Condition 2	CM	RA	OI
Condition 3	OI	CM	RA

4.7 Chapter Summary

This chapter described the main research aims and hypotheses, and materials for the series of studies that will be reported in Chapters 5, 6, and 7. Any measures not described in this chapter such as demographic questions and questions about gambling behaviour will be described in detail in the following chapters. Chapter 5 proceeds this and describes the aims, hypotheses, method, results and interpretation of a mixed factorial designed study on adolescent engagement with the gambling education videos.

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5 Chapter Five: Study 1 – Adolescents

Preamble: The main topic in this Chapter is adolescent gambling behaviour. An overview of adolescent gambling behaviour is presented, including participation in various gambling forms, mode of access, self-reported expenditure, and problem severity. The overview also introduces the first of three experimental studies in this thesis. A randomised mixed-factorial design was used to test differences in effects of the three educational videos described in Chapter 4 on measures of engagement, perceived effectiveness, likelihood of accommodating new conceptual information, and understanding of mathematical concepts related to EGM gambling.

5.1 Introduction

Reported prevalence rates of adolescent gambling are several times greater than that observed amongst adult gamblers (Derevensky & Gupta, 2000; Gupta et al., 2013; Purdie, Matters, Hillman, Ozolins, & Millwood, 2011; Splevins, Mireskandari, Clayton, & Blaszczynski, 2010; Welte, Barnes, Tidwell, & Hoffman, 2008). Such estimates, however, demonstrate considerable variation depending on the particular sample (online versus land-based, males vs females, etc.) and measures used. Measurement varies considerably as there is no one best approach. The most common adolescent measures include: the South Oaks Gambling Screen-Revised for Adolescents (SOGS-RA) (Winters, Stinchfield, & Fulkerson, 1993); the DSM-IV-MR-J criteria, which was revised in 2000 (Fisher, 2000) from its original version developed in 1992 (DSM-IV-J) (Fisher, 1992); the Massachusetts Gambling Screen (MAGS)(Shaffer, LaBrie, Scanlan, & Cummings, 1994) and the Canadian Adolescent Gambling Inventory (CAGI)(Tremblay, Stinchfield, Wiebe, & Wynne, 2010) (see Stinchfield, 2010 for a comprehensive review).

A critical review of adolescent gambling measures demonstrated that many are unreliable, have issues with validity, and demonstrate poor classification accuracy (Stinchfield, 2010). Additionally, despite several different measures of adolescent gambling problems, adolescents report spending very low amounts of money gambling (Hanss et al., 2015; Hayer, Kalke, Meyer, & Brosowski, 2018; Lambos, Delfabbro, & Pulgies, 2007) and do not tend to experience the same severity of harm that adult gamblers do (mortgage stress, debt, divorce, job loss) (Dickson, Derevensky, & Gupta, 2002; Monaghan, 2008).

Compared to adult gamblers, fewer adolescents seek treatment for gambling problems (Gupta & Derevensky, 2000; Hardoon, Derevensky, & Gupta, 2003). For example, during development and validation of the CAGI, the lead researchers originally planned to further test the scale in a sample of treatment-seeking adolescent gamblers. This was not possible, however, as the authors described on their website: *“Despite a Canada-wide search, however, the research team was unable to locate any adolescents in treatment”* (Tremblay, Stinchfield, Wiebe, & Wynne, 2017). Consequently, there has been insufficient research to determine a best-practice approach to treating adolescent gambling problems (Gupta & Derevensky, 2005) which has likely influenced ambiguity when deciding what should be included in prevention approaches.

Despite the above, many current gambling education programs focus on promoting awareness of the harmful consequences of gambling, in lieu of addressing specific risk factors which may direct trajectories toward gambling problems (Keen, Blaszczynski, & Anjoul, 2016). Chapter 3 elaborated on some of the issues associated with current awareness-raising gambling education programs, including low program efficacy among adolescent populations who may not find the information engaging (Keen et al., 2016; Productivity Commission, 2010). Young people who are not spending large amounts of money gambling, are not experiencing the same severity of harm as adult problem gamblers, and are not seeking treatment, should not be expected to engage with education that emphasises severe harms, consequences, and treatment options. Moreover, a review of the pedagogical literature suggested that teaching adolescents about misconceptions may improve engagement with educational content (Chi & Roscoe, 2002; Chi, Slotta, & De Leeuw, 1994; Posner, Strike, Hewson, & Gertzog, 1982; Strike & Posner, 1982).

The purpose of this study was to test the potential effects that educational content about gambling misconceptions may have in relation to future prevention programs aimed at adolescents. In particular, this study evaluated educational material which presented gambling misconceptions about the design of electronic gaming machines as a risk factor that may lead to problematic levels of gambling. The study aimed to determine if educating adolescents about common misconceptions relating to gaming machine outcomes is more engaging compared to educating them about the fact that such gambling can lead to harmful consequences, without providing an account of how that may happen.

5.2 Hypotheses

On review of existing literature, educating young people about gambling misconceptions was hypothesised to have two effects. The first was that it would provide a detailed developmental account of problem gambling etiology and increase engagement amongst young people. The second, is that it would facilitate learning complex game mathematics by providing foundational mental scaffolding and creating dissatisfaction with the gambler's fallacy. Additional analyses also investigated whether critically appraising misconceptions would prevent development of future misconceptions, contingent on gambling experiences. Secondary directional hypotheses stated the predicted trend of results; that the Cognitive Misconceptions (CM) video would outperform the Operator Information (OI) video, which would outperform the Risk Awareness (RA) video. Specifically, this study aimed to use the educational videos described in Chapter 4 to test the following hypotheses:

5.2.1 H_1 Engagement.

H_1a: Those in the CM video group will report higher engagement with the educational material than those in the RA and OI groups.

H_1b: Those in the OI group will report higher engagement with educational material than those in the RA group.

5.2.2 H_2 Understanding important gambling-related mathematics concepts.

H_2a: Those in the CM video group will report greater understanding of independence of events and negative long-term payoff compared to those in the OI and RA groups.

H_2b: Those in the OI video group will report greater understanding of independence of events and negative long-term payoff than those in the RA group.

5.2.3 H_3 Perceived effectiveness.

H_3a: Those in the CM video group will perceive the video to be more effective than those in the RA and OI groups.

H_3b: Those in the OI group will perceive the video to be more effective than those in the RA group.

5.2.4 H_4: Likelihood of accommodating new information.

H_4a: Those in the CM video group will be more likely to accommodate the educational information compared to those in the RA and OI groups.

H_4b: Those in the OI group will be more likely to accommodate the educational information compared to those in the RA group.

5.2.5 H_5 Misconceptions in gamblers.

H_5a: Gamblers in the CM video group will report lower misconception scores compared to those in the RA and OI groups at the six-month follow up.

H_5b: Gamblers in the OI group will report lower misconception scores than those in the RA group at the six-month follow up.

5.2.6 Exploratory questions.

Exploratory analyses aimed to determine if there were any group differences in gambling expenditure or gambling problem severity at the six-month follow-up compared to baseline. It was important to investigate whether any changes observed in attitudinal and cognitive measures translated into behavioural effects over time as few studies have measured this (Keen et al., 2016).

5.3 Methodology

5.3.1 Design

This study used a randomised mixed-factorial design. The independent variable was education type and its three conditions were the educational videos described in Chapter 4: Risk-Awareness, Operator Information, and Cognitive Misconceptions. The dependent variables included measures of emotional engagement, likelihood of accommodating new information, perceived effectiveness, EGM misconceptions, understanding of important gambling concepts, gambling expenditure, and problem gambling severity. Participants were randomly allocated to one of three experimental groups and measures were administered immediately before and after watching the educational video, and at one- and six-months post-intervention.

5.3.2 Sample size requirements.

An a-priori power analysis was conducted using G*Power analysis software to estimate the sample size needed to achieve statistical power = .8 for a two-way mixed ANOVA calculating main effects of the educational videos (three levels) over time (four levels). It was calculated that a sample size of N = 158 would be sufficient to detect a medium effect size ($F = .25$) with a statistical power of 80% ($\alpha = .05$).

5.3.3 Participants

Participants were 164 adolescents in year 11 schooling and were purposively sampled as it was important to investigate the potential impact of education interventions at this developmental stage. Participants were recruited from three Sydney Catholic senior schools. Twelve schools which had been given approval by Sydney Catholic Schools (SCS) were approached to take part in the study, six declined, three did not respond to the invitation, and three agreed to take part. Recruitment took place between May and September 2018 in the three schools; two of which were co-educational whereas the other was an all-male school. The survey was distributed to the entire year 11 cohort in two of the schools, and to a class of year 11 students (approx. 30) in the other school. The online survey link was distributed to around 250 students (the exact number cannot be determined as some students were absent on the day due to illnesses and absenteeism). Two hundred and fifteen (215; 86%) students attempted the online survey, 172 (68.8%) completed the full set of pre-intervention questions, 156 (62.4%) of those also completed some or all of the post-intervention questions, and 102 (40.8%) provided contact details for the follow-up surveys. Of those who provided contact details, fourteen participants completed the one-month follow-up survey (13.7%) and 14 took part in the final six-month follow-up survey (13.7%). After data cleaning, 164 participants were included in the final sample; analyses investigating intervention effects were conducted on a smaller sample described in the results section. Participants received invitations for the follow up survey by email and were sent a reminder email one week later, as well as an SMS reminder one week after that.

5.3.4 Measures

Participants were asked questions relating to their demographic situation, gambling behaviour, including simulated gambling games and problems, misconceptions about EGMs, understanding of mathematical concepts related to EGM gambling (independence of events (IE) and negative long-term payoff (NP)), engagement with the educational video, likelihood of accommodating the information in the video, and its perceived effectiveness. These measures are provided below with their relevant response options in parentheses.

Demographics: Gender, age, postcode, language other than English, born in Australia, years lived in Australia, Indigenous, income type and amount, living expenses, school grades, maths class level, and maths grade.

Gambling behaviour: Participants were asked if they had bet money on the following forms of gambling in the past three months (select all that apply): Scratch cards, lottery, Bingo, Keno, Electronic Gaming Machines (EGMs, pokies), sports betting, racing (horse, dog, harness), casino (roulette, blackjack, cards, poker), E-sports (betting on the outcome of a video game tournament), Daily fantasy sports competitions (paid entry fee per contest, per-round/week competition, chance to win money e.g., Moneyball – this is not the same as traditional fantasy sports which is free-to-play), Personal bets (e.g., private bets with friends/family on card games, sporting events, competitions, or other activities), Other (specify), and I have not gambled in the past three months. Participants were also asked if they typically bet this money in-person or online (online in-person, only online, both).

Data was collected on past three-month stake amounts on gambling. All dollar amounts are in AUD$ unless otherwise stated. This was phrased as "On average, for (all forms of gambling) how much money would you typically risk… By 'risk' we mean the amount of money staked, not including any winnings. For example, if you bet $30 but won back $20, write '30'.". Participants were also asked how much they agreed or disagreed with the following statements on a scale of 1 (totally disagree to 10 (totally agree): "The first time I gambled, I had a big win", and "Thinking back to when I first started gambling, I had a few big wins". At each of the follow-up time points, participants were also asked if they had experienced a big win since first taking part in the study, how much that big was ($) and the form of gambling it was on (same response options as above).

Participants were asked if they had engaged in any of the following simulated gambling activities in the past three months: Social casino games (free-to-play casino style games usually played through social media apps like Facebook - e.g., Slotomania, Texas HoldEm Poker, Caesars Casino), Betting virtual items through a video gaming platform (e.g., skins betting, Counter-Strike: Global Offensive), Fantasy Sports competitions (Season-long competitions, typically free-to-play, e.g., SuperCoach). Participants were asked if they had spent any money on these games in the past three months (e.g., In-app purchases, paying real money to buy skins, or paying a league entry-fee for a fantasy sports competition; yes, no, how much per week/month), and if this money was spent online (only in-person, only online, both).

Understanding of important mathematical concepts: Participants were asked both hypothetical scenario questions described in Chapter 4. The first question aimed to measure participants' knowledge of independence of events (IE), whereas the second aimed to measure their knowledge of negative long-term payoff (NP). Lower scores on both scales indicated a better understanding of the concepts and by proxy, fewer misconceptions.

Gambling problems: Participants were administered the Canadian Adolescent Gambling Inventory Gambling Problems Severity Subscale (CAGI-GPSS)(Tremblay et al., 2010). Average scores were calculated where lower scores indicated lower gambling severity and a score of eight or more indicated problem gambling. Details on the reliability and validity of this scale can be found in Chapter 4.

Emotional engagement: Participants' level of emotional engagement was measured by asking how interesting the video was, how hard they concentrated on the video, and how much they enjoyed watching the video. Participants were asked to respond to each of the three questions using a five-point Likert scale (1=not at all, 5=very). The scale had good internal consistency amongst the current sample of adolescents (Cronbach's α = .89). Lower scores indicated lower engagement. See Chapter 4 for an in-depth description of the items.

Likelihood of accommodating new information (LANI): In line with the Conceptual Change theory of science education described in Chapter 3 (Posner et al., 1982), participants were asked to rate how much they understood the video, and found it to be believable, useful, and relevant on a five-point Likert scale (1=strongly disagree, 5=strongly agree). Internal consistency was reasonable for a new measure amongst the current sample (Cronbach's α = .69). Lower scores indicated low likelihood of accommodating new information. Details of the measure can be found in Chapter 4.

Perceived effectiveness: Participants were asked to rate how effective they thought each video was on a scale from 1 (not at all effective) to 5 (very effective) in terms of preventing young people from developing gambling problems, as well as reducing the amount of money young people will spend on EGMs in the future. Lower scores indicated lower perceived effectiveness. Details of the measure can be found in Chapter 4.

EGM Cognitions Scale (ECS): The 16-item ECS was administered to participants who reported gambling in the past three months to measure their level of misconceptions relating to EGM play. Scores on the scale range from 16 to 64 where lower scores indicate fewer misconceptions. See Chapter 4 for an in-depth description of the scale items and psychometrics.

Data was collected at baseline, post-intervention, and at one- and six-months post-intervention. These timepoints are henceforth referred to as T1, T2, T3, T4, respectively. Table 5.1 details the timeline of when each measure was administered.

Table 5.1: Study 1 timeline of measures

Measure	T1	Video	T2	T3	T4
Gambling & simulated gambling behaviour	✓				✓
CAGI-GPSS	✓				✓
Engagement			✓		
LANI			✓		
Perceived effectiveness			✓		
Independence of Events (IE)	✓		✓	✓	✓
Negative long-term Payoff (NP)	✓		✓	✓	✓
ECS	✓		✓	✓	✓

5.3.5 Procedure

Approval was obtained from the Sydney University Human Research Ethics Committee (HREC; project no. 2017/392) and Sydney Catholic Schools (SCS) research ethics department and an approved list of schools were invited to participate. Participating schools set aside one hour of class time for students to take part in the initial stage of the research study. During this time, students were provided a URL link to the online survey which included baseline assessments, random allocation to one of the three educational videos conditions, and measures of the dependent variables (before and after the video).

Information about the study was emailed to students' parents at least two weeks prior to participation in the first survey. Parental consent was not required, but parents were given the option to 'opt-out' their child from the study (no withdrawal forms were returned). Similar procedures have been carried out with other problem gambling prevention programs (e.g., Parham et al., 2018). Consent was obtained from participants via a checkbox on the online survey. Instructions were provided on the first page of the survey asking participants not to share answers with other students and not to talk during the survey. Participants were reimbursed with a $10 grocery voucher for completing the first pre-post online survey and participation in each follow-up survey was associated with entry into a draw to win an iPad. A URL link to the follow-up surveys were emailed to participants who were able to complete them outside of school time.

5.3.6 **Data**

SPSS Statistics version 24 was used to analyse all data. Outliers in the data were identified as having Z scores of ≥ 3 and were either deleted if all responses appeared non-genuine (e.g. gender = "robot", expenditure = "$1m" etc.; N=8), or truncated to the next largest value (and adjusted for weight if necessary) if responses were deemed genuine (N=2). Kruskal Wallis H-tests were used to analyse group differences between median scores on measures of engagement, LANI, and PE. Generalised estimating equations (GEE) were used to compare the effects of intervention type over time on outcome variables IE and NP. See Chapter 4 for justification of statistical approaches.

5.4 Results

5.4.1 Demographics

In line with the CONSORT (2010) statement, it was not necessary to perform or report significance tests for group differences between baseline demographic variables (Moher et al., 2010). See De Boer (2015) for a review of the arguments against publishing baseline difference testing in randomised controlled trials. There was a higher proportion of male participants in the sample as one of the schools that was sampled was a male-only college. Most participants were 16 years old and many spoke a language other than English (LOTE) at home (42.7%). Nearly half the sample (48.2%) reported receiving grades that were mostly C's, whereas a similar proportion reported grades of typically A's or B's (47.5%). Nineteen students were not enrolled in any form of mathematics class, whereas those who were, typically studied general mathematics and reported grades of mostly B's or C's (Table 5.2).

Table 5.2: Adolescents' demographic characteristics

	N	Valid %*	M	SD
Gender				
Female	42	25.6%		
Male	122	74.4%		
Age			16.24	0.51
LOTE	70	42.7%		
Born Australia	156	95.1%		
Years lived in Australia			8.29	5.28
Indigenous				
Aboriginal	4	2.4%		
Torres Strait Islander	0	0%		
Aboriginal and Torres Strait Islander	0	0%		
None	155	94.5%		
Prefer not to answer	5	3%		
Grades				
Straight A's	4	2.4%		
A's and B's	43	26.2%		
Mostly B's	35	21.3%		
Mostly C's	80	48.8%		
Mostly D's	2	1.2%		

Mathematics enrolment		
General mathematics	88	53.7%
Mathematics (2 unit)	43	26.2%
Mathematics extension 1 (3 units)	12	7.3%
Mathematics extension 2 (4 units)	2	1.2%
Not enrolled in mathematics	19	11.6%
Previous Mathematics Grade (n = 145)		
A	23	15.9%
B	52	35.9%
C	56	38.6%
D	12	8.3%
E	2	1.4%

*Valid% refers to % of participants belonging to that group
Percentages may not add up to 100% due to rounding.

Under one-third (30.5%) of the sample reported gambling in the past three months, and the most popular forms were personal bets (52%), followed by scratchcards (34%), and sports betting (26%). Nearly half reported gambling in-person only (49%), whereas a notable portion did so online only (26.5%). Eight of the 50 gamblers (16%) were categorised as high severity gamblers according to the CAGI-GPSS (Table 5.3).

Table 5.3: Adolescents' gambling participation, mode, and problems in the past three months

Participation	**N**	**% Gamblers**	**% Sample**
Any gambling	50	100%	30.5%
Scratchcards	17	34%	10.4%
Lottery	9	18%	5.5%
Bingo	6	12%	3.7%
Keno	4	8%	2.4%
EGMs	6	12%	3.7%
Sports	13	26%	7.9%
Racing	8	16%	4.9%
Casino	3	6%	1.8%
E-Sports	7	14%	4.3%
Daily fantasy sports	4	8%	2.4%
Personal bets	26	52%	15.9%
Other	0	0%	0%
Have not gambled in the past three months	114	0%	69.5%
Mode (N = 49)			
Only in-person	24	49%	14.6%
Only online	13	26.5%	7.9%
Both	12	24.5%	7.3%
CAGI-GPSS categories (N =50)			

Non-problem gamblers	33	66%	20.1%
Low to moderate severity gamblers	9	18%	5.5%
High severity gamblers	8	16%	4.9%

Over one-third (34.8%) of the sample reported participating in some form of simulated gambling (Table 5.4). Weekly income and expenditure responses were heavily skewed by a small number of large data points. Although these responses were considered statistical outliers, they also represented possible true responses and so were maintained in the dataset. Median values are reported alongside mean vales in Table 5.5 for meaningful interpretation. Most participants did not spend large amounts of money gambling (Mdn = $2.50 per week) and many reported spending nothing at all (Figure 5.1 and Figure 5.2).

Table 5.4: Adolescents' simulated gambling participation in the past three months.

Participation (N = 57)	**N**	**Valid %**	**% Sample**
Social Casino	24	42.1%	14.6%
Skins betting	25	43.9%	15.2%
Fantasy Sports	26	45.6%	15.9%

Table 5.5: Adolescents' gambling and simulated gambling expenditure and income

Weekly (AUD$)	**M(SD)**	**Mdn**
Income	$94.58(133.76)	$39.62
Income after expenses	$85.25(129.25)	$38.46
Gambling stake (N = 50)	$6.55(15.60)	$2.50
Simulated gambling stake (N = 57)	$5.38(22.12)	$0.00

There were several participants that although reporting engaging in at least one gambling activity in the past three months, reported spending no money on these activities (n = 13/50; 26%; Figure 5.1). Additionally, six of the 50 participants that reported gambling in the past three months conversely indicated that they had 'never gambled' when asked about an early big win.

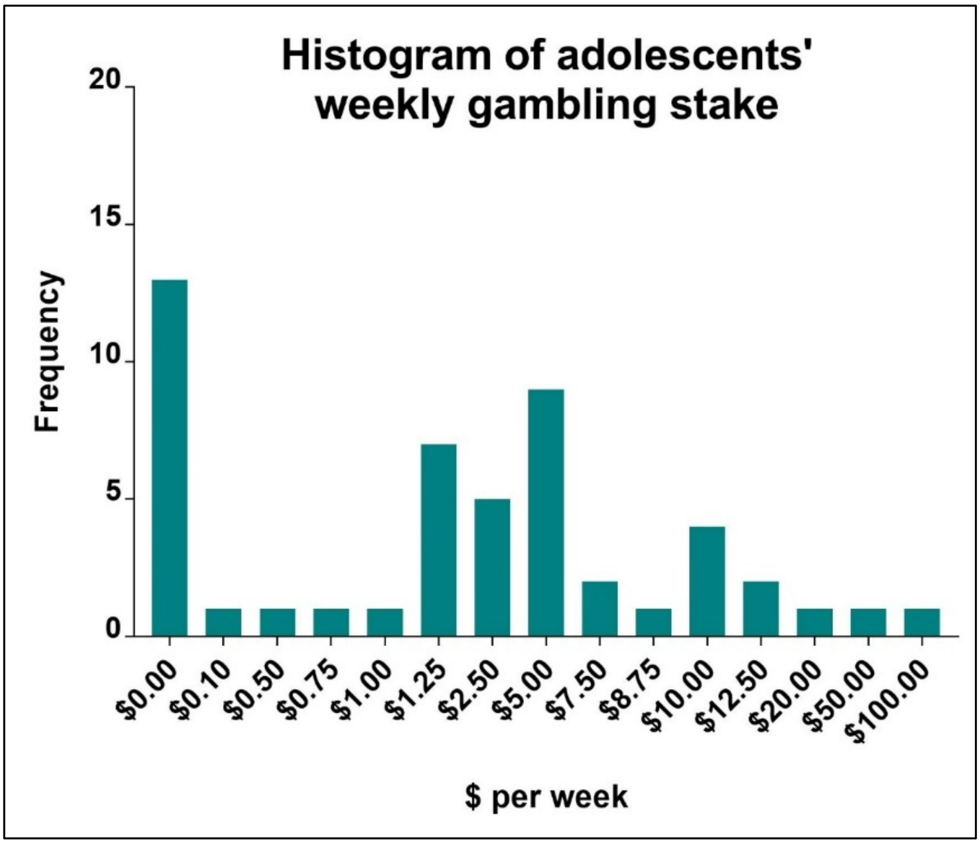

Figure 5.1: Adolescents' weekly gambling stake histogram.

It may be that in these cases, students did not consider their involvement to constitute true gambling. For example, an adolescent may have had a parent buy them a scratchcard or lottery ticket, or place a bet on the Melbourne Cup horse race for them, or played bingo or Keno with relatives while attending a family dinner at their local club/pub. In these instances, the adolescent may not have considered themselves as spending their own money and may have indicated that they have 'never gambled' because a bet was placed for them by someone else.

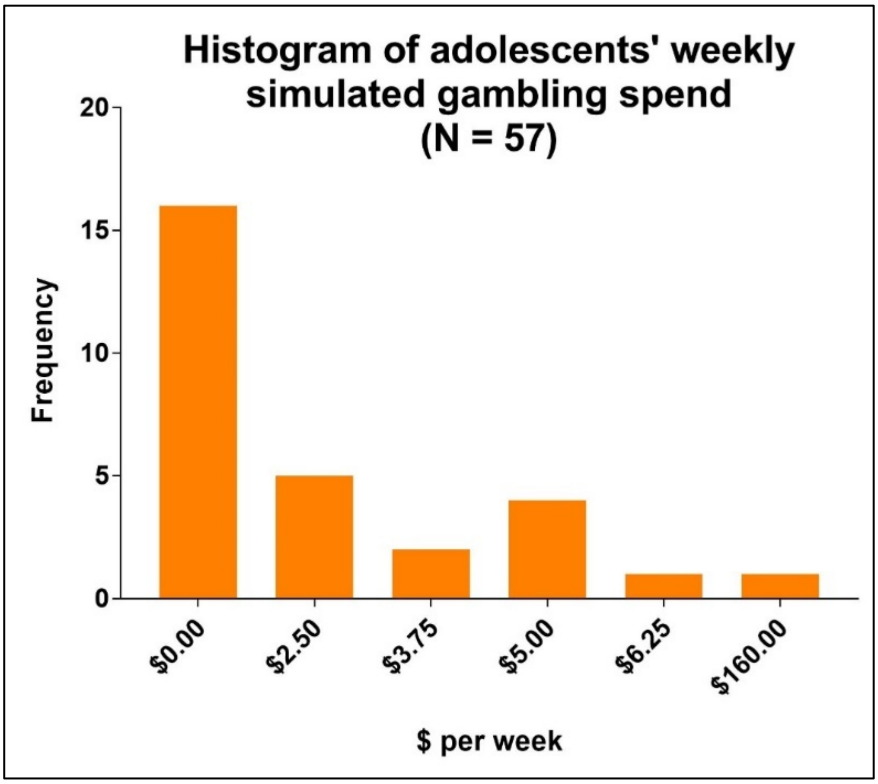

Figure 5.2: Adolescents' weekly simulated gambling spend histogram.

5.4.2 Effects of Educational Videos

Whether or not participants watched the educational videos in their entirety was an issue in the current sample because the intervention was delivered to classes of 50+ students per session rendering close monitoring of each participant impractical. This resulted in a considerable number of participants watching only part of the educational video before skipping to the next set of questions (despite instruction not to). In order to reliably determine intervention effects, participant responses were screened according to their total duration (≥1000 seconds/16.5 mins) which resulted in the removal of 84 participants (51.2%). Excluded respondents spent 713.67 seconds (approx. 12 minutes) on average completing the online questionnaire and watching one of the educational videos (which each ran for 15, 18, or 20 minutes). Exclusions appeared to be distributed evenly and equal numbers were left in each treatment condition (RA=26, OI=25, CM=24).

5.4.2.1 *Engagement.*

A Kruskal-Wallis H-test was run to determine if there were differences in engagement scores between the three video conditions. Distributions of engagement scores were similar for all groups, as assessed by visual inspection of a boxplot. Median engagement scores were not statistically significantly different between groups, $\chi^2(2) = 0.485$, $p = .785$, Risk Awareness (RA) *Mdn* = 10.5, Operator Information (OI) *Mdn* = 11, Cognitive Misconceptions (CM) *Mdn* = 10. Figure 5.3 illustrates that all videos were deemed to be somewhat engaging, as indicated by median values above 7.5 (indicating a neutral response, where min = 3, max = 15).

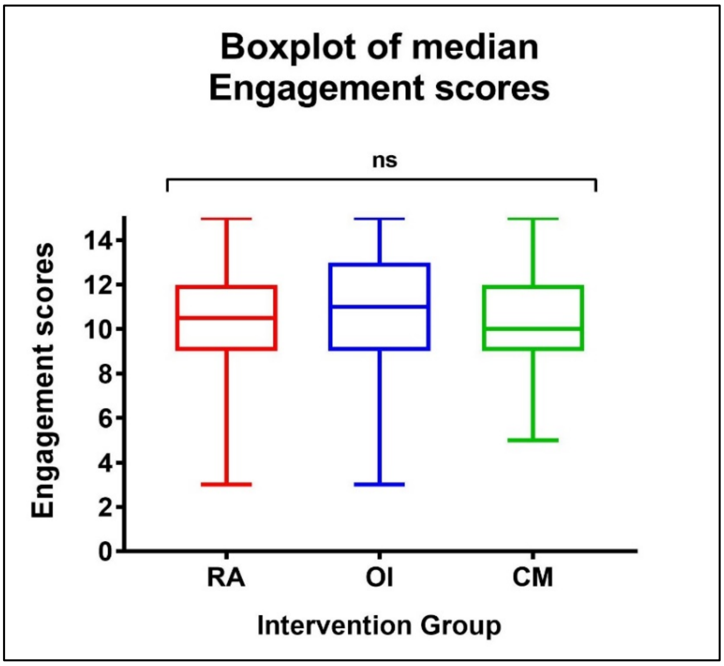

Figure 5.3: Boxplot of adolescents' median engagement scores

Ns = non-significant difference (p >.05)

5.4.2.2 *Likelihood of accommodating new information (LANI).*

A Kruskal-Wallis H-test was run to determine if there were differences in LANI scores between the three video conditions. Distributions of LANI scores were similar for all groups, as assessed by visual inspection of a boxplot. Median LANI scores were not statistically significantly different between groups, $\chi^2(2) = 0.080$, $p = .961$ (Figure 5.4).

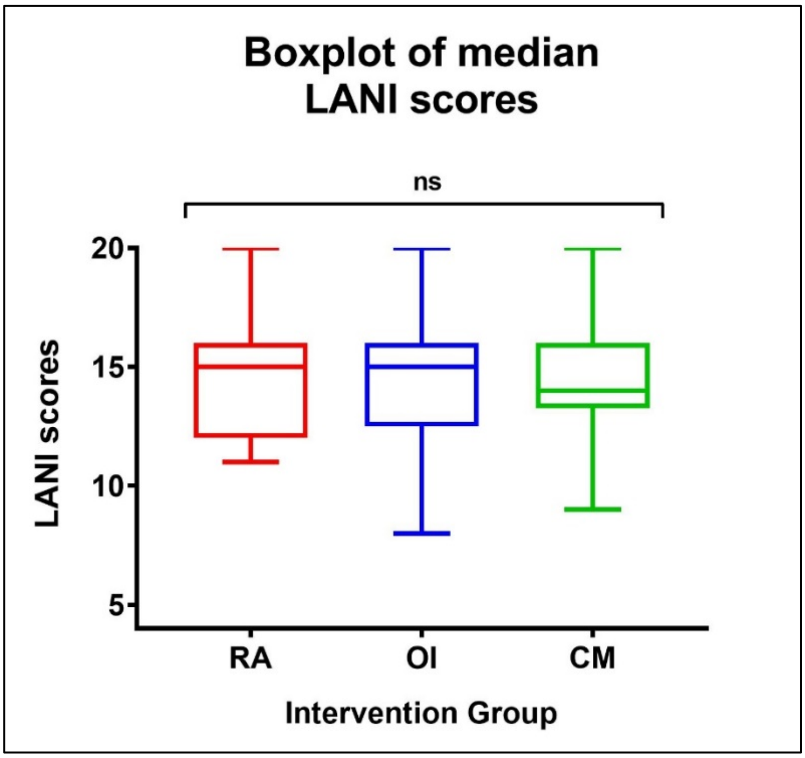

Figure 5.4: Boxplot of adolescents' median LANI scores.

Ns = non-significant difference ($p > .05$)

In analysing the items that constituted the LANI measure (understandability, believability, usefulness, and relevance), relevance scores did not correlate with the other items in the measure and appeared to encourage different responses from the other items. Although participants found all videos to be reasonably understandable, believable, and useful, they did not find them personally relevant. Figure 5.5 represents the plotted median values of each item on the LANI measure and demonstrates how all videos were reflected on positively by participants on the first three items, but not on the fourth item indicating relevance (score of 1 = not at all, 3= neutral, 5 = very).

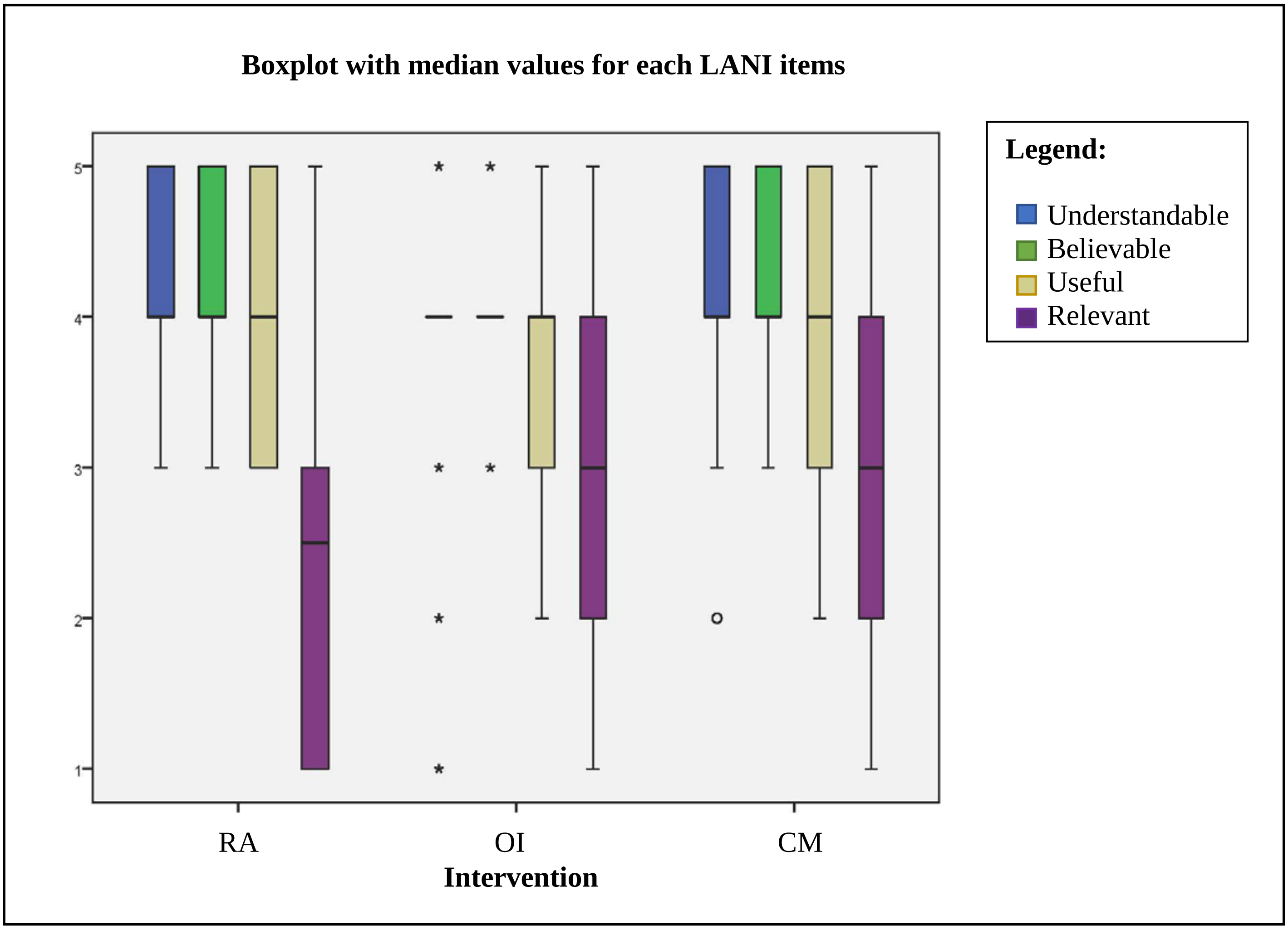

Figure 5.5: Boxplot of adolescents' LANI items by group.

5.4.2.3 Perceived effectiveness.

A Kruskal-Wallis H-test was carried out to determine if there were differences in perceived effectiveness scores between the three video conditions. Distributions of perceived effectiveness scores were similar for all groups, as assessed by visual inspection of a boxplot. Median perceived effectiveness scores were not statistically different between groups, $\chi^2(2) = 1.610$, $p = .447$; Risk Awareness (RA) *Mdn* = 7, Operator Information (OI) *Mdn* = 8, Cognitive Misconceptions (CM) *Mdn* = 8. Figure 5.6 displays the median values for each group where a minimum score of 2 = Not effective at all, 6 = Neutral, and a maximum score of 10 = Very effective.

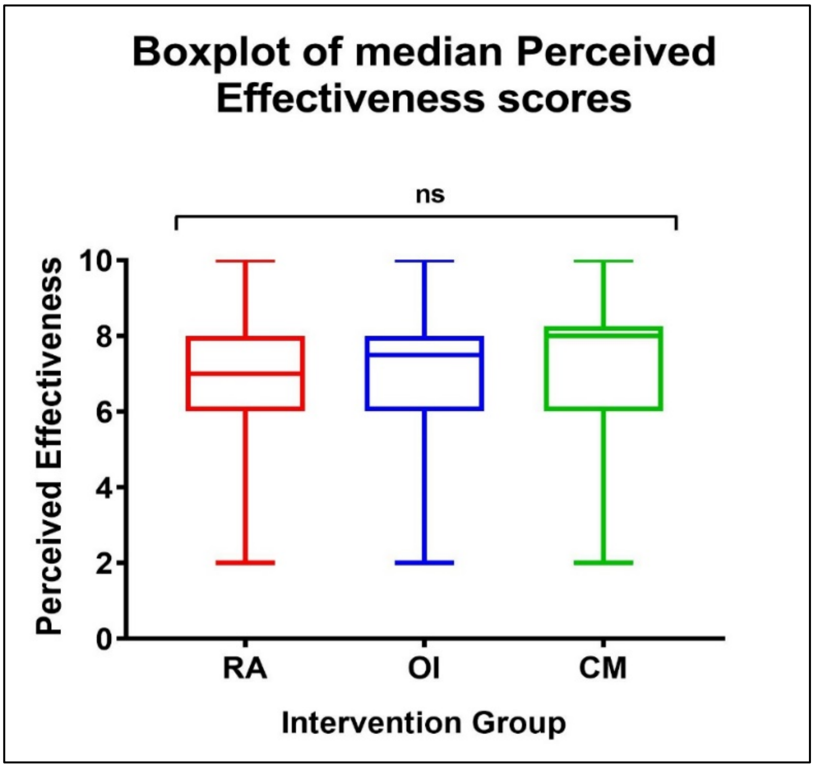

Figure 5.6: Boxplot of adolescents' median perceived effectiveness scores.

Ns = non-significant difference (*p* >.05)

5.4.3 Generalised Estimating Equations (GEEs)

In order to obtain relevant comparison information for all three experimental conditions, three separate GEE analyses were carried out with each of the treatment conditions as the reference category. This was performed on each outcome measure using two steps. First, only main effects were included in the three GEE models (Group, Time). Following this, the three separate GEEs were run again and included the interaction terms in the model (Group, Time, Group*Time). This provided statistics for each possible comparison between the three experimental conditions.

Each GEE table provides estimated parameters for the video condition set as the reference category, where values for Time indicate the change scores from the reference time (always Time 1) for that reference category (intervention group). Interaction values represent the change in that group at that time, *over and above* any change in the reference category at the reference time (T1). The tables below report parameter estimates for each model's beta coefficients and standard error, the upper and lower 95% confidence intervals, and whether the parameter is significantly different ($p < .05$) from the reference category. Note that GEE analyses manage missing data by selecting subjects with responses at two or more time points. Because there were no covariates included in the model the estimated marginal means represent the actual means.

Although follow-up data was collected at one- and six-months post-intervention, attrition was high, and few participants took part in the follow-up surveys. Table 5.6 provides a summary of the sample size in each group at each time point of the study (including those who were later excluded due to brief survey duration; a further 51.2%). As can be seen, sample sizes at T3 and T4 are substantially reduced, resulting in the decision to exclude these timepoints from the following analyses. A similar decision was made not to include analyses of EGM misconceptions because there were too few gamblers in the current sample to warrant this analysis. Previous research in Australia and internationally has suggested high rates of gambling amongst adolescents (upwards of 60%; Volberg, Gupta, Griffiths, Ólason, & Delfabbro, 2010), however only 30.5% of the current sample reported gambling in the past few months, and only 3.7% reported any experience with EGMs. Such small samples substantially reduce the power of longitudinal tests and may result in misleading conclusions about intervention effects. Descriptive statistics for both of the following outcome variables (IE and NP) at all time points can be found in Appendix L.

Table 5.6: Number of included adolescents who responded at each time point by intervention group (N)

	Time 1	Time 2	Time 3	Time 4
RA	56	52	6	7
OI	52	47	2	2
CM	56	50	6	5

5.4.3.1 Independence of events (IE).

GEEs were used to analyse differences in IE scores between the three video conditions before and after the intervention. IE responses were highly positively skewed and zero-inflated. Prior to analysis, scores were transformed by adding a value of 1 to each score, resulting in positively skewed scores >1 (min = 1, max = 5.62). A Gamma distribution was then able to fit the data using a log link function and an autoregressive working correlation structure. Table 5.7 shows the results of the main effects GEE analysis.

Table 5.7: GEE parameter estimates of main effects of adolescents' IE scores.

Parameter	β	Std. Error	95% CI (Lower, Upper)		Sig.
Method 1 (Ref = RA)					
(Intercept)	0.841	0.1056	0.634	1.048	.000
CM	0.197	0.1500	-0.097	0.491	.188
OI	0.065	0.1459	-0.221	0.351	.656
RA	0[a]	.	.	.	.
TIME 2	-0.084	0.0516	-0.185	0.017	.104
TIME 1	0[a]	.	.	.	.
Method 2 (Ref = CM)					
(Intercept)	1.038	0.1057	0.831	1.245	.000
OI	-0.132	0.1448	-0.416	0.151	.361
RA	-0.197	0.1500	-0.491	0.097	.188
CM	0[a]	.	.	.	.
TIME 2	-0.084	0.0516	-0.185	0.017	.104
TIME 1	0[a]	.	.	.	.
Method 3 (Ref = OI)					
(Intercept)	0.906	0.0990	0.712	1.100	.000
RA	-0.065	0.1459	-0.351	0.221	.656
CM	0.132	0.1448	-0.151	0.416	.361
OI	0[a]	.	.	.	.
TIME 2	-0.084	0.0516	-0.185	0.017	.104

TIME 1	0[a]	.	.	.	.

[a] Set to zero because this parameter is redundant (reference category).

For all participants, there was no significant reduction in IE misconceptions from T1 to T2 (β = -0.084, *p* = .104). After including the interaction term in the models, Table 5.8 demonstrates a significant difference between the Risk Awareness and Cognitive Misconceptions groups at T1 (β = ±0.297, *p* = .048, but there were no significant changes in either groups' scores over time (Figure 5.7).

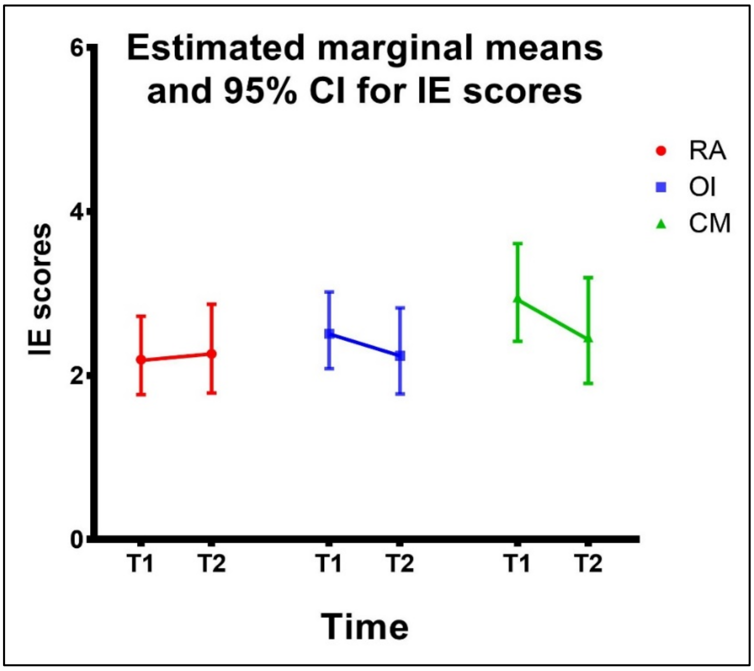

Figure 5.7: Estimated marginal means for adolescents' IE scores

5.4.3.2 Negative long-term payoff (NP).

GEEs were used to analyse differences in NP scores between the three video conditions before and after the intervention. Responses to NP were positively skewed and non-normally distributed in each group as indicated by significant Shapiro-Wilk tests (*p* <.05). A Gamma distribution was specified using a Log link function and an autoregressive working correlation structure. Although the scale was ordinal, responses were treated as continuous to enhance interpretability and meaningfulness.

Table 5.8: Parameter estimates for main effects and interactions of adolescents' IE scores

	Method 1 (Ref = RA)					Method 2 (Ref = CM)					Method 3 (Ref = OI)				
Parameter	**β**	**Std. Error**	**95% CI**		**Sig.**	**β**	**Std. Error**	**95% CI**		**Sig.**	**β**	**Std. Error**	**95% CI**		**Sig.**
Intercept	0.786	0.1104	0.569	1.002	.000	1.083	0.1024	0.882	1.284	.000	0.920	0.0942	0.735	1.104	.000
Tx = CM	**0.297**	**0.1506**	**0.002**	**0.592**	**.048**	0[a]	.	.	.	.	0.163	0.1392	-0.110	0.436	.241
Tx = OI	0.134	0.1452	-0.151	0.419	.356	-0.163	0.1392	-0.436	0.110	.241	0[a]	.	.	.	.
Tx = RA	0[a]	.	.	.	.	**-0.297**	**0.1506**	**-0.592**	**-0.002**	**.048**	-0.134	0.1452	-0.419	0.151	.356
Time 2	0.032	0.0902	-0.145	0.209	.725	-0.180	0.0981	-0.373	0.012	.066	-0.113	0.0743	-0.259	0.032	.127
Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.
CM * Time 2	-0.212	0.1333	-0.473	0.049	.111	0[a]	.	.	.	.	-0.067	0.1230	-0.308	0.174	.585
CM * Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.
OI * Time 2	-0.145	0.1169	-0.374	0.084	.215	0.067	0.1230	-0.174	0.308	.585	0[a]	.	.	.	.
OI * Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.
RA * Time 2	0[a]	.	.	.	.	0.212	0.1333	-0.049	0.473	.111	0.145	0.1169	-0.084	0.374	.215
RA * Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.

[a] Set to zero because this parameter is redundant (reference category).

Table 5.9: GEE parameter estimates of main effects of adolescents' NP scores

Parameter	β	Std. Error	95% CI (Lower, Upper)		Sig.
Method 1 (Ref = RA)					
(Intercept)	0.831	0.1641	0.510,	1.153	.000
CM	-0.051	0.2107	-0.464,	0.362	.808
OI	-0.146	0.2046	-0.547,	0.255	.475
RA	0[a]	.	.	.	.
TIME 2	-0.014	0.0920	-0.195,	0.166	.876
TIME 1	0[a]	.	.	.	.
Method 2 (Ref = CM)					
(Intercept)	0.780	0.1460	0.494,	1.066	.000
OI	-0.095	0.2022	-0.491,	0.301	.639
RA	0.051	0.2107	-0.362,	0.464	.808
CM	0[a]	.	.	.	.
TIME 2	-0.014	0.0920	-0.195,	0.166	.876
TIME 1	0[a]	.	.	.	.
Method 3 (Ref = OI)					
(Intercept)	0.685	0.1441	0.403,	0.968	.000
RA	0.146	0.2046	-0.255,	0.547	.475
CM	0.095	0.2022	-0.301,	0.491	.639
OI	0[a]	.	.	.	.
TIME 2	-0.014	0.0920	-0.195,	0.166	.876
TIME 1	0[a]	.	.	.	.

[a] Set to zero because this parameter is redundant (reference category).

Table 5.9 shows no significant Group or Time effects of NP scores. After including the interaction term in the model, Table 5.10 shows that there was a significant reduction in NP misconceptions for those in the Risk Awareness group only (β = -0.238, p = .035; Figure 5.8), indicating better understanding of negative long-term payoff.

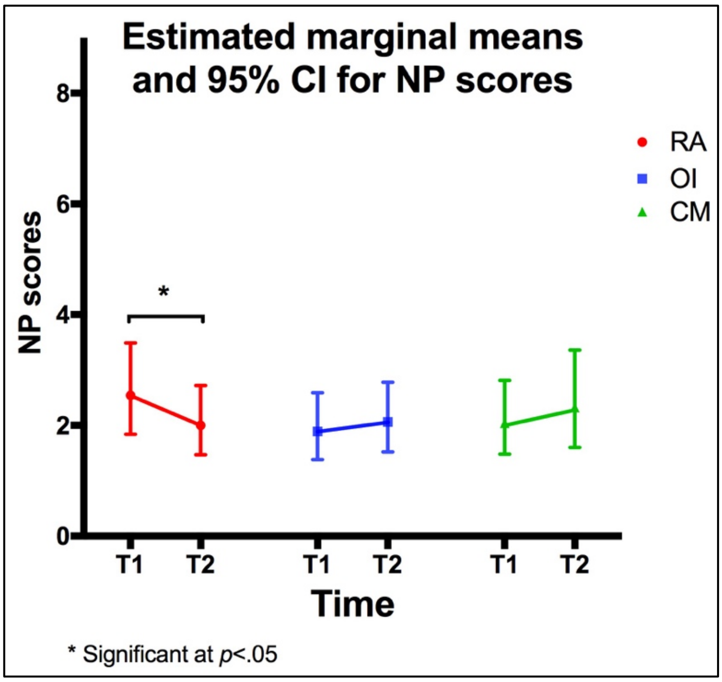

Figure 5.8: Estimated marginal means for adolescents' NP scores

Table 5.10: Parameter estimates for main effects and interactions of adolescents' NP scores

	Method 1 (Ref = RA)					Method 2 (Ref = CM)					Method 3 (Ref = OI)				
Parameter	**β**	**Std. Error**	**95% CI**		**Sig.**	**β**	**Std. Error**	**95% CI**		**Sig.**	**β**	**Std. Error**	**95% CI**		**Sig.**
Intercept	0.930	0.1636	0.610	1.251	.000	0.713	0.1628	0.394	1.032	.000	0.636	0.1601	0.322	0.950	.000
Tx = CM	-0.218	0.2308	-0.670	0.235	.346	0[a]	.	.	.	.	0.077	0.2284	-0.371	0.525	.736
Tx = OI	-0.294	0.2289	-0.743	0.154	.198	-0.077	0.2284	-0.525	0.371	.736	0[a]	.	.	.	.
Tx = RA	0[a]	.	.	.	.	0.218	0.2308	-0.235	0.670	.346	0.294	0.2289	-0.154	0.743	.198
Time 2	**-0.238**	**0.1132**	**-0.460**	**-0.016**	**.035**	0.129	0.1918	-0.247	0.505	.501	0.086	0.1493	-0.207	0.379	.564
Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.
CM * Time 2	0.367	0.2227	-0.069	0.803	.099	0[a]	.	.	.	.	0.043	0.2430	-0.433	0.519	.860
CM * Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.
OI * Time 2	0.324	0.1873	-0.043	0.691	.084	-0.043	0.2430	-0.519	0.433	.860	0[a]	.	.	.	.
OI * Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.
RA * Time 2	0[a]	.	.	.	.	-0.367	0.2227	-0.803	0.069	.099	-0.324	0.1873	-0.691	0.043	.084
RA * Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.

[a] Set to zero because this parameter is redundant (reference category).

5.5 Discussion

The purpose of the current study was to determine if including misconceptions about electronic gaming machine design improved engagement amongst adolescents compared to educating about the harmful consequences of gambling and educating about gaming machine design alone. It also sought to determine if this method would improve understanding of important mathematical concepts related to how EGM's are designed in a way that disadvantages the player. The study reported on data from 164 adolescents, including their gambling behaviours and attitudes, and the effects of the three different educational videos described in Chapter 4 (intervention effects evaluated using a subsample of N=84).

5.5.1 Adolescent Gambling

Most adolescents (69.5%) had not gambled in the past three months, which represented a lower adolescent gambling participation rate than previous Australian studies have reported (30.5% current sample vs. 41-81% previous studies; Delfabbro, Lahn, & Grabosky, 2005; Jackson, Dowling, Thomas, Bond, & Patton, 2008; Lambos et al., 2007; Splevins et al., 2010; Volberg et al., 2010). This discrepancy may come from the difference in measurement; the aforementioned studies reported past-year gambling, whereas the present study reported on gambling in the past three-months.

Of those who had gambled, small amounts of money were being wagered (Mdn $2.50 per week), and the most popular forms of gambling were personal bets between friends or family, scratchcards, and sports betting. Participation in these gambling forms were consistent with previous Australian studies on adolescent gambling suggesting these three forms of gambling are most popular amongst adolescent gamblers (Jackson et al., 2008; Lambos et al., 2007; Splevins et al., 2010). Importantly, personal bets and scratchcards are typically associated with low problem prevalence in adult populations (Gainsbury, Russell, Hing, Wood, & Lubman, 2014; Wardle et al., 2010).

The current study found that eight participants were categorised as ‘high severity’ gamblers by the CAGI-GPSS. This equated to 4.9% of the total sample and is similarly consistent with previous findings reporting high rates of adolescent problem gambling (Derevensky & Gupta, 2000; Gupta et al., 2013; Purdie et al., 2011; Splevins et al., 2010; Welte et al., 2008) compared to adults (e.g., 0.6% Australian adults in Gainsbury et al., 2014). Of note, five of the eight participants who were categorised as ‘high severity’ gamblers reported spending ‘$0’ per week gambling, and six of the eight reported spending ‘$0’ on simulated forms of gambling. Future research in this area should aim to determine how consistent this finding is in larger samples, and whether it may contribute to suggestions that rates of adolescent problem gambling may be inflated. Previous concerns for inflated rates rise from considerable false positives and weak construct validity in screening instruments, a lack of gambling opportunities for adolescents compared to adults, engagement with gambling forms associated with low problem prevalence, and the paucity of adolescents seeking treatment for gambling problems (Derevensky, Gupta, & Winters, 2003; Gainsbury et al., 2014; Hardoon et al., 2003; Wardle et al., 2010).

More adolescents in the current sample engaged in simulated forms of gambling (34.8%) than traditional forms of gambling (30.5%). These findings are consistent with a small number of studies which suggest simulated gambling is popular among young people (Hayer et al., 2018; King, Delfabbro, Kaptsis, & Zwaans, 2014). Little is known about the association between simulated and traditional gambling, but there is some evidence that the former may act as a ‘gateway’ to traditional gambling (Hayer et al., 2018; King et al., 2014). Due to the largely non-monetary nature of these games, there is no regulation surrounding pay-out schedules or win rates, leading many researchers to caution against their role in creating unrealistic expectations of winning in gambling games which may carry over into play in monetary forms (Armstrong, Rockloff, Browne, & Li, 2018; Derevensky & Gainsbury, 2016; Hayer et al., 2018; King et al., 2014).

5.5.2 Educational Effects

5.5.2.1 Fidelity.

One limitation of the current study is that it was not possible to guarantee the fidelity of participants' consumption of the educational material. Upon assessing questionnaire duration times, a substantial portion of participants' responses were associated with very short timeframes (<15 mins); insufficient to complete the pre- and post- measures as well as watch the entirety of the educational video. Although analyses of educational effects were carried out on a subsample of participants (survey duration >15 minutes) this finding suggests that a video-only format may not represent the most effective mode of delivery to convey gambling education material.

5.5.2.2 Engagement.

Relating to Hypotheses 1, 3, and 4; there was no difference between the educational videos on measures of engagement, likelihood of accommodating new information, or perceived effectiveness. All videos were considered somewhat engaging, likely to be accommmodated, and effective by participants, but none more so than the others. Despite this, participants consistently rated all three videos as not personally relevant (the fourth item on the LANI measure)(Figure 5.5). The most likely conclusion from this is that despite differences in content, all videos shared the same subject matter – EGM gambling. Given that only 3.7% of the current sample reported playing an EGM in the past three months, it is reasonable that the videos were dismissed as irrelevant because they focussed on a form of gambling adolescents were not engaging in. However, EGMs remain the most problematic form of gambling for those seeking treatment (Blaszczynski et al., 2015; Productivity Commission, 2010), suggesting prevention efforts remain necessary.

5.5.2.3 Understanding gambling mathematics.

Results indicated that Hypothesis 4 was not supported because there was no difference in IE scores for participants in any of the video conditions. There are several possible explanations for this finding. Firstly, the data suggests that information about EGMs was not deemed relevant to this particular sample. Information that aims to target gambling misconceptions tailored to the type of gambling preferred at the individual level may be more fruitful. The two most popular forms of gambling in this sample – placing personal bets and playing scratch cards – are not typically associated with gambling problems. However, the third most popular form was sports betting, which has been associated with misconceptions about illusions of control and misattribution of skill in outcomes (Cantinotti, Ladouceur, & Jacques, 2004; Russell, Hing & Browne, 2019). Information which seeks to break down such misconceptions relating to sports betting may be an appropriate target for this age group.

On the other hand, it may be more important to educate about more general concepts in gambling, and the relative misconceptions which may develop in each gambling form, as longitudinal data suggests participation in gambling forms is unstable over time amongst this age group. That is, teaching about misconceptions relating to one specific form of gambling (i.e., sports betting) may be relevant for some adolescents at that time, but they are likely to engage in multiple different forms of gambling and are unlikely to persist with one form over time (Delfabbro, King, & Griffiths, 2014). Lastly, the lack of participant fidelity suggests that presenting information about misconceptions through a video-only format in a classroom setting may not be an adequate mode of delivery. It may be more effective to present such information in a more interactive way, in the presence of a facilitator or teacher.

Scores relating to participants' understanding of the long-term negative payoff of EGM gambling significantly improved from pre to post after watching the Risk video and did not change for those in the Operator and Misconception video conditions. This result is counterintuitive because the Risk video did not aim to teach underlying game mathematics, whereas both the Operator and Misconceptions videos did. This result supports the interpretation that complex material is not well adopted by a non-invested sample and may be best delivered to adolescents through a facilitator or teacher to encourage their continuing attention.

Previous research has attempted to determine if learning about mathematics more generally can alter gambling behaviour (Lambos & Delfabbro, 2007; Peard, 2008; Pelletier & Ladouceur, 2007; Turner, Macdonald, Bartoshuk, & Zangeneh, 2008; Turner, Macdonald, & Somerset, 2008; Williams & Connolly, 2006). Although this question cannot be answered with the current research, experts in mathematics remain confident that such knowledge is crucial, that previous studies have lacked epistemic components, and that this field of research requires more interdisciplinary collaboration (Barboianu, 2013, 2015; Peard, 2008). Future research should investigate whether gambling mathematics education may mediate or moderate the relationship between known immutable risk factors (male gender, trait impulsivity, low income, etc.) and gambling problems and if understanding these concepts may serve as a protective factor for gambling problems.

5.6 Chapter Summary

This chapter reported on a study of adolescents’ gambling attitudes, beliefs, and behaviours. Results indicated most adolescents did not gamble, and those who did (including problem gamblers) spent very little money gambling. This raises questions over the validity of adolescent problem gambling measures, as well as conceptual ambiguity around adolescent gambling harm in general. Results of a mixed factorial designed study suggested critical appraisal of EGM misconceptions in gambling education did not improve engagement or understanding of mathematical concepts related to gambling amongst adolescents more than educating about the harmful consequences alone. This finding may be unique to the sample tested or it may relate to the mode of delivery and the low personal relevance to EGM gambling. The following chapter reports on the results of a repeated measures study investigating preferences for educational material amongst an independent sample of first-year university students.

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6 Chapter Six: Study 2 – First-year University Students

Preamble: This chapter details the second of the three studies in this thesis. In this study, a repeated measures design was used to determine which of the three educational videos described in Chapter 4 was preferred over the others in terms of engagement, likelihood of accommodating new conceptual information, and perceived effectiveness among a sample of first-year university students.

6.1 Introduction

Similar to adolescents, university (or 'college') students represent a high-risk group for gambling problems. A recent meta-analysis of over 13,000 college students worldwide revealed that 10.2% were estimated to be probable pathological gamblers (Nowak & Aloe, 2014). Reported rates of university student gambling problems in Australia are comparably lower at around 5% (Moore et al., 2013), however, still constitute substantially higher rates than those found in the general adult population (0.6% in Gainsbury, Russell, Hing, Wood, & Lubman, 2014).

High rates of problem gambling amongst university students may be associated with the age for legal gambling. Those studying at university are typically aged early in adulthood (17-25 years old), which coincides with the legal age to access commercial forms of gambling (18 years old in Australia). Increased accessibility has been associated with increased problem gambling rates (Welte, Barnes, Tidwell, & Hoffman, 2009). Researchers have also argued that gambling could be considered one of many 'coming-of-age' activities (including drinking alcohol and smoking) that are associated with high use in the early stages of access, and subsequently decline as the behaviour becomes normalised (Stinchfield, 2000, 2011; Stinchfield, Hanson, & Olson, 2006). Furthermore, longitudinal research has demonstrated that gambling problems are often transient (Edgerton, Melnyk, & Roberts, 2015; Slutske, Jackson, & Sher, 2003; Winters, Stinchfield, Botzet, & Slutske, 2005), and many people recover without formal assistance (Slutske, 2006, 2010).

Such cross-sectional variation in problem gambling trajectories has sparked debate about whether preventative gambling education is better targeted at those who are most at-risk (targeted) or provided to all people regardless of risk status (universal) (Ladouceur, Goulet, & Vitaro, 2013). The benefit of the former is that education can be tailored specifically to the group of people who need it most, whereas the latter ensures that all people are provided some basic level of education should they find themselves on the path to gambling problems. University students may be considered an at-risk group because they are older and have more access to gambling opportunities, compared to adolescents who have had fewer gambling experiences, and many have had none at all.

It is not clear whether the same preventative interventions influences both adolescents and young adults, such as university students, in the same way. Despite evidence that gambling misconceptions play an important role in the early development of gambling problems, it is not clear if the use of misconceptions in preventative programs has differing impact at different developmental stages of individual trajectories towards gambling problems (Myrseth, Brunborg, & Eidem, 2010; Tani, Gori, & Ponti, 2018; Xian et al., 2008).

Although the majority of adolescents in high school are not of legal age to play EGMs, young adults at university can legally participate in gambling. Those who opt to gamble on EGM's are likely to be in the early stages of learning about this form of gambling. How EGMs are designed and the nature of the underlying processes that govern game outcomes is difficult to understand. In the absence of an accurate understanding of game outcomes, first time players are susceptible to misunderstanding how EGMs work. This is in line with Mathieu et al.'s (2018) process model of gambling problems which suggests misconceptions arise from repeated gambling (practice) and supported by data indicating misconceptions increase as gambling intensity does (Miller & Currie, 2008; Moodie, 2008).

As outlined in Chapter 3, gambling misconceptions represent a key risk factor for gambling problems, contingent on gambling experiences. That is, we should not expect one to possess gambling misconceptions if one has not had adequate gambling experiences, and so misconceptions temporally follow initial gambling experiences. Given the slightly older demographic of university students compared to adolescents, and their legal entitlement to access commercial forms of gambling like EGMs, education that focuses on EGM misconceptions may be more relevant to this age group than education that focuses on the harmful consequences of gambling.

Educating about misconceptions may increase engagement with educational material among young adults as it offers them a framework for understanding how gambling problems may develop over time. Whereas preventative programs that only educate about the harmful consequences of gambling omit reference to the intermediate stages leading to harmful consequences that arise from excessive gambling. Raising awareness by depicting severe examples of gambling outcomes may not resonate with an audience who are relatively early in their gambling experiences and are unlikely as of yet to be experiencing elevated levels of gambling related harm. The purpose of the current study was to determine the effects of educational content that focuses on gambling misconceptions related to electronic gaming machines on university students, compared to educational content that focuses on the harmful consequences of gambling and education about EGM game design alone. This study builds on the previous study in Chapter 5 and allows for comparisons to be made between intervention effects across development cohorts on both sides of the legal age to gamble.

6.2 Hypotheses

The primary hypothesis that guided this study was that when exposed to all three videos, university students would find the Misconception video more engaging than the other two videos. Secondary directional hypotheses stated the predicted trend of results; that Cognitive Misconceptions (CM) would outperform Operator Information (OI), which would outperform Risk Awareness (RA).

6.2.1 H_1 Engagement.

H_1a: Emotional engagement scores will be significantly higher after watching the CM video compared to the OI and RA videos.

H_1b: Emotional engagement scores will be higher after watching the OI video compared to the RA video.

6.2.2 H_2: Likelihood of accommodating new information.

H_2a: Likelihood of accommodating new information scores will be higher after watching the CM video compared to the OI and RA videos.

H_2b: Likelihood of accommodating new information scores will be higher after watching the OI video compared to the RA video.

6.2.3 H_3 Perceived effectiveness.

H_3a: Perceived effectiveness scores will be higher after watching the CM video compared to the OI and RA videos.

H_3b: Perceived effectiveness scores will be higher after watching the OI video compared to the RA video.

6.3 Methodology

6.3.1 Design

This study implemented a repeated measures design where the independent variable was education type (Risk Awareness [RA], Operator Information [OI], and Cognitive Misconceptions [CM]), and the dependent variables included engagement, likelihood of accommodating new information, and perceived effectiveness. Participants were exposed to all three educational videos, the order of which was counterbalanced to control for order effects. The purpose of employing a repeated measures design was to determine if one educational video was perceived to perform better on these outcome measures when participants were able to compare them against each other. The current study complements the previous study in Chapter 5 by providing insight into the thoughts and attitudes of a developmentally older age group who have legal access to commercial forms of gambling.

6.3.2 **Sample size requirements.**

An a-priori power analysis was conducted to calculate the number of participants required for a repeated measures design using non-parametric tests. In line with suggestions made by Lehmann (2006), the required sample size for the parametric equivalent test was computed and then 15% was added as an adjustment. G*Power power analysis software was used to determine that for a repeated measures ANOVA, a sample size of N = 42 would be needed to detect a small-medium effect size (F = 0.2) with a statistical power of .8. Non-sphericity correction E was imputed = 1 as the default assumption of sphericity for the parametric test. The total sample size required to achieve power of .8 for a non-parametric test was thus calculated as (N=42+15%) N = 48.

6.3.3 **Participants**

The sample consisted of 58 first-year psychology university students, recruited from the University of Sydney's first-year psychology subject pool. The benefit of recruiting first-year university students was that they constituted a cohort of predominantly young adults. Sampling this age group enabled insight into the attitudes and perspectives of a slightly older developmental age group who are of legal age to gamble, relative to adolescents.

6.3.4 **Measures**

Participants were asked to complete a series of online surveys which involved questions about their demographic details, and gambling behaviour. Due to the repeated measures nature of the design it was not appropriate to measure the influence of the videos on understanding gambling mathematics as participants would demonstrate cumulative educational effects. Each of these measures are described in more detail below with their relevant response options in parentheses.

Demographics: Gender, age, marital status, household type, employment type, Occupation type, past year income before taxes, language other than English, born in Australia, years lived in Australia, Indigenous.

Gambling behaviour: Participants were asked if they had bet money on the following forms of gambling in the past three months: Scratch cards, lottery, Bingo, Keno, Electronic Gaming Machines (EGMs, pokies), sports betting, racing (horse, dog, harness), casino (roulette, blackjack, cards, poker), E-sports (betting on the outcome of a video game tournament), Daily fantasy sports competitions (paid entry fee per contest, per-round/week competition, chance to win money e.g., Moneyball – this is not the same as traditional fantasy sports which is free-to-play), Personal bets (e.g., private bets with friends/family on card games, sporting events, competitions, or other activities). Participants were also asked if they typically bet this money in-person or online (online in-person, only online, both). Data was collected on past three-month stake amounts on all forms of gambling and on EGMs only. All dollar amounts are in AUD$ unless otherwise stated. This question was phrased as "On average, for (all forms of gambling/EGMs), how much money would you typically risk… By 'risk' we mean the amount of money staked, not including any winnings. For example, if you bet $30 but won back $20, write '30'.

Emotional engagement: Participants' level of emotional engagement was measured by asking how interesting the video was, how hard they concentrated on the video, and how much they enjoyed watching the video. Participants were asked to respond to each of the three questions using a five-point Likert scale (1=not at all, 5=very). The scale had good internal consistency amongst the current sample of first-year students (Cronbach's α = .818). Lower scores indicated lower engagement. See Chapter 4 for an in-depth description of the items.

Likelihood of accommodating new information (LANI): Participants were asked to rate how much they understood the video, and found it to be believable, useful, and relevant on a five-point Likert scale (1=strongly disagree, 5=strongly agree). Internal consistency for the scale was calculated by averaging the Cronbach's α for each repeated measure of the scale (M α = .701). Lower scores indicated low likelihood of accommodating new information. Details of the scale can be found in Chapter 4.

Perceived effectiveness: Participants were asked to rate how effective they thought each video was on a scale from 1 (not at all effective) to 5 (very effective) in terms of preventing young people from developing gambling problems, as well as reducing the amount of money young people will spend on EGMs in the future. Lower scores indicated lower perceptions of effectiveness. Details of the scale can be found in Chapter 4.

Table 6.1 indicates the structure of the questionnaire measures.

Table 6.1: Study 2 structure of questionnaire.

Measure	Pre	Video 1	Post 1	Video 2	Post 2	Video 3	Post 3
Gambling behaviour	✓						
LANI			✓		✓		✓
Engagement			✓		✓		✓
Perceived Effectiveness			✓		✓		✓

6.3.5 Procedure

Approval was obtained from the Sydney University Human Research Ethics Committee (HREC; project no. 2017/392). Participants were recruited via the Sydney University first-year psychology subject pool through which they were awarded course credit for their participation (1.5 credits for 1.5 hours). The details of the study were advertised via the online subject pool study enrolment system. Prospective participants were asked to read the information statement about the study and sign up to one of several timeslots available. The study took place in a university computer room. After signing up and arriving to the study location participants were assigned a computer and randomly allocated to one of six conditions of the online survey, which represented the six different variations of counterbalanced video order. Allocation was carried out according to random permutations to assure relatively equal numbers of participants in each condition. This type of design enabled better control of individual differences compared to a between-subjects design which may influence preferences of educational videos.

All participants were asked to read the information statement and consent form before providing consent to take part. Participants then completed the online questionnaire which followed the structure outlined in Table 6.1. Following participation, participants were emailed a debrief letter explaining in detail what the study was about and contact information for further enquiries.

6.3.6 Data analyses

SPSS Statistics version 24 was used to analyse all data. Descriptive statistics were analysed for baseline data including participant demographics, and gambling behaviour and expenditure. Friedman tests were conducted to compare differences between groups (educational videos) on the repeated measures variables: engagement, likelihood of accommodating new information, and perceived effectiveness.

6.4 Results

6.4.1 Baseline Measures

6.4.1.1 Sample demographics.

The statistics in Table 6.2 demonstrate that most of the sample were young women who were not married and lived at home with their parents. The majority were full-time students who earned less than $20,000 per year. There was also a large proportion of the sample that were born outside of Australia and spoke a language other than English (LOTE) at home.

Table 6.2: Demographic characteristics of university students.

	N	%	M	SD
Gender				
Female	43	74.1%		
Male	14	24.1%		
Other	1	1.7%		
Age			19.76	3.67
Marital status				
De/facto	3	5.2%		
Widowed	2	3.5%		
Never married	53	91.4%		
Household				
Single person	15	25.9%		
Single parent family with child/children	3	5.2%		
Couple with child/children	23	39.7%		
Couple with no child/children	7	12.1%		
Group household	10	17.2%		
Employment				
Full-time work	1	1.7%		
Part-time work	11	19%		
Unemployed	8	13.8%		
Full-time student	36	62.1%		
Other	2	3.5%		
Main occupation				
Professional	1	1.7%		
Technician or trade worker	1	1.7%		
Clerical or administrative	1	1.7%		
Sales	11	19%		
Other	44	75.9%		
Income				
< $20,000	46	79.3%		
$20,000 to $49,999	4	6.9%		
$50,000 to $79,999	1	1.7%		
$80,000 to $109,999	0	0%		
$110,000 to $149,999	1	1.7%		
$150,000 or more	0	0		
Prefer not to say	6	10.3%		
LOTE	31	53.5%		
Indigenous				
Aboriginal	0	0%		
Torres Strait Islander	0	0%		
Aboriginal and Torres Strait Islander	0	0%		
None	58	100%		
Prefer not to answer	0	0%		
Born in Australia				
Yes	31	53.5%		
No	27	46.6%		
Years lived in Australia			4.23	4.97

Note: Percentages may not add up to 100% due to rounding.

6.4.1.2 Gambling behaviour.

Twenty of the 58 participants (34.5%) reported gambling at least once in the past three months. Participation in gambling forms by the 20 people who reported gambling can be found in Table 6.3.

Table 6.3: University students' gambling participation and mode in the past three months.

Participation	**N**	**Valid %**	**Sample %**
Any gambling	20	100%	34.5%
Scratchcards	2	10%	3.5%
Lottery	4	20%	6.9%
Bingo	1	5%	1.7%
Keno	0	0%	0%
EGMs	6	30%	10.3%
Sports	4	20%	6.9%
Racing	4	20%	6.9%
Casino	7	35%	12.1%
E-Sports	0	0%	0%
Daily fantasy sports	0	0%	0%
Personal bets	15	75%	25.9%
Other	0	0%	0%
Have not gambled in the past three months	38		65.5%
Mode (N = 20)			
Only in-person	13	65%	22.4%
Only online	2	10%	3.5%
Both	5	25%	8.6%

*Valid% refers to % of participants who reported gambling.

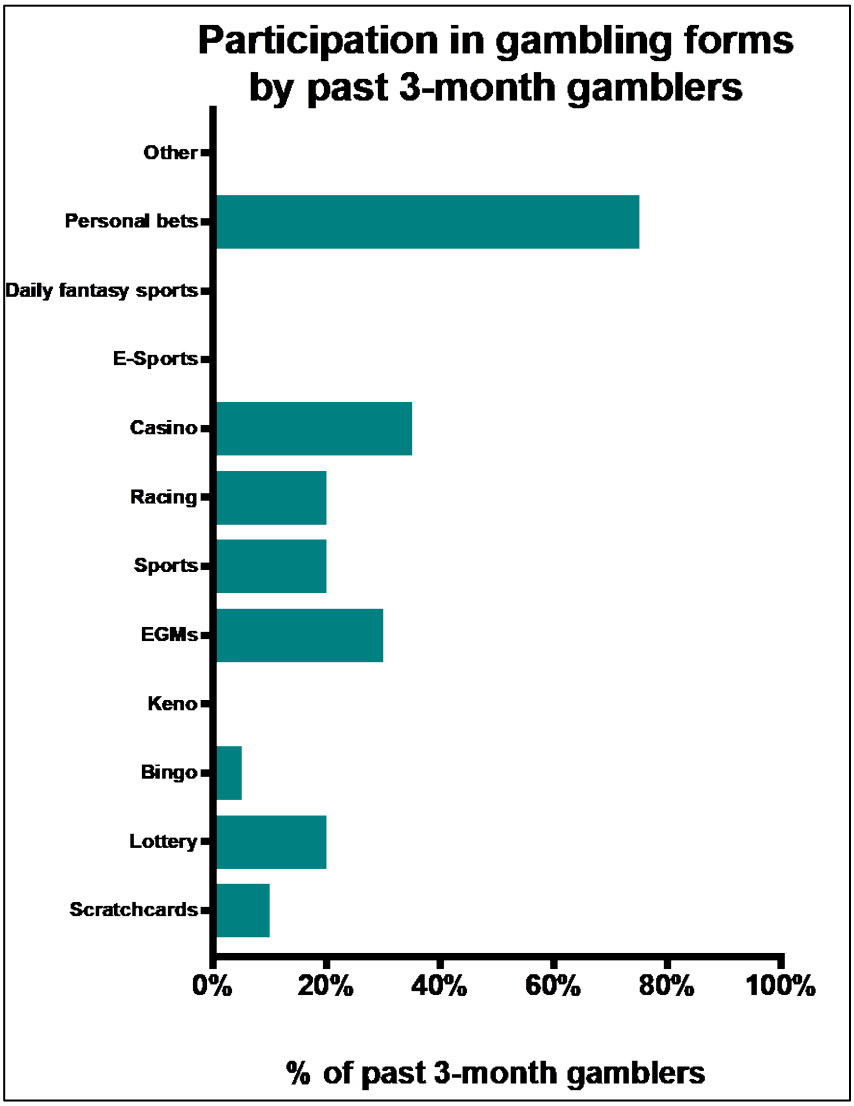

Figure 6.1: University students' participation in various gambling forms in the past three months (n=20).

For respondents who reported gambling in the past three months (n=20), their reported EGM stake amount was subtracted from their total stake amount to produce a difference score. Positive scores indicated spending money on other forms of gambling, whereas negative scores indicated unreliable responses (reporting greater EGM expenditure than 'total' expenditure, which includes EGMs). One respondent (1.7%) produced a negative difference score for stake amounts, indicating that they reported spending more on EGMs than their total gambling expenditure (including EGMs). This response was excluded from analyses; results for expenditure data report on valid responses only.

Table 6.4: University students' weekly total gambling and EGM gambling stake ($AUD) (N=19).

	M	SD	Mdn
All gambling	$19.79	38.84	$5.00
EGM gambling	$1.84	4.70	$0.00

Of the 19 participants who provided responses to self-reported expenditure, the average amount spent was $19.79 per week on all forms of gambling, and $1.84 on EGM gambling. However, as indicated by the median values in Table 6.4 and the histogram in Figure 6.2, most participants reported spending small amounts, including nothing at all.

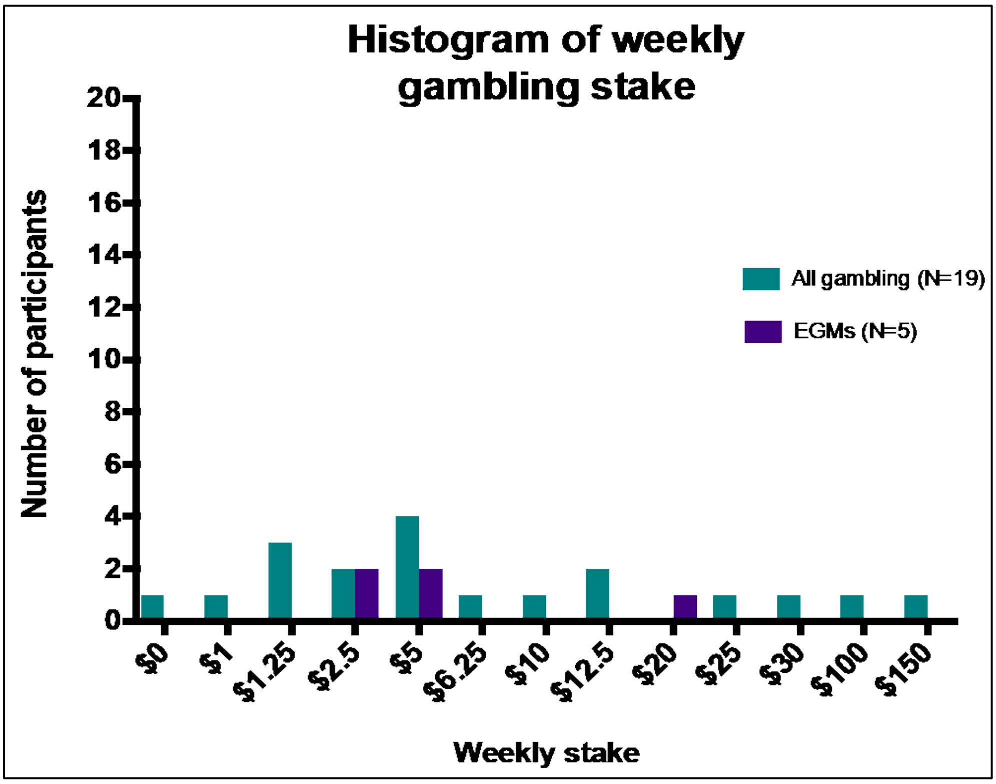

Figure 6.2: Histogram of university students' weekly dollar amount spent on all forms of gambling and EGM gambling.

6.4.2 **Preference for Educational videos**

6.4.2.1 Engagement.

A Friedman test was run to determine if there were differences in engagement scores across the experimental videos. All videos were rated between "somewhat" (Mdn=9) to "very" (Mdn=15) engaging. Engagement was statistically significantly different across the experimental videos, $\chi^2(2) = 13.864$, $p < .001$.

Pairwise comparisons were performed with a Bonferroni correction for multiple comparisons. Post-hoc analyses revealed Engagement was statistically significantly different between Risk Awareness (RA) (*Mdn* = 12.00) and Operator Information (OI) (*Mdn* = 11.00; *p* = .012) and RA (*Mdn* = 12.00) and Cognitive Misconceptions (CM) (*Mdn* = 11.00; *p* = .009), but not between CM and OI (Figure 6.3). This suggests that first-year students found the RA video to be more engaging than the other two videos.

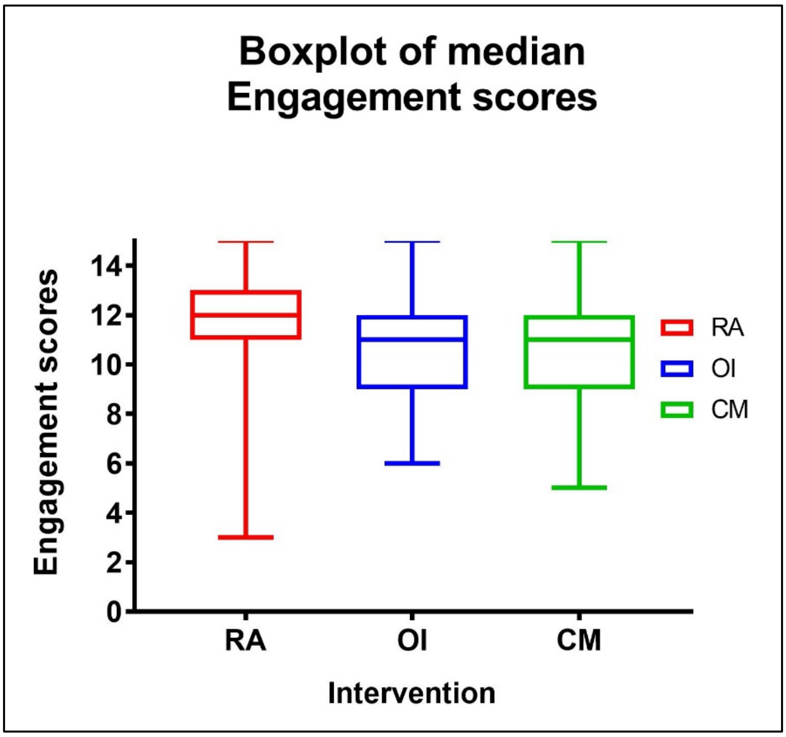

Figure 6.3: Boxplot of university students' median engagement scores.

6.4.2.2 Likelihood of accommodating new information (LANI).

A Friedman test was run to determine if there were differences in LANI scores across the experimental videos. There was no significant difference in LANI scores across the three experimental videos, $\chi^2(2) = 5.698$, $p = .058$. Higher median values indicated that each video was rated, on average, favourably (Figure 6.4) (Mdn=12 indicating neutral responses), RA (*Mdn* = 16.00), OI (*Mdn* = 15.00), CM (*Mdn* = 15.00).

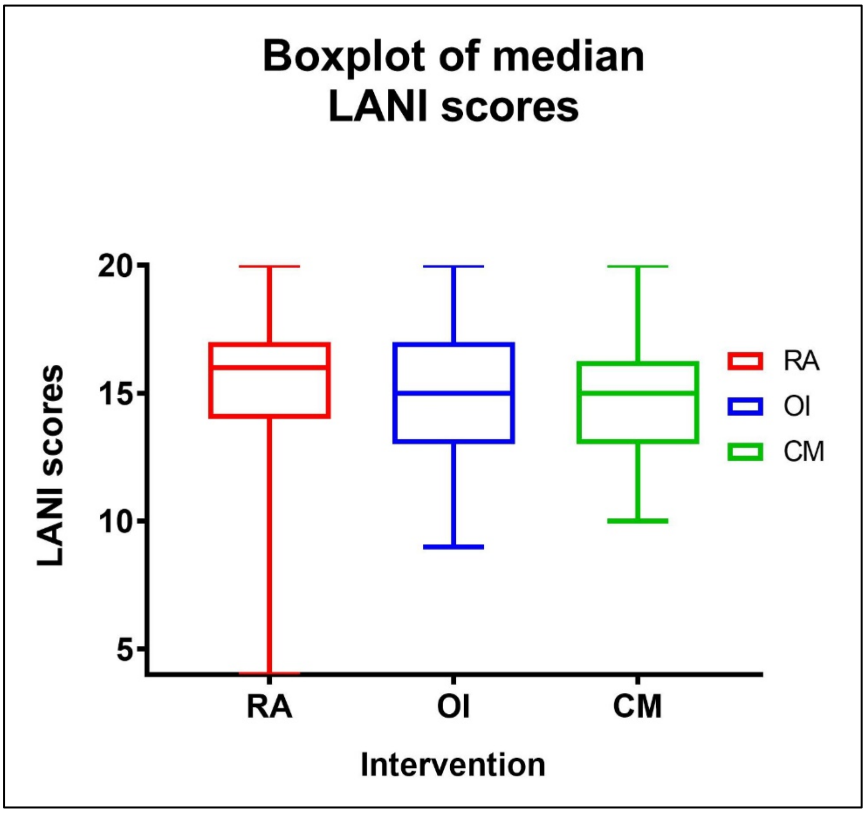

Figure 6.4: Boxplot of university students' median LANI scores.

In line with results from the adolescent sample reported in Chapter 5, Figure 6.5 indicates that compared to other items in the measure, relevance was low amongst all intervention types (*Mdn* = 3 indicating neutral response).

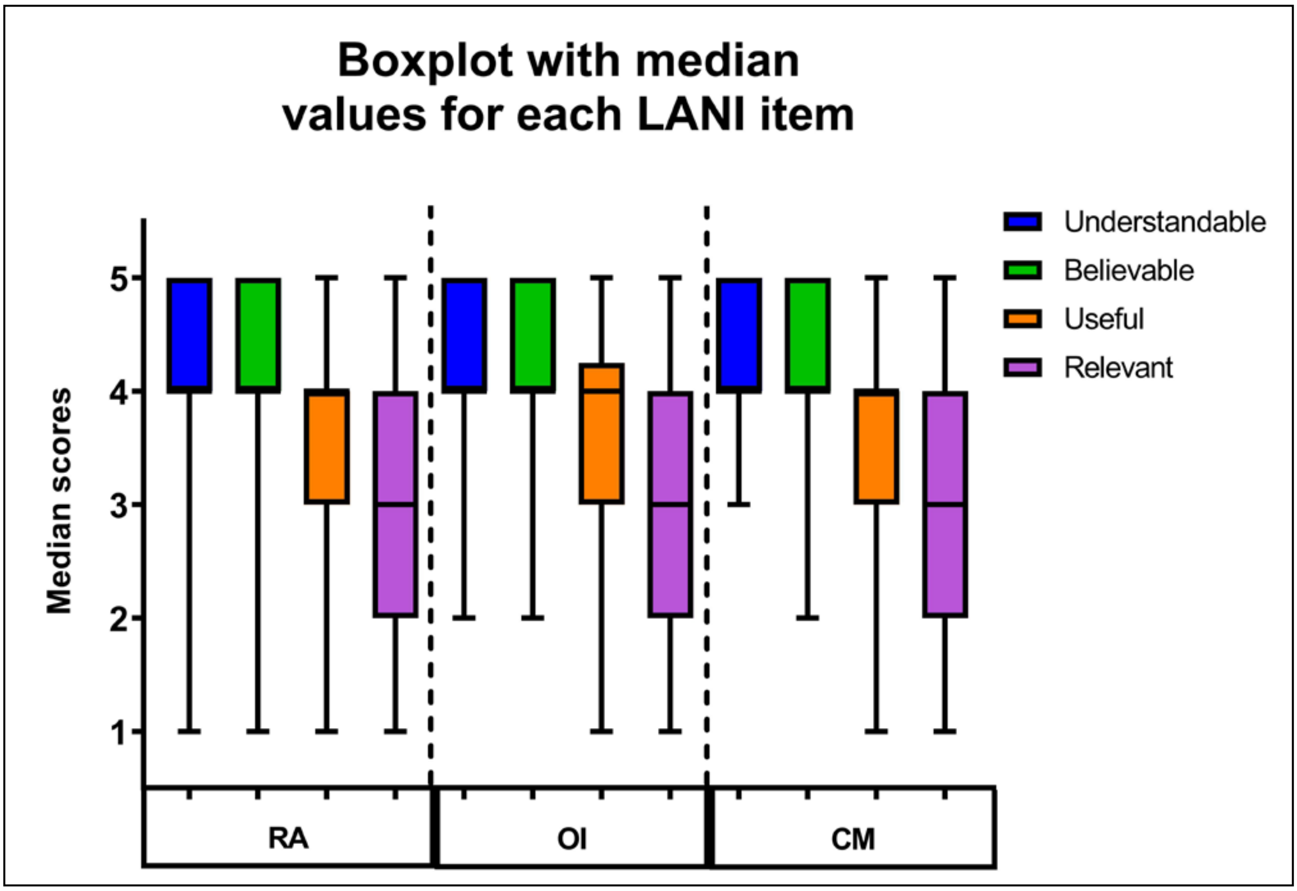

Figure 6.5: Boxplot with university students' median values for each LANI item

6.4.2.3 Perceived Effectiveness (PE).

A Friedman test was run to determine if there were differences in median perceived effectiveness scores across the experimental videos. There was no significant difference in PE scores across the three experimental videos, $\chi^2(2) = 2.048$, $p = .359$. Median scores of 8 indicated that all three videos were rated as 'somewhat effective', RA (*Mdn* = 8.00), OI (*Mdn* = 8.00), CM (*Mdn* = 8.00) (Figure 6.6).

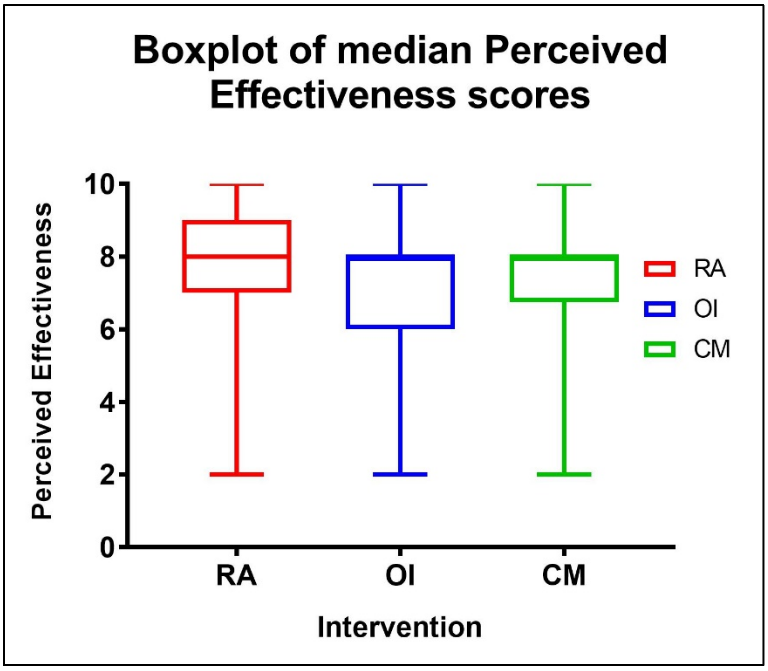

Figure 6.6: Boxplot of university students' median perceived effectiveness scores.

6.5 Discussion

Most participants in the current study reported no gambling in the past three-months. Of those who did (n=20), the most popular form of gambling was personal bets, followed by casino games, and EGMs; most of which was carried out in person. Of the 19 participants who provided a valid response for their weekly stake amount, relatively low amounts of money were reported to be spent on all forms of gambling (Mdn $5/week), as well as by those reporting EGM expenditure (N=5; Mdn = $5/week).

Results indicated that Hypotheses 1, 2, and 3 were not supported. All videos were deemed to be 'somewhat' or 'very' engaging as indicated by median values >9. However, first-year students rated the Risk video as more engaging compared to the Operator or Misconception videos. There were no differences between the videos in terms of the likelihood of accommodating new information or perceived effectiveness. All videos were rated between 'neutral' and 'somewhat' likely to accommodate new information, and 'somewhat' effective at reducing or preventing problems.

The findings suggest that university students found the Risk video more engaging than the other two videos. However, although slightly higher than adolescents, there was relatively low representation of interest for this form of gambling with just over 10% of the sample (n=6) betting on EGMs in the past three months. Low gambling participation in general may have been influenced by the relatively low representation of male students in the sample, as male university students tend to gamble more frequently on all forms of gambling (except lottery and bingo) compared to female students (Moore et al., 2013). A breakdown of the LANI measure indicated all videos were perceived to be of low relevance to participants (Figure 6.5).

These results suggest that, similar to adolescents, most university students were not participating in EGM gambling and did not find the information personally relevant. Due to these factors, it is likely the current sample reported the more generalisable, palatable information conveyed in the Risk video as more engaging than the two other videos which tended to provide more complicated information specific to EGMs. Although on face-value lay people may prefer simpler information, it lacks the necessary complexities inherent in abstract explanations which make arguments both accurate and useful (Hopkins, Weisberg, & Taylor, 2016; Lombrozo, 2016). Philosophers have argued that abstract explanations are superior to concrete ones, because they highlight causal mechanisms, however people still tend to prefer concrete details and do not penalise these explanations for having causally irrelevant information (Bechlivanidis, Lagnado, Zemla, & Sloman, 2017).

In the context of gambling education, it is not known how reductive explanations of how gaming machines work may contribute to development of common misconceptions. For those who do not generally gamble, this may not pose any particular threat. However, for those who frequently engage in EGM gambling, reductive explanations of its associated functions (‘they are programmed to return a certain per cent of money’) may encourage problem-solving which, in the absence of accurate information, ultimately leads to misconceptions (Ejova & Ohtsuka, 2019).

Despite the inherent challenges present in communicating abstract explanations of scientific concepts, researchers have argued that experts in this area have a responsibility to effectively communicate these ideas to the public (Shah, Michal, Ibrahim, Rhodes, & Rodriguez, 2017). As such, it is necessary that gambling researchers continue to explore ways to educate the public about key risk factors such as gambling misconceptions.

From the results in Chapters 5 and 6, it is not clear what impact the educational videos may have on future EGM gambling. It appears that information about EGMs is not relevant to adolescents or young adults and this may have resulted in low engagement with complex information in the Misconceptions video and preferences for simpler and briefer information in the Risk video. However, it is not known how this information may influence participants' gambling behaviour should they begin or continue to play EGMs. Evaluating the impact of the same educational videos on people who find information about EGMs personally relevant may provide some insight into the potential longer-term outcomes of the educational videos.

6.6 Chapter Summary

This chapter reported on the results of a repeated measures study investigating the relative effects of each of the three educational videos on a sample of young adults attending university. Results suggested that for young adults who do not generally gamble on EGMs, simpler information about harmful consequences as found in the Risk video was more engaging than information critically appraising misconceptions and information about EGM game design. The current findings suggest that similar to adolescents, information about EGMs was not personally relevant to this cohort. The following chapter reports on the results of a mixed factorial study investigating the effects of the three educational videos amongst a sample of regular EGM gamblers. The next study aimed to determine if the CM video was more effective in reducing misconceptions and improving understanding of gambling mathematics amongst those who find information about EGM gambling personally relevant.

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7 Chapter Seven: Study 3 –Electronic Gaming Machine (EGM) Gamblers

Preamble: This chapter details the third and final study of this thesis. This study aimed to test the impact of the three educational videos amongst those already exposed to regular interactions with gaming machines and likely possessing some misconceptions. Regular EGM gamblers were recruited and randomly allocated to one of the three experimental conditions (educational video type) and completed questionnaires before and immediately after watching one of the videos, as well as three and six months later. This chapter outlines the specific hypotheses, procedure, and methodology used in the study and details its results, including a summary of the findings. The implications of the three studies are synthesised and discussed in the next chapter.

7.1 Introduction

Recent figures indicate approximately half of gambling expenditure (51.2%) in Australia is spent on electronic gaming machines (EGMs)[1] (Queensland Treasury and Trade, 2018). Although more people play lotteries and buy scratch cards, more money is spent on EGMs each year than any other form of gambling (Armstrong & Carroll, 2017; Queensland Treasury and Trade, 2018). In Australia, gaming machines are restricted to licenced premises and are located in non-profit registered clubs and for-profit hotels (pubs), in addition to casinos. EGMs are also overrepresented as the preferred form of gambling in treatment seeking populations and are most associated with harms in the community (Blaszczynski et al., 2015; Productivity Commission, 2010). Consequently, many of the current public health campaigns and available treatment services have focused on reducing harm emanating from gaming machines.

The ease with which one can access EGMs, their continuous and rapid play, and potentially misleading design features are some of the most cited explanations for the increased rates of problems amongst players (Dowling, Smith, & Thomas, 2005; Productivity Commission, 1999). However, psychological therapies for gambling problems tend to emphasise the unique impact of gambler’s thoughts on their playing behaviour (Chretien, Giroux, Goulet, Jacques, & Bouchard, 2017; Cowlishaw et al., 2012). Several studies have demonstrated that both problem and non-problem gamblers exhibit misconceptions while gambling on EGMs (Delfabbro & Winefield, 2000; Gaboury & Ladouceur, 1989; Griffiths, 1994; Walker, 1992). Although most gamblers hold misconceptions about gambling, experimental research has demonstrated that those with gambling problems express such misconceptions more frequently and more intensely than those without problems (Baboushkin, Hardoon, Derevensky, & Gupta, 2001; Joukhador, Blaszczynski, &

[1] [1] Excluding expenditure on EGMs in Casinos

Maccallum, 2004; Raylu & Oei, 2004).Cognitive-based therapies and techniques that address gambler's misconceptions have demonstrated reasonable efficacy in reducing problems (Petry, 2009; Raylu & Oei, 2010). Cognitive restructuring techniques generally involve challenging and replacing misconceptions with more accurate and helpful cognitions (Chretien et al., 2017). Misconceptions relating to EGM play generally centre around the profitability of the machines and predictability of their outcomes. That is, players mistakenly believe that they can predict when a winning outcome will occur and thus profit from the game. As such, it seems feasible that educating EGM players about the unprofitability of gaming machines may help to reduce or correct misconceptions, and this may be an effective method of reducing or preventing problems.

7.1.1 Educating Gamblers

Several researchers have already tested educational interventions amongst gamblers with mixed results. Most notably, Wohl et al. (2010) tested the effects of an educational video on non-problem slots (North American gaming machines) gamblers. The purpose of their video was to provide a cognitively simple understanding of how slots function in order to reduce associated misconceptions, as well as encourage limit setting and strategies to avoid problems. The video followed a similar approach to the Misconceptions video described in Chapter 4, whereby the misconceived process of how slots outcomes are produced was presented first, (conveyor belt metaphor, each losing outcome gets you one step close to a winning one), and then systematically undermined by providing an accurate description of the random nature of sampling in determining outcomes (marbles in a bag, every time you draw one, you put it back and draw from the whole sample again). The purpose of the video was to instil an understanding of the independence of events and re-sampling in slots gambling outcomes. The video was shown to reduce misconceptions, increase understanding of slots' functions, increase intention to use limit-setting strategies, and reduce the frequency of exceeding limits compared to a control video (Wohl et al., 2010).

In contrast, other studies have demonstrated no association between understanding important gambling mathematics and associated reductions in misconceptions or gambling behaviour. Lambos and Delfabbro (2007) compared samples of gamblers and non-gamblers on measures of numerical reasoning, objective gambling knowledge, and biased reasoning and determined that although pathological gamblers reported greater cognitive biases this could not be attributed to limited numerical reasoning or knowledge of odds. Similarly, Pelletier and Ladouceur (2007) found that gamblers' knowledge of chance had no bearing on their behaviour during a video lottery terminal (VLT; UK gaming machine) gambling session and concluded mathematics knowledge was unlikely to represent a protective factor for excessive gambling.

Despite inconsistencies, experts in mathematics education have suggested the mixed results may be due to a lack of epistemic consideration when teaching mathematical concepts and that a comprehensive understanding of concepts such as probability and randomness will inevitably assist in resolving gambling misconceptions (Barboianu, 2013; Borovcnik, 2005; Peard, 2008). The purpose of the current study was to determine if critically appraising gambling misconceptions by teaching game mathematics would reduce EGM misconceptions amongst a sample of regular EGM players compared to educating about risks or educating about game design features alone.

7.2 Hypotheses

Critically appraising gambling misconceptions was hypothesised to aid in learning important yet complex game mathematics and reduce associated misconceptions amongst those who have them. It was hypothesised that EGM gamblers randomly allocated to the Misconceptions (CM) video would report significantly less misconceptions and better understanding of game mathematics than those who watched the Operator (OI) or Risk (RA) videos. Secondary directional hypotheses also stated the predicted trend of results; that the Misconceptions video would outperform the Operator video, which would outperform the Risk video.

7.2.1 H_1 Misconceptions.

H_1a: Gamblers in the CM video group will report lower misconception scores compared to those in the RA and OI groups.

H_1b: Gamblers in the OI group will report lower misconception scores than those in the RA group.

7.2.2 H_2 Understanding important gambling-related mathematics concepts.

H_2a: Those in the CM video group will report greater understanding of independence of events and negative long-term payoff compared to those in the OI and RA groups.

H_2b: Those in the OI video group will report greater understanding of independence of events and negative long-term payoff than those in the RA group.

Additional exploratory analyses aimed to investigate whether there were differences between experimental groups in terms of their expenditure on EGMs, problem gambling severity scores, and gambling-related harms.

7.3 Methodology

7.3.1 Design

This study used a mixed-factorial randomised controlled design. Participants were randomly allocated to one of three experimental conditions of the independent variable (educational video type; Risk Awareness, Operator Information, Cognitive Misconceptions) and the dependent variables (listed below) were measured at four timepoints, pre-video, post-video, three-months later, and six-months later. Each of these timepoints is henceforth referred to as Time 1 (T1), Time 2 (T2), Time 3 (T3), and Time 4 (T4).

7.3.2 **Sample size requirements.**

An a-priori power analysis was conducted using G*Power analysis software to estimate the sample size needed to achieve statistical power = .8 for a two-way mixed ANOVA calculating main effects and interactions of the educational videos (three levels) over time (four levels). It was calculated that a sample size of N = 158 would be sufficient to detect a medium effect size ($F = .25$) with a statistical power of .8 ($\alpha = .05$).

7.3.3 **Participants**

Participants were eligible to take part in the study if they played EGMs at least once per month in the past three months, spoke fluent English, and had a valid email address (so they could be emailed a URL link to the follow-up surveys). Participants were recruited from eight different registered club venues across New South Wales and the Australian Capital Territory from October 2017 until May 2018. The sample was not intended to be representative of all EGM gamblers.

A total of 97 participants consented to taking part in the research and commenced the online survey. Participant's responses were excluded if they indicated that they had not played EGMs in the past three months (n = 20) or had insufficient baseline data (n = 4) leaving a total sample of N = 73.

7.3.4 **Measures**

Participants were asked questions relating to their demographic situation, gambling behaviour, EGM misconceptions, understanding of mathematical concepts related to EGM gambling (independence of events (IE) and negative long-term payoff (NP)), and gambling problems and harm. Details of these measures are provided below with their relevant response options in parentheses.

Demographics: Gender (male, female, other [specify]); Age (open); Martial (married, living with partner/de facto, widowed, divorced/separated, never married); Household (single person, single parent family with child/children, couple with child/children, group household, other [specify]); Employment (full-time, part-time, unemployed, full-time student, self-employed, disability or other not aged pension, retired, other [specify]); Occupation (manager, professional, technician or trade worker, community or personal service worker, sales, machinery operator or driver, labourer, other [specify]); Past year income before taxes (< $20,000, $20,000-$49,999, $50,000-$79,999, $80,000-$109,999, $110,000-$149,999, $150,000 or more, Prefer not to say); Language other than English (no, yes [specify]); Born in Australia (yes, no); Years lived in Australia (open response); Indigenous (no, yes Aboriginal, yes Torres Strait Islander, yes Aboriginal and Torres Strait Islander, prefer not to answer).

Gambling behaviour: Participants were asked if they had bet money on the following forms of gambling in the past three months: Scratch cards, lottery, Bingo, Keno, Electronic Gaming Machines (EGMs, pokies), sports betting, racing (horse, dog, harness), casino (roulette, blackjack, cards, poker), E-sports (betting on the outcome of a video game tournament), Daily fantasy sports competitions (paid entry fee per contest, per-round/week competition, chance to win money e.g., Moneyball – this is not the same as traditional fantasy sports which is free-to-play), Personal bets (e.g., private bets with friends/family on card games, sporting events, competitions, or other activities). Participants were also asked if they typically bet this money in-person or online (online in-person, only online, both). Data was collected on past three-month stake amounts on all forms of gambling and on EGMs only. All dollar amounts are in AUD$, unless otherwise stated. This question was phrased as "On average, for (all forms of gambling/EGMs), how much money would you typically risk… By 'risk' we mean the amount of money staked, not including any winnings. For example, if you bet $30 but won back $20, write '30'." Participants were also asked how much they agreed or disagreed with the following statements on a scale of 1 (totally disagree to 10 (totally agree):

“The first time I gambled, I had a big win”, and “Thinking back to when I first started gambling, I had a few big wins”. At each of the follow-up time points, participants were also asked if they had experienced a big win since first taking part in the study, how much that big was ($) and the form of gambling it was on (same response options as above).

EGM Cognitions Scale (ECS): The 16-item ECS was administered to participants to measure their level of misconceptions relating to EGM play where lower scores indicated fewer misconceptions. See Chapter 4 for an in-depth description of the scale items and psychometrics.

Understanding of important mathematical concepts: Participants were asked both questions described in Chapter 4 relating to understanding EGM game mathematics. The first measured gambler’s knowledge of independence of events (IE), whereas the second measured their knowledge of negative long-term payoff (NP). Lower scores on both scales indicated a better understanding of the concepts and by proxy lower misconceptions.

Gambling harm: Participants were administered a measure of gambling-related harm described by Shannon et al. (2017). The scoring considers both the severity of the harm and its causal relationship with gambling. Average scores were calculated for items across the six (excluding critical events) harm domains where lower scores indicated lower gambling-related harms.

Gambling problems: Participants were administered the Problem Gambling Severity Index (PGSI) (Ferris & Wynne, 2001). Average scores were calculated where lower scores indicated lower gambling severity and a score of eight or more indicated problem gambling. More details on the reliability and validity of this scale can be found in Chapter 4. Table 7.1 provides a timeline of when each measure was used across the study.

Table 7.1: Study 3 timeline of measures

Measure	T1	Video	T2	T3	T4
Gambling behaviour	✓			✓	✓
ECS	✓		✓	✓	✓
GPGI-PGSI	✓				✓
Gambling Harm	✓				✓
Independence of Events (IE)	✓		✓	✓	✓
Negative long-term payoff (NP)	✓		✓	✓	✓

7.3.5 **Procedure**

Approval was obtained from the Sydney University Human Research Ethics Committee (HREC; project no. 2017/392. With permission from each individual clubs' management, researchers entered eight separate club venues in both NSW and ACT between October 2017 and May 2018. Researchers approached potential participants with research flyers inviting them to a separate research room with laptop computers and iPads to complete the pre- and post- online surveys and watch one of the three educational videos. All participants were provided a participant information sheet and indicated their consent via a checkbox on the online survey prior to participation. Participants were then randomly allocated to one of three experimental conditions (the three educational animations). Headphones were provided to watch the animation and participants were compensated for their time with a $30 gift voucher (some participants at the beginning of the study were reimbursed with a $10 voucher which was subsequently increased after observing a poor response rate). Participants were sent an email with a link to the follow-up questionnaires at 3-and 6-months post-intervention. Participation in each follow-up survey was associated with entry into a draw to win an iPad.

7.3.6 **Data analyses**

SPSS Statistics version 24 was used to analyse all data. Descriptive statistics were analysed for baseline data including participant demographics, and self-reported gambling behaviour including form, expenditure, and big wins. Generalised Estimating Equations (GEE) were used to determine if education type predicted differences in the outcome variables over time. Although ANOVAs were planned to analyse group differences a-priori, upon reviewing the final dataset several key assumptions of the test were breached (normality, missing data) and it was no longer the most appropriate analysis. GEEs are considered more flexible and robust than ANOVAs and it is not likely that the use of this analysis negatively affected predicted power. See Chapter 4 for a more in-depth justification for the use of GEEs in this study. For responses where participants had entered inconsistent values for both weekly and monthly gambling expenditure (n = 4, e.g., $20 per week and $100 per month), the lower of the two values was taken as a conservative estimate.

7.4 Results

7.4.1 Baseline Data

7.4.1.1 Demographic characteristics of the sample.

In line with the CONSORT (2010) statement, it was not necessary to perform or report significance tests for group differences between baseline demographic variables (Moher et al., 2010). See De Boer (2015) for a review of the arguments against publishing baseline difference testing in randomised controlled trials. Demographic characteristics of the sample are presented in Table 7.2. Participants were middle-aged predominantly men, worked full-time or were retired, and earned between $20,000-$80,000 per year. A substantial proportion (20.6%) spoke a language other than English (LOTE) at home.

Table 7.2: Adult EGM gamblers' demographic characteristics.

	N	Valid %	M	SD
Gender				
Female	27	37%		
Male	46	63%		
Age			50.06	16.94
Marital status				
Married	26	35.6%		
Living with partner/de facto	15	20.5%		
Widowed	3	4.1%		
Divorced/separated	7	9.6%		
Never married	22	30.1%		
Household				
Single person	21	28.8%		
Single parent family with child/children	4	5.5%		
Couple with child/children	19	26%		
Couple with no child/children	21	28.8%		
Group household	8	11%		
Employment				
Full-time	29	39.7%		
Part-time	8	11%		
Unemployed	6	8.2%		
Full-time student	1	1.4%		
Self-employed	6	8.2%		
Disability or other (not aged) pension	6	8.2%		
Retired	17	23.3%		
Occupation (N = 48 working)				
Manager	10	20.8%		
Professional	3	6.3%		
Technician or trade worker	10	20.8%		
Community or personal service worker	6	12.5%		
Clerical or administrative	8	16.7%		
Sales	5	10.4%		
Machinery operator or driver	3	6.3%		
Labourer	3	6.3%		
Income				
< $20,000	11	15.1%		
$20,000 to $49,999	25	34.2%		
$50,000 to $79,999	18	24.7%		
$80,000 to $109,999	6	8.2%		
$110,000 to $149,999	1	1.4%		
$150,000 or more	4	5.5%		
Prefer not to say	8	11%		
LOTE	15	20.6%		
Born in Australia	50	68.5%		
Years lived in Australia			29.45	17.63
Indigenous				

Aboriginal	1	1.4%
Torres Strait Islander	0	0%
Aboriginal and Torres Strait Islander	1	1.4%
None	70	95.9%
Prefer not to answer	1	1.4%

7.4.1.2 Gambling behaviour.

Gambling type and mode are displayed in Table 7.3. The most popular other forms of gambling in the past three months amongst EGM players were lottery (47.9%), race wagering (39.7%), and Keno (38.4%). Most gambled only in-person (72.6%), whereas a reasonable proportion engaged in both online and land-based gambling (24.7%). Participants' average early big wins scores were calculated using their responses to the two early big wins questions. The median score was 3.5, which indicated that most participants disagreed with the statement that they had experienced an early big win or few wins when they first started gambling (1=totally disagree, 10=totally agree).

Table 7.3: Adult EGM gamblers' gambling participation and mode in the past three months (N = 73).

Participation	**N**	**%**
Gambling form		
Scratchcards	17	23.3%
Lottery	35	47.9%
Bingo	11	15.1%
Keno	28	38.4%
EGMs	73	100%
Sports	22	30.1%
Racing	29	39.7%
Casino	13	17.8%
E-Sports	1	1.4%
Daily fantasy sports	0	0%
Personal bets	5	6.8%
Other	0	0%
Mode		
Only in-person	53	72.6%
Only online	2	2.7%
Both	18	24.7%

Respondents' reported EGM stake amount was subtracted from their total stake amount to produce a difference score. Positive scores indicated spending on other forms of gambling, whereas negative scores indicated unreliable responses (reporting greater EGM expenditure than 'total' expenditure, which includes EGMs). Eight respondents (11%) produced negative difference scores for stake amounts, indicating that they reported spending more on EGMs than their total gambling spend (including EGMs). Invalid responses to expenditure were excluded from analyses on this variable; results for expenditure data report on valid responses only. Of the 65 participants who provided valid responses to questions about gambling stake amounts, EGM gambling constituted about half their weekly stake amount of all gambling (Table 7.4).

Table 7.4: Adult EGM gamblers' weekly total gambling and EGM gambling stake ($AUD).

	Range	**M**	**SD**	**Mdn**
All gambling	$5 - $5010	$281.57	682.81	$100.00
EGM gambling	$0 - $2000	$177.00	324.51	$50.00

N = 65 valid responses

7.4.2 Intervention Effects

7.4.3 Generalised Estimating Equations (GEEs).

In order to obtain relevant comparison information for all three experimental conditions, three separate GEE analyses were carried out with each of the treatment conditions as the reference category. This was carried out on each outcome measure using two steps. First, only main effects were included in the three GEE models. Following this, the three separate GEEs were run again and included the interaction terms in the model. This provided statistics for each possible comparison between the three experimental conditions.

Each GEE table provides estimated parameters for the treatment group set as the reference category, where values for Time indicate the change scores from the reference time (always Time 1) for that reference category (intervention group). Interaction values represent the change in that group at that time, *over and above* any change in the reference category at the reference time (T1). The tables below report parameter estimates for each model's beta coefficients and standard error, the upper and lower 95% confidence intervals, and whether the parameter is significantly different ($p < .05$) from the reference category. Note that GEE analyses manage missing data by selecting subjects with responses at two or more time points. Because there were no covariates included in the model the estimated marginal means represent the actual means.

Although follow-up data was collected at three- and six-months post-intervention, attrition was high, and few participants took part in the follow-up surveys. Table 7.5 provides a summary of the sample size in each group at each time point of the study. As can be seen, sample sizes at T3 and T4 are substantially reduced, resulting in the decision to exclude these timepoints from the following analyses. Such small samples substantially reduce the power of longitudinal tests and may result in misleading conclusions about intervention effects. Descriptive statistics for each of the following outcome variables at all time points can be found in Appendix M.

Table 7.5: Adult EGM gamblers' responses at each time point by group.

	T1	**T2**	**T3**	**T4**
RA	26	26	7	11
OI	21	21	7	5
CM	26	26	7	7
Total	73	73	21	23

7.4.3.1 EGM Cognitions Scale (ECS).

GEEs were used to analyse differences in ECS scores between the three video conditions groups before and after the intervention. ECS responses were normally distributed as indicated by non-significant Shapiro-Wilk tests (p >.05), however a Gamma distribution and log link function was applied to the data as it produced a considerably better goodness-of fit compared to the data when fitted with a normal (Gaussian) distribution (Corrected Quasi Likelihood under Independence Model Criterion (QICC) score where smaller-is-better = 13.06 vs. 5646.19, respectively). An autoregressive working correlation structure was specified. The betas on the ECS variable reported in Table 7.6 and Table 7.7 do not correspond to the estimated mean values because they represent the log transformed values. Exponentiating the below betas will result in estimated mean values, which are also plotted in Figure 7.1 and Figure 7.2 for ease of interpretation.

The results in Table 7.6 indicate that there was a significant difference in overall ECS scores for those in the Risk Awareness (RA) group compared to those in the Cognitive Misconceptions (CM) group ($\beta = \pm 0.120$, $p = .003$). There was also a significant reduction in ECS scores for all participants from T1 to T2 ($\beta = -0.115$, $p < .001$).

Table 7.6: GEE parameter estimates of main effects of adult EGM gamblers' ECS scores.

Parameter	**β**	**Std. Error**	**95% CI (Lower, Upper)**		**Sig.**
Method 1 (Ref = RA)					
(Intercept)	3.663	0.0261	3.612	3.714	.000
CM	**-0.120**	**0.0411**	**-0.201**	**-0.040**	**.003**
OI	-0.049	0.0480	-0.143	0.046	.312
RA	0[a]	.	.	.	.
TIME 2	**-0.115**	**0.0205**	**-0.155**	**-0.075**	**.000**
TIME 1	0[a]	.	.	.	.
Method 2 (Ref = CM)					
(Intercept)	3.542	0.0330	3.478	3.607	.000
OI	0.072	0.0514	-0.029	0.173	.161
RA	**0.120**	**0.0411**	**0.040**	**0.201**	**.003**
CM	0[a]	.	.	.	.
TIME 2	**-0.115**	**0.0205**	**-0.155**	**-0.075**	**.000**
TIME 1	0[a]	.	.	.	.
Method 3 (Ref = OI)					
(Intercept)	3.614	0.0400	3.536	3.692	.000
RA	0.049	0.0480	-0.046	0.143	.312
CM	-0.072	0.0514	-0.173	0.029	.161
OI	0[a]	.	.	.	.
TIME 2	**-0.115**	**0.0205**	**-0.155**	**-0.075**	**.000**
TIME 1	0[a]	.	.	.	.

[a] Set to zero because this parameter is redundant (reference category).

A second set of GEEs was conducted including the interaction terms in the model. Table 7.7 indicates that for those in the RA group, ECS scores were significantly lower at T2 compared to T1 (β = -0.055, p = .013). For those in the CM group, ECS scores were significantly lower at T2 compared to T1 (β =-0.181, p < .001). For those in the Operator Information (OI) group, ECS scores were significantly lower at T2 compared to T1 (β = -0.106, p = .001). The reduction in ECS scores from T1 to T2 was significantly greater for those in the CM group compared to those in the RA group (β = ±0.126, p = 0.008). The estimated marginal means for ECS responses from T1 to T2 in each group are illustrated in Figure 7.1 and Figure 7.2.

Table 7.7: GEE parameter estimates and interactions of adult EGM gamblers' ECS scores

	Method 1 (Ref = RA)					Method 2 (Ref = CM)					Method 3 (Ref = OI)				
Parameter	**β**	**Std. Error**	**95% Lower**	**CI Upper**	**Sig.**	**β**	**Std. Error**	**95% Lower**	**CI Upper**	**Sig.**	**β**	**Std. Error**	**95% Lower**	**CI Upper**	**Sig.**
Intercept	3.633	0.0235	3.586,	3.679	.000	3.575	0.0358	3.505,	3.645	.000	3.610	0.0382	3.535,	3.685	.000
Tx = CM	-0.058	0.0428	-0.142,	0.026	.179	0[a]	.	.	.	.	-0.035	0.0524	-0.137,	0.068	.508
Tx = OI	-0.023	0.0449	-0.111,	0.065	.610	0.035	0.0524	-0.068,	0.137	.508	0[a]	.	.	.	.
Tx = RA	0[a]	.	.	.	.	0.058	0.0428	-0.026,	0.142	.179	0.023	0.0449	-0.065,	0.111	.610
Time 2	**-0.055**	**0.0223**	**-0.099,**	**-0.012**	**.013**	**-0.181**	**0.0420**	**-0.264,**	**-0.099**	**.000**	**-0.106**	**0.0333**	**-0.171,**	**-0.041**	**.001**
Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.
CM * Time 2	**-0.126**	**0.0476**	**-0.219,**	**-0.033**	**.008**	0[a]	.	.	.	.	-0.076	0.0536	-0.181,	0.030	.159
CM * Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.
OI * Time 2	-0.051	0.0401	-0.129,	0.028	.208	0.076	0.0536	-0.030,	0.181	.159	0[a]	.	.	.	.
OI * Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.
RA * Time 2	0[a]	.	.	.	.	**0.126**	**0.0476**	**0.033,**	**0.219**	**.008**	0.051	0.0401	-0.028,	0.129	.208
RA * Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.

[a] Set to zero because this parameter is redundant (reference category).

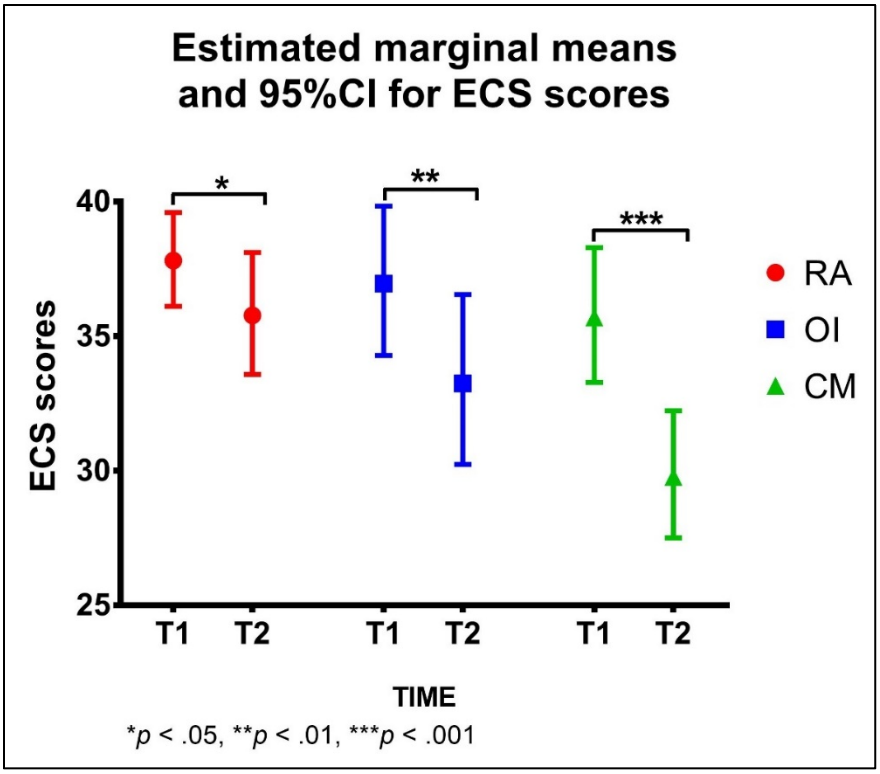

Figure 7.1: Estimated marginal means of adult EGM gamblers' ECS scores (within groups).

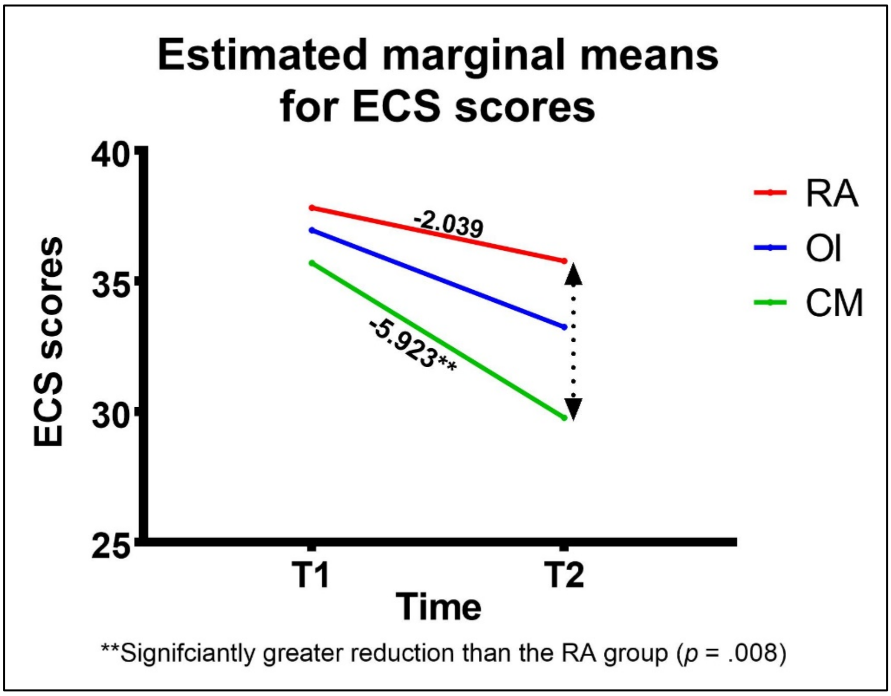

Figure 7.2: Estimated marginal means of adult EGM gamblers' ECS scores (interactions).

7.4.3.2 Independence of events (IE).

GEEs were used to analyse differences in IE scores between the three intervention groups before and after the intervention. IE responses were highly positively skewed and zero-inflated. Prior to analysis, scores were transformed by adding a value of 1 to each score, resulting in positively skewed scores >1 (min = 1, max = 5.38). A Gamma distribution was then able to fit the data using a log link function and an autoregressive working correlation structure. The betas on the IE variable reported in Table 7.8 and Table 7.9 do not correspond to the estimated mean values because they represent the log transformed values. Exponentiating the below betas will result in estimated mean values, which are also plotted in Figure 7.3 and Figure 7.4 for ease of interpretation.

For all participants, IE scores were significantly lower at T2 compared to T1 (β = -0.339, *p* <.001), indicating improved understanding of independence of events. Overall IE scores for those in the RA group were significantly different from those in the CM group (β = ±0.241, *p* = .043) (Table 7.8).

Table 7.8: GEE parameter estimates of main effects of adult EGM gamblers' IE scores.

Parameter	**β**	**Std. Error**	**95% CI (Lower, Upper)**		**Sig.**
Method 1 (Ref = RA)					
(Intercept)	1.283	0.0809	1.124,	1.441	.000
CM	**-0.241**	**0.1190**	**-0.474,**	**-0.007**	**.043**
OI	-0.032	0.1073	-0.242,	0.179	.767
RA	0[a]	.	.	.	.
TIME 2	**-0.339**	**0.0663**	**-0.469,**	**-0.208**	**.000**
TIME 1	0[a]	.	.	.	.
Method 2 (Ref = CM)					
(Intercept)	1.042	0.0899	0.866,	1.219	.000
OI	0.209	0.1111	-0.009,	0.426	.060
RA	**0.241**	**0.1190**	**0.007,**	**0.474**	**.043**
CM	0[a]	.	.	.	.
TIME 2	**-0.339**	**0.0663**	**-0.469,**	**-0.208**	**.000**
TIME 1	0[a]	.	.	.	.
Method 3 (Ref = OI)					
(Intercept)	1.251	0.0675	1.119,	1.383	.000
RA	0.032	0.1073	-0.179,	0.242	.767
CM	-0.209	0.1111	-0.426,	0.009	.060

OI	0[a]	.	.	.	.
TIME 2	**-0.339**	**0.0663**	**-0.469,**	**-0.208**	**.000**
TIME 1	0[a]	.	.	.	.

[a] Set to zero because this parameter is redundant (reference category).

A second set of GEEs was conducted including the interaction terms in the model. Table 7.9 indicates that the reduction in IE scores was statistically significant from T1 to T2 for each of the three experimental conditions (RA β = -0.214, *p* = .001; CM β = -0.493, *p* < .001; OI β = -0.302, *p* = .014). No other significant differences were observed. The data from these tables is summarised in Figure 7.3 and Figure 7.4.

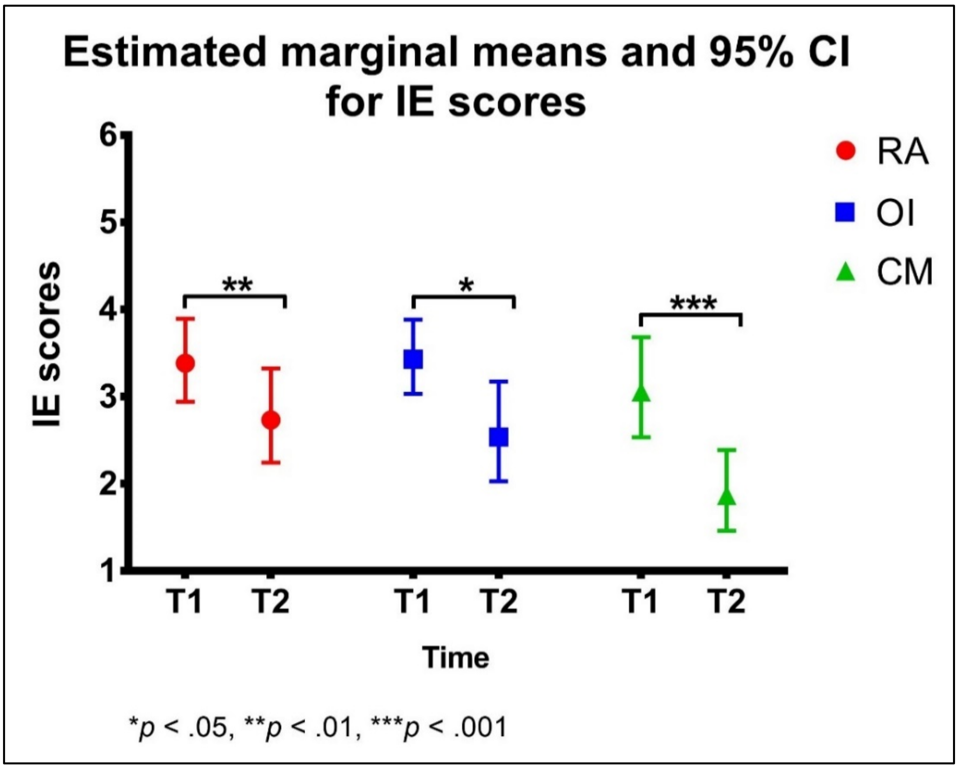

Figure 7.3: Estimated marginal means of adult EGM gamblers’ IE scores (within groups).

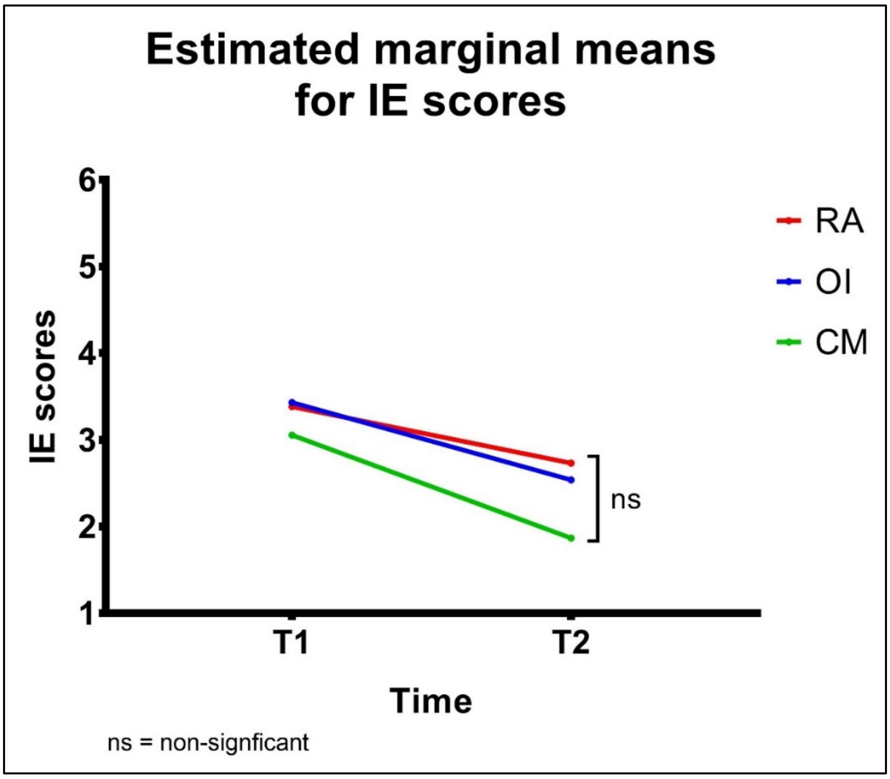

Figure 7.4: Estimated marginal means of IE scores of adult EGM gamblers' IE scores (interactions).

Table 7.9: GEE parameter estimates and interactions of adult EGM gamblers' IE scores.

	Method 1 (Ref = RA)					Method 2 (Ref = CM)					Method 3 (Ref = OI)				
Parameter	**β**	**Std. Error**	**95% Lower**	**CI Upper**	**Sig.**	**β**	**Std. Error**	**95% Lower**	**CI Upper**	**Sig.**	**β**	**Std. Error**	**95% Lower**	**CI Upper**	**Sig.**
Intercept	1.219	0.0716	1.078,	1.359	.000	1.116	0.0955	0.929,	1.304	.000	1.232	0.0632	1.109,	1.356	.000
Tx = CM	-0.102	0.1194	-0.336,	0.132	.391	0[a]	.	.	.	.	-0.116	0.1145	-0.341,	0.108	.311
Tx = OI	0.014	0.0955	-0.174,	0.201	.886	0.116	0.1145	-0.108,	0.341	.311	0[a]	.	.	.	.
Tx = RA	0[a]	.	.	.	.	0.102	0.1194	-0.132,	0.336	.391	-0.014	0.0955	-0.201,	0.174	.886
Time 2	**-0.214**	**0.0667**	**-0.345,**	**-0.084**	**.001**	**-0.493**	**0.1371**	**-0.761,**	**-0.224**	**.000**	**-0.302**	**0.1225**	**-0.542,**	**-0.062**	**.014**
Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.
CM * Time 2	-0.278	0.1525	-0.577,	0.021	.068	0[a]	.	.	.	.	-0.191	0.1839	-0.551,	0.170	.299
CM * Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.
OI * Time 2	-0.087	0.1394	-0.361,	0.186	.531	0.191	0.1839	-0.170,	0.551	.299	0[a]	.	.	.	.
OI * Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.
RA * Time 2	0[a]	.	.	.	.	0.278	0.1525	-0.021,	0.577	.068	0.087	0.1394	-0.186,	0.361	.531
RA * Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.

[a] Set to zero because this parameter is redundant (reference category).

7.4.3.3 Negative long-term payoff (NP).

GEEs were used to analyse differences in NP scores between the three intervention groups before and after the intervention. A Gamma distribution was specified using a Log link function as responses were positively skewed. Although the scale was ordinal, responses were treated as continuous to enhance interpretability and meaningfulness and an autoregressive working correlation structure was specified. Table 7.10 indicates that for all participants, there were no significant effects of Time or group. Table 7.11 indicates that after including the interaction term in the model, there were no significant interaction effects. The data from these tables is summarised in Figure 7.5and Figure 7.6.

Table 7.10: GEE parameter estimates of main effects of adult EGM gamblers' NP scores.

Parameter	**β**	**Std. Error**	**95% CI (Lower, Upper)**		**Sig.**
Method 1 (Ref = RA)					
(Intercept)	0.766	0.1279	0.516,	1.017	.000
CM	-0.270	0.1768	-0.617,	0.076	.126
OI	-0.241	0.1644	-0.564,	0.081	.142
RA	0[a]	.	.	.	.
TIME 2	-0.129	0.0832	-0.293,	0.034	.120
TIME 1	0[a]	.	.	.	.
Method 2 (Ref = CM)					
(Intercept)	0.496	0.1252	0.251,	0.741	.000
OI	0.029	0.1658	-0.296,	0.354	.860
RA	0.270	0.1768	-0.076,	0.617	.126
CM	0[a]	.	.	.	.
TIME 2	-0.129	0.0832	-0.293,	0.034	.120
TIME 1	0[a]	.	.	.	.
Method 3 (Ref = OI)					
(Intercept)	0.525	0.1293	0.272,	0.779	.000
RA	0.241	0.1644	-0.081,	0.564	.142
CM	-0.029	0.1658	-0.354,	0.296	.860
OI	0[a]	.	.	.	.
TIME 2	-0.129	0.0832	-0.293,	0.034	.120
TIME 1	0[a]	.	.	.	.

[a] Set to zero because this parameter is redundant (reference category).

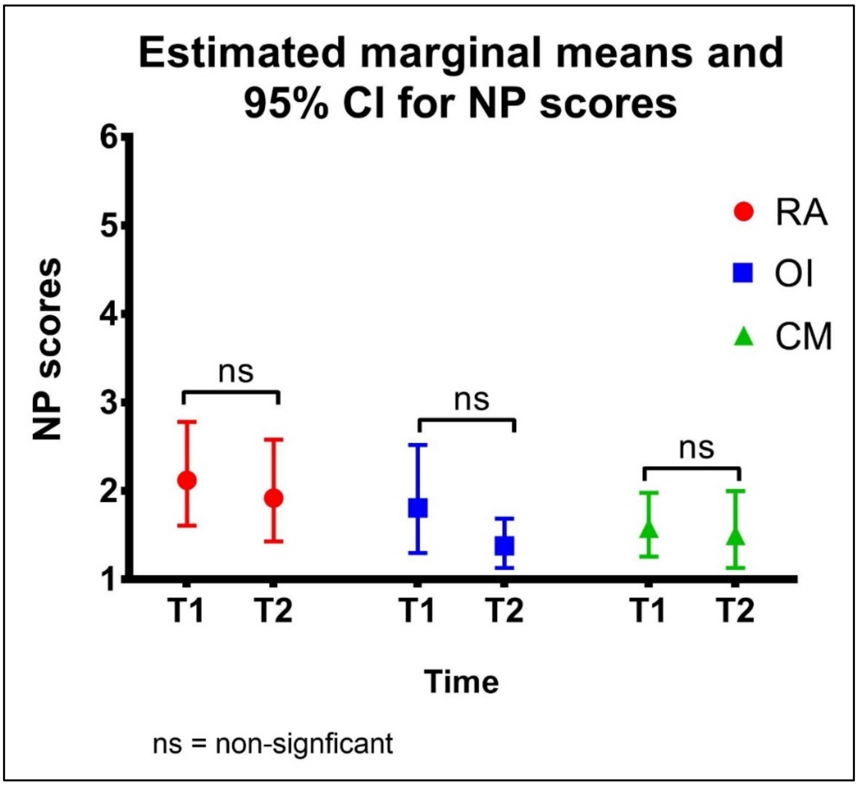

Figure 7.5: Estimated marginal means of adult EGM gamblers' NP scores (within groups).

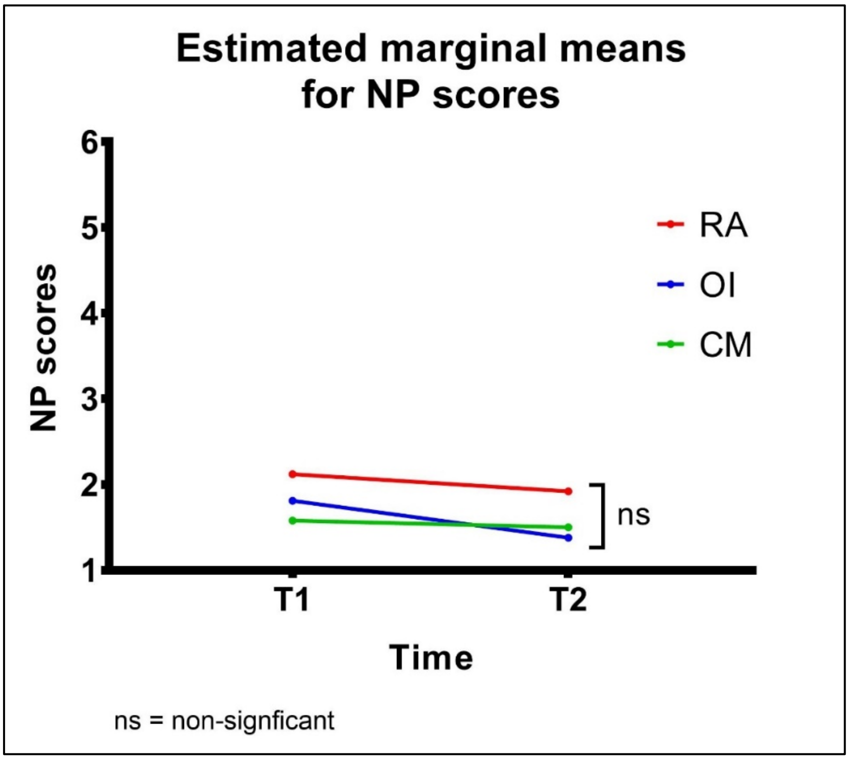

Figure 7.6: Estimated marginal means of adult EGM gamblers' NP scores (interactions).

Table 7.11: GEE parameter estimates and interactions of adult EGM gamblers' NP scores.

	Method 1 (Ref = RA)					Method 2 (Ref = CM)					Method 3 (Ref = OI)				
Parameter	**β**	**Std. Error**	**95% Lower**	**CI Upper**	**Sig.**	**β**	**Std. Error**	**95% Lower**	**CI Upper**	**Sig.**	**β**	**Std. Error**	**95% Lower**	**CI Upper**	**Sig.**
Intercept	0.749	0.1392	0.476	1.022	.000	0.455	0.1153	0.229	0.681	.000	0.593	0.1690	0.262	0.924	.000
Tx = CM	-0.294	0.1808	-0.648	0.061	.104	0[a]	.	.	.	.	-0.138	0.2046	-0.539	0.263	.501
Tx = OI	-0.156	0.2190	-0.585	0.273	.476	0.138	0.2046	-0.263	0.539	.501	0[a]	.	.	.	.
Tx = RA	0[a]	.	.	.	.	0.294	0.1808	-0.061	0.648	.104	0.156	0.2190	-0.273	0.585	.476
Time 2	-0.095	0.1481	-0.386	0.195	.520	-0.050	0.0807	-0.208	0.108	.536	-0.270	0.1861	-0.635	0.094	.146
Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.
CM * Time 2	0.045	0.1686	-0.285	0.376	.788	0[a]	.	.	.	.	0.220	0.2028	-0.177	0.618	.277
CM * Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.
OI * Time 2	-0.175	0.2378	-0.641	0.291	.462	-0.220	0.2028	-0.618	0.177	.277	0[a]	.	.	.	.
OI * Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.
RA * Time 2	0[a]	.	.	.	.	-0.045	0.1686	-0.376	0.285	.788	0.175	0.2378	-0.291	0.641	.462
RA * Time 1	0[a]	.	.	.	.	0[a]	.	.	.	.	0[a]	.	.	.	.

[a] Set to zero because this parameter is redundant (reference category).

7.5 Gambling behaviour

7.5.1 PGSI.

Average PGSI scores are presented in Table 7.12 along with the number and proportion of participants in each group who scored ≥8 on the PGSI indicating problem gambling. Small numbers at follow-ups precluded longitudinal analyses.

Table 7.12: Adult EGM gamblers' mean PGSI scores over time by experimental condition.

	T1			T4		
	N	**M(SD)**	**N=PG(%)**	**N**	**M(SD)**	**N=PG(%)**
RA	26	4.42(4.51)	5 (19.2%)	11	2.82(2.71)	1 (9.1%)
OI	21	5.24(4.64)	3 (14.3%)	5	4.20(3.70)	1 (20%)
CM	26	4.65(4.48)	7 (26.9%)	7	3.14(3.44)	1 (14.3%)
TOTAL	73	4.74(4.48)	15 (20.5%)	23	3.34(3.02)	3 (13%)

7.5.2 EGM participation.

Inspection of participants' responses to EGM participation over time revealed most participants continued to play EGMs over the course of the study. The descriptive statistics are presented in Table 7.13.

Table 7.13: Adult EGM gamblers' EGM Participation over time by experimental condition.

	T1			T3			T4		
	N	**N= EGMs**	**% EGMs**	**N**	**N= EGMs**	**% EGMs**	**N**	**N= EGMs**	**% EGMs**
RA	26	26	100%	7	6	85.7%	11	9	81.8%
OI	21	21	100%	9	7	77.7%	6	5	83.3%
CM	26	26	100%	7	6	85.7%	7	6	85.7%
TOTAL	73	73	100%	23	13	56.5%	24	20	83.3%

N = number of participants who responded to this question, N EGMs = number of those respondents who reported playing EGMs, % EGMs= proportion of respondents who reported playing EGMs.

7.5.3 **Gambling Expenditure.**

Responses to weekly EGM stake amount were highly positively skewed and had considerable statistical outliers. Despite responses that were considered statistical outliers (±2 SD), it was not appropriate to remove these responses from analyses because they represented possible genuine responses (expenditure is relative to income and is highly subjective and variable amongst gamblers). For these reasons median values are reported in Table 7.14 across the repeated measures components for each experimental condition.

Table 7.14: Adult EGM gamblers' median weekly EGM stake amount over time by experimental condition.

		T1		T3		T4
	N	**Mdn ($)**	**N**	**Mdn ($)**	**N**	**Mdn ($)**
RA	26	$50.00	7	$20.00	11	$30.00
OI	21	$100.00	9	$50.00	5	$50.00
CM	26	$50.00	7	$25.00	7	$20.00
TOTAL	73	$50.00	23	$25.00	23	$30.00

All three groups demonstrated reductions in median weekly EGM stake amounts from T1 to T4 but due to low sample sizes at the follow-up timepoints it was not possible to determine if these reductions were statistically meaningful. Median values for weekly EGM expenditure are described in Table 7.14.

7.5.4 **Gambling-related harm.**

Most people did not report suffering any gambling related harms, and mean scores on this measure were zero-inflated and highly positively skewed with little variation. The descriptive statistics are reported below; Table 7.15 provides count data on the number of gambling-related harms present in each group at each time point (any gambling harm = mean gambling harm >0).

Table 7.15: Number of adult EGM gamblers reporting any gambling-related harms.

	T1			**T4**		
	N	**Any harm**	**%**	**N**	**Any harm**	**%**
RA	26	12	46.2%	11	0	0.0%
OI	21	6	28.6%	5	3	60.0%
CM	26	11	42.3%	7	1	14.3%
TOTAL	73	29	39.7%	23	4	17.4%

7.6 Discussion

This chapter reported on a study of 73 regular EGM players from Australia. The majority of the sample were male, middle-aged, and born in Australia, whereas a notable proportion spoke a language other than English at home. Most were in full-time work, followed closely by a large portion of the sample who were retired, and the majority of the sample earned between $20,000-$80,000 per year. Analysis of baseline data demonstrated that the most popular other forms of gambling amongst the sample were lottery, race wagering, and Keno, and most participants gambled on these forms in person. Most participants disagreed with the statement that they had experienced an early big win gambling, and EGM gambling constituted about half their weekly stake amount for all gambling.

Analyses of group differences in level of EGM misconceptions as measured by the ECS indicated that for all participants, misconceptions were significantly lower immediately after the intervention (T2) compared to baseline. In line with the primary hypothesis (H_1), interaction analyses revealed that although each group demonstrated a significant reduction in misconceptions from pre to post, the Misconceptions video group demonstrated a significantly greater reduction (nearly three times larger) than those in the Risk video group (Figure 7.1). The relative size of this effect can be noticed by examining the error bars (95% CI) for the reduction in each group (Figure 7.1). The hypothesised direction of effect was also supported, whereby the Misconceptions video group produced the greatest reduction in misconceptions (-5.923, $p<.001$), followed by those in the Operator video group (-3.714, $p<.01$), and then the Risk video group (-2.039, $p<.05$).

Results provided partial support for H_2. Understanding the concept of independence of events (IE) improved significantly for all participants immediately after watching all videos (T2) compared to baseline (T1). Secondary analyses revealed the improvements observed from T1 to T2 were statistically significant for each experimental condition. Similar to the intervention effects on misconceptions, the error bars for IE scores for those in the Misconceptions video group did not overlap, suggesting the significant p-value is likely to be a true representation of the reduction in this group. These results are in line with Wohl et al.'s (2010) findings indicating it is possible to correct misconceptions about gaming machines with animations that incorporate didactic learning techniques.

There was no change in understanding of negative long-term payoff (NP) for those in any of the video groups. This may be because this measure suffered from considerable floor effects in the current sample. That is, most participants before watching the educational video had already indicated that the hypothetical player 'Ben' should 'stop playing' (score of 1). As such, there was little room to reduce already low mean scores. Consistent with the findings of the previous two studies, the NP measure may have suffered from poor content validity, as manifest by counterintuitive intervention effects in the adolescent and university student studies.

Despite changes observed in misconceptions and understanding of independence of events, most participants who completed the follow up surveys (83.3%) were still playing EGMs at 3- and 6-months. However, there were reductions from baseline to 6-months in those meeting criteria for problem gambling according to the PGSI (20.5% vs. 13%), in the amount of money spent on EGMs each week ($50 vs. $30), and in the number of participants reporting gambling-related harms (17.4% vs. 39.7%). Due to small sample sizes, it is not known if these reductions were statistically meaningful or differed by group.

Given the small number of participants retained at follow-up, it is important to keep results from the two follow-up surveys (T3 and T4) in perspective. Of most interest in the current study is the change observed from pre-post intervention (T1-T2) which indicated that the Misconceptions video significantly reduced associated EGM misconceptions amongst EGM gamblers compared to educating about harmful consequences. Further, the Misconceptions video demonstrated the largest effect in terms of improving EGM gamblers' understanding of independence of events. This was a sizeable result given that the study was ultimately underpowered; analysing only 73 participants compared to the estimated 158 needed to achieve 80% power.

Unlike the previous two studies which involved educating non-invested participants about EGMs, the current study suggests that for those who find EGMs personally relevant, the approach used in the Misconceptions video is an effective method of improving understanding of independence of events and reducing related misconceptions. Such findings can be considered a proof of concept for critically appraising gambling misconceptions among audiences with experiences or interest in that form of gambling.

This study builds on the wealth of literature implicating misconceptions as key factors motivating gamblers to continue gambling despite excessive losses. The findings provide evidence that such misconceptions can be reduced by applying didactic learning techniques when teaching them and educating about underlying game mathematics. Previous challenges in reducing misconceptions have related to the robust nature of such convictions and their resistance to change, as well as the inherent difficulty in teaching the complex mathematical concepts that may help to combat them (Batanero & Diaz, 2012; Garfield & Ahlgren, 1988). The current findings suggest that these challenges can be addressed with careful consideration for the educational approach. Importantly, this approach does not need to include demanding or intensive training. The current study demonstrated that misconceptions can be reduced in the space of 20 minutes using computer animations and data visualisations. This findings is in line with previous research in other science fields which has suggested data visualisations are particularly helpful in teaching complex concepts and reducing related misconceptions (Borovcnik, 2007; Chandra & Watters, 2012; Gürbüz & Birgin, 2012; Mayer & Moreno, 2002; McKagan et al., 2008; Nelson et al., 2017; Özyurt, Özyurt, Güven, & Baki, 2014; Pilli & Aksu, 2013). Future researchers, regulators, and policy makers should consider how gamblers may better access this type of information. Given the digital nature of the information, it is possible to disseminate information to gamblers via a number of mediums, including websites, on mobile applications, and potentially on gaming machines themselves. The potential implications of this research are discussed in the following chapter.

7.7 Chapter Summary

The current chapter suggested that by critically appraising EGM misconceptions and explaining its underlying game design features, the Misconceptions video was effective in significantly reducing EGM misconceptions and improving understanding of independence of events amongst regular EGM gamblers. These results provide a proof of concept to move away from harm-based education which does little to reduce important risk factors and towards education that effectively reduces misconceptions which help maintain gambling problems. The following chapter provides a discussion which summarises the overall aims, hypotheses, and research findings of the thesis and synthesises the results from all three studies. Limitations, strengths, implications for prevention and education, and opportunities for future research are also discussed.

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8 Chapter Eight: Discussion

Preamble: This chapter summarises the main aims and objectives of the research and synthesises the findings from the literature reviews and experimental studies presented in previous chapters. This chapter draws on the information learned from this research and provides insight into its broader implications in the field of gambling education and suggests key areas and opportunities for future research.

8.1 Thesis Aims and Objectives

Adolescent problem gambling rates are reportedly amongst the highest of any age group (Derevensky & Gupta, 2000; Gupta et al., 2013; Purdie, Matters, Hillman, Ozolins, & Millwood, 2011; Splevins, Mireskandari, Clayton, & Blaszczynski, 2010; John Welte, Barnes, Tidwell, & Hoffman, 2008), and many educational programs fail to adequately engage young people with messages of harms (Keen, Blaszczynski, & Anjoul, 2016). Such inconsistencies have resulted in limited evidence supporting education amongst young audiences as a means of preventing gambling problems (Lambos, Delfabbro, & Pulgies, 2007; Williams & Connolly, 2006). Further, adult gamblers have a poor understanding of the profitability of commercial gambling; and despite knowledge that such misconceptions play a significant role in the development and maintenance of gambling problems, efforts to educate gamblers on the matter have often been largely unsuccessful (Fortune & Goodie, 2012; Leonard, Williams, & Vokey, 2015).

The aims of the thesis were to: 1) identify the current standard of gambling education among youth by systematically reviewing empirically evaluated school-based programs in order to 2) determine the gaps in such programs and develop recommendations for improvements via a comprehensive review of etiological perspectives of problem gambling and pedagogical insights, and to 3) develop and test educational material based on the rationale and insights identified by Aim 2 via a series of experimental studies amongst developmentally progressive samples.

The systematic and theoretical literature reviews described in Chapters 2 and 3 were conducted to meet the objectives outlined in Aims 1 and 2. Following this, specific research hypotheses were developed to test the recommendations that emerged from the review findings. The following section provides a brief summary of the research findings and describes how the results of those studies inform the research hypotheses and questions.

8.2 Summary of Main Findings

Based on the systematic review in Chapter 2 and the theoretical review in Chapter 3, several recommendations were integrated into the development of the animations and the design of the studies. The choice to develop and evaluate videos was based on many of the findings from Chapter 2 which suggested that multi-media platforms were commonly used in school-based gambling education and may be more relevant for young people as well as overcome issues of different instructors effecting outcomes. Efforts were also made to incorporate measures beyond problem gambling status (cognitions, engagement, expenditure, and harms).

Focusing on mathematical principles in the Misconceptions video was also a strong focus from the findings of the two reviews. Critically appraising misconceptions was suggested to have two primary benefits for educating young people about gambling: 1) Relevance: It provides a developmental explanation of problem gambling etiology which adolescents may relate to more than descriptions of harmful consequences; and 2) Didactic: It provides novice learners with the mental scaffolding necessary to build more complex representations about gambling mathematics. Such an approach also addresses the motivational role of misconceptions in adult gamblers who are affected by them.

From the literature reviews in Chapters 2 and 3, three hypotheses were developed:

H_1 = Critically appraising gambling misconceptions will improve engagement with gambling education among adolescents and young adults compared to teaching about harmful consequences.

H_2 = Critically appraising gambling misconceptions will facilitate learning key mathematical concepts related to gambling compared to teaching about harmful consequences.

H_3 = Critically appraising gambling misconceptions will help to reduce misconceptions in those who have them.

To test these hypotheses, three educational videos were developed and evaluated in three different studies investigating the thoughts and behaviours of adolescents, university students, and adult EGM gamblers. The purpose of this design was to investigate the impact of the various roles that misconceptions play in gambling education amongst those in different age groups and with different gambling experiences. That is, was the CM video effective in increasing engagement and improving understanding of mathematical concepts amongst young audiences, and was it able to reduce misconceptions amongst EGM gamblers?

Results indicated that adolescents and young adults found all videos engaging, but not relevant. Young adults found the Risk video more engaging than the other videos. However, the Misconceptions video significantly reduced misconceptions amongst EGM gamblers and helped them to better understand independence of events. These findings suggest that young people who do not engage in EGM gambling may prefer briefer, simpler information, such as that in the Risk video. Without longitudinal analyses, the longer-term impact of the educational material on adolescents and young adults in the current research cannot be determined. The unique strengths and limitations of this research are presented below, followed by a discussion regarding the implications of these findings on theory, research, policy and practice.

8.3 Limitations and Strengths

The studies reported in Chapters 5, 6, and 7 attempted to address some of the key limitations of previous evaluations of gambling education mentioned in Chapter 2. Primarily, the adolescent and adult gambler studies incorporated behavioural measures in addition to important cognitive measures and aimed to follow up participants at longer-term intervals (1, 3, and 6 months). Unfortunately, like many previous studies in this area, small sample sizes precluded analyses of follow-up timeframes. In this sense, due to the small numbers of gamblers in the adolescent and young adult samples it cannot be discounted that teaching gambling misconceptions may lead to preventative effects. Future research should aim to determine if teaching gambling misconceptions to adolescents regularly involved in gambling activities results in a similar reduction in misconceptions and if any reductions reduce the likelihood of gambling problems.

Greater incentives may have improved participants retention in follow up assessments. One study on the methodological variables affecting results of web-based studies suggested that requiring participants to enter their email address as well as offering payment via lottery draws increased the likelihood that participants would drop out of the study (O'Neil & Penrod, 2001). However, other research has demonstrated that incentive strategies differ depending on the target population (pro-social/altruistic/financially motivated) and that increasing financial incentives is not always the best method of improving survey response rates (Conn, Mo, & Sellers, 2019). It is likely that at least in the case of the gambler sample, participants may have been motivated by financial incentives (since money is a large motive for gambling; Crewe-Brown, Blaszczynski, & Russell, 2014; Lee, Chae, Lee, & Kim, 2007). It was not possible to offer cash incentives for all follow-up assessments in the current research due to budget restrictions.

Issues of self-reported expenditure estimates have been reported extensively in the gambling literature and suggest that gamblers consistently overestimate wins and underestimate losses (Blaszczynski, Dumlao, & Lange, 1997; Blaszczynski, Ladouceur, Goulet, & Savard, 2006; Wohl, Davis, & Hollinghsead, 2017; Wood & Williams, 2007). To address this concern, the phrasing of expenditure questions was modified in the current research to encompass total 'stake amount' in an effort to reduce such biases, however it is likely that expenditure data in this research suffered the same issues as many other research studies. In addition, responses that indicated inconsistencies in expenditure were excluded from analyses on this variable and random allocation of participants to experimental conditions also limited the influence of such biases.

Previous researchers have expressed the difficulty in measuring gambling misconceptions (Leonard et al., 2015). Although the scales used to measure misconceptions and understanding of mathematical concepts in the current research were not empirically validated; the vignette-style questions used to measure understanding of gambling-mathematics were particularly well suited to this type of research, as it may have encouraged more critical thought through non-obvious response options. However, perhaps future research on gambling misconceptions could make use of think-aloud or interview approaches to measuring cognitive processes. Such approaches would involve asking participants to explain in their own words, how gaming machines operate. These types of qualitative approaches have been used extensively with students to measure misconceptions in science education (Hamza & Wickman, 2007; Heddy & Sinatra, 2013; Kendeou & van den Broek, 2005).

A small amount of overlapping content between educational videos may have reduced the influence of the Misconceptions video. There was a small description of misconceptions in the Operator video, and a small explanation of game design in the Risk video, however these portions were managed and balanced against the importance of using ecologically valid educational material. The additional strength of the current intervention design was that any impact of the Misconception video could be considered relatively robust, because the comparison conditions constituted active comparisons rather than placebo or control groups.

The length of video media may need to be considered in future emendations of gambling education using a similar approach. The videos used in this research ranged between 15-20 minutes, which may have exceeded participants' attentional capacity, particularly for those in the repeated measures study (combined viewing 53 minutes of animations). This was likely a contributing factor to the preference for the Risk video amongst this sample, as it was the shortest video (15 minutes) with the simplest information. Integration of the videos with interactive class discussions or activities facilitated by an instructor may also improve engagement. Ferland, Ladouceur, and Vitaro (2002) demonstrated that gambling misconceptions were best reduced when an educational video was paired with activities and a lecture.

8.4 Implications for Theory, Research, and Practice

The current research suggests that critically appraising gambling misconceptions may be a more effective approach to increase EGM gambler's understanding of random outcomes and reduce problematic misconceptions compared to educating about harmful consequences. However, the information required to do so is dense, complex, and abstract, and only likely to be engaged by those with a vested interest in the concept (EGM players). For those who do not perceive EGM gambling as personally relevant (i.e., non-gambling adolescents and university students), examples of misconceptions that motivate gambling behaviour may need to relate to gambling games they participate in and may need to be delivered in a more engaging learning context.

Although the current research was not longitudinal, cross-sections from three developmentally progressive samples provided insight into the effects of misconception education at different ages and for those with different gambling experiences. Future research may endeavour to modify the study design to investigate the effects of educational material in one age group (i.e. adolescents) across different level of gambling experiences and problems. Such a design would provide an indication of the type of content which may be better suited to those who are non-gamblers (as a primary prevention measure) compared to those at-risk of problems (second-tier harm minimisation measure). Although the information in the Misconception video was not immediately engaged with by young audiences, the results from the EGM gambler study suggest that this type of information may be an effective harm reduction intervention for adult gamblers.

8.4.1 Preference for Reductive Information and Conceptual Change

Simple messaging about inherent harms of gambling replaces more complex nuanced explanations of the interplay between human psychological biases, mathematical understanding, and pursuit for financial wealth. The results from Study 2 indicated that this type of reductive information appears to be more engaging for young adults who mostly do not gamble.

More generally, research in cognitive psychology suggests that laypeople prefer explanations that comprise reductive information (Hopkins, Weisberg, & Taylor, 2016). Explanations which focus on end-goals are generally preferred more than those which involve causal mechanisms (Lombrozo & Carey, 2006). For example, reductive explanations of gambling motivations such as “we gamble because it is addictive” may be more appealing than information which deconstructs the complex interplay between random gambling outcomes and misconceptions about profitability or predictability. However, Study 3 indicated that this reductive information was not as effective at reducing problematic misconceptions amongst those who gamble regularly. Consequently, reductive information may be preferred by non-target groups (non-gamblers), but it is a less effective harm-reduction strategy for gamblers.

These results are consistent with the theoretical approach outlined at the beginning of this thesis. In the case of gambling education, the process of conceptual change is predicated on the assumption that one must first possess strongly held convictions about EGM gambling, which act as initial frameworks for future information to either build on, or replace in the case of a misconception (Chi, Kristensen, & Roscoe, 2012; Posner, Strike, Hewson, & Gertzog, 1982). This process can be applied to EGM gamblers’ conceptions with considerable ease given their extensive experience playing EGMs and likely strong conceptual representations of the game’s functions and outcomes. However, it is not clear how this process applies to adolescents who are unlikely to hold previous convictions about the relative functions and outcomes of gaming machines. Clement (1982) indicated that this kind of learning process must involve replacement of pre-conceived ideas that novice learners have developed over many years. Presentation of more complex information about EGM misconceptions in the early stages of learning about gambling may fail to sit within existing mental frameworks and may receive little attention. Modifications may need to be made to the content and delivery of gambling education so that personally relevant gambling experiences are depicted, and participants are fully engaged with the information.

8.4.2 Designing Future Gambling Education

Gambling education may require staggering of information over several years in line with the mathematics curriculum. Broader information about relevant mathematical concepts nay need to be introduced in the earlier years with relevant examples from forms of gambling younger adolescents most frequently engage with, such as personal bets, scratch cards, and lotteries. Critical evaluation of problematic belief systems relating to commercial forms of gambling like sports betting may then be introduced as older adolescents begin to engage in this form of gambling, and participation increases into early adulthood (Delfabbro, King, & Griffiths, 2014). Information learned from accompanying mathematics classes relating to probabilities, randomness, and expected value may then be applied to expose misconceptions which motivate gambling play.

Members of the Mathematics Association of Victoria (MAV) in Australia have recently worked closely with the Victorian Responsible Gambling Fund to develop gambling education units that sit within the current mathematics curriculum and specifically address the concepts of independence of events and long-term negative payoff, and how these concepts refute problematic gambling misconceptions (Lowe & Money, 2017). The units include data simulations and visualisations of gambling outcomes and examples of EGM gambling, sports betting, and card play to demonstrate how gambling losses can be predicted in the long-term. Results from the current research, and suggestions from mathematics educators indicates that programs like that from the MAV are likely to have a stronger impact on preventing gambling-related harm compared to those which focus on promoting awareness of the risks and harms (Barboianu, 2013; Peard, 2008).

The importance of incorporating education about mathematics into gambling interventions has been argued for ardently in recent times (Barboianu, 2013, 2019; Peard, 2008). Barboianu (2013, 2019) has advocated that gambling games cannot exist without their underlying mathematical design, and so we must consider gambling mathematics when aiming to investigate, prevent, and treat gambling problems. As stated, this is often a challenging task, one which requires action from multiple angles. The tangible impact of education lies within a reduction in demand for the product, however these efforts will always compete against increases in demand for the product encouraged by operators through advertisements, and liberal supply and availability of gambling opportunities in the community (Livingstone & Adams, 2011; Vasiliadis, Jackson, Christensen, & Francis, 2013).

In line with his research on mathematics education in gambling, Barboianu (2014) has also suggested that it is an ethical obligation of gambling operators to make available the mathematical configuration of electronic gaming machines. Such sentiments have been supported in part, by a large government-funded report in Australia which recommended the New South Wales government mandate reporting of the actual proportion of annual profitable gamblers, prohibit inducements to gamble, and list misleading ‘losses disguised as wins’ (when positive auditory and visual cues cooccur with a players’ win amount that is less than the original stake amount) on the Gaming Machine prohibited Features Register (Blaszczynski et al., 2016). Such game design features likely contribute to the formation and maintenance of problematic misconceptions. These recommendations highlight the need to take into account the systemic nature of gambling-related harms and for strong public policy to operate alongside education efforts (Derevensky, Gupta, Dickson, & Deguire, 2005).

A crucial insight from the current research was that half of the adolescents in Study 1 did not watch the entirety of the educational video, suggesting the delivery of this kind of information may need to be modified. Animations and video content represent an important design feature of future gambling education. The ability to visualise gambling outcomes in the long term via simulations is critical to promoting deep learning of challenging mathematical concepts (Borovcnik, 2007; Gürbüz & Birgin, 2012; McKagan et al., 2008; Özyurt, Özyurt, Güven, & Baki, 2014; Pilli & Aksu, 2013). However, didactic video content may be better supported in a blended learning environment – that is, in conjunction with class discussions – so that non-gamblers can better engage with the content. Chandra and Watters (2012) found that not only did adolescents prefer to receive information about physics in a blended learning environment, but it improved their overall learning outcomes. More complex information may be better suited to a blended, interactive learning environment compared to a static one. Similarly, the speed with which technology advances may pose potential limitations to online and digital content development. A video or Internet-based program may appear outdated within a very short time-frame due to rapid advancements in animation technology and web-page capabilities. This stands as a predominantly financial issue – ongoing funding into educational initiatives may help to ensure that updates can be made regularly to maintain the technology is relevant to young people.

8.4.3 Adolescents and Gambling-Related Harm

A particularly noteworthy finding of the adolescent study was the distinctively low amount of money spent by adolescents reporting gambling in the past three months. More curious was the low amount of money wagered by those categorised as ‘high severity’ gamblers, including many who reported wagering no money at all. Although this finding should be tempered due to the small sample it is drawn from, it is generally consistent with previous research on adolescent gambling which suggests very low amounts of money are wagered (Hanss et al., 2015; Hayer, Kalke, Meyer, & Brosowski, 2018; Lambos et al., 2007). However, these findings are juxtaposed with the large body of literature which suggests gambling amongst adolescents is a major public health issue, as manifest by high rates of problem gambling (Derevensky & Gupta, 2000; Gupta et al., 2013; Purdie et al., 2011; Splevins et al., 2010; Welte et al., 2008).

Little is known about the exact mechanisms of action via which adolescents experience harms as a result of their gambling. As such, many of the current taxonomies of adolescent gambling harm have been modified from those involving adult gamblers. Adolescent problem gambling measures have been amended accordingly and generally have some mention of impacts on schoolwork and influences of peer or parental gambling (Wilber & Potenza, 2006). However, a critical review of adolescent gambling measures demonstrated that many are unreliable, have issues with validity, and demonstrate poor classification accuracy (Stinchfield, 2010).

Similarly, very few adolescents are seen in treatment settings for gambling problems (Gupta & Derevensky, 2000; Hardoon, Derevensky, & Gupta, 2003; Tremblay, Stinchfield, Wiebe, & Wynne, 2017), and longitudinal studies have identified that problem gambling in adolescence does not appear to predict problem gambling in adulthood (Delfabbro et al., 2014; Delfabbro, Winefield, & Anderson, 2009; Edgerton, Melnyk, & Roberts, 2015; Slutske, Jackson, & Sher, 2003). Similarly, longitudinal research on adult gambler populations suggests that the disorder is transitory and episodic in nature (Slutske et al., 2003; Winters, Stinchfield, Botzet, & Slutske, 2005). That is, people tend to move in and out of risk categories over time, and unassisted recovery is common (Slutske, 2006, 2010).

This raises considerable concern surrounding the validity of adolescent problem gambling measures and the conceptualisation of adolescent gambling harm in general. If the primary historical indicator of harm (monetary losses) is low or absent, there are very few adolescents seeking treatment for gambling problems, and adolescent gambling problems do not reliably predict future gambling problems, then we must concede to reconsideration of our conceptualisation of adolescent problem gambling.

Such considerations are in line with recent findings from a longitudinal study of problem gambling trajectories amongst young adults in Canada. Edgerton et al., (2015) used latent growth curve modelling to analyse four-wave longitudinal data examining how initial problem gambling severity and rate of change were influenced by a number of time-invariant factors. The results of the study indicated that problem gambling severity generally reduced over time, and contrary to depictions of gambling problems as chronic and enduring, problem gambling among young adults was more likely transient, episodic, and likely to resolve naturally over time (Edgerton et al., 2015). The authors draw parallels here with similar research carried out with Minnesota youth, which suggests that youth may be becoming less interested in gambling generally (Stinchfield, 2011), and that gambling can be conceived as one of a number of 'risky' activities that youth invariably experiment with during transition to adulthood (Stinchfield, 2000). Another explanation for the resolution of gambling problems over time put forth by Edgerton and colleagues (2015) is one of exposure and adaption. At initial data collection, many young adults in the study were likely engaging in commercial gambling legally as a novel activity, but by the final wave of data collection many had adapted to the exposure and the novelty had worn off (Shaffer & Martin, 2011).

In light of the above considerations, the lack of a clear trajectory for gambling problems suggests that universal education amongst adolescents is the best approach to preventing future potential harms. Currently, it is not possible to reliably predict adolescents who are most at-risk of developing gambling problems in order to target this group with prevention initiatives. However, the content of that universal education should be relevant to young people and involve gambling activities that young people frequently take part in. It also suggests a clear need for future research endeavours to investigate the concept of adolescent gambling harms and develop a clearer model of what these harms look like, and their impact on individuals and the community more broadly.

8.4.4 Simulated Gambling Games and Adolescents

Another potential consideration given adolescents' low engagement with gambling is that it may represent a transition from more traditional forms of gambling to online simulated types such as social casino games including free-to-play slots or roulette. Consistent with previous studies, over one-third (34.8%) of the adolescents in Study 1 reported playing simulated gambling games in the past three months (Griffiths & Wood, 2007; Ipsos MORI, 2011; Meerkamper, 2010).

A study investigating the gambling behaviours of Icelandic adolescents demonstrated that although land-based gambling participation was declining, internet-based gambling was increasing in this age group (Olason et al., 2011). In addition, there is some evidence that people who participate in online free-to-play simulated gambling games may be more inclined to transition into playing traditional for-money commercial gambling games (Gainsbury, Russell, King, Delfabbro, & Hing, 2016; Hayer et al., 2018; McBride & Derevensky, 2009).

A particular cause for concern amongst adolescents is that free-to-play simulated gambling games do not necessarily operate using the same game design functions as commercial forms and often operate as 'practice' sites for gambling (Derevensky & Gainsbury, 2016). For example, Sévigny et al. (2005) found that 40% of the internet gambling sites visited by respondents in their sample used return-to player payout rates over 100% in their demo games, which were not maintained when players transitioned to play their for-money games (<100%). This has led to concerns that playing simulated gambling games that have overinflated payout rates may lead users to develop an unrealistic expectation of winning in real gambling games (Gainsbury et al., 2016; Sévigny et al., 2005). Education around accurate payout rates in simulated gambling games in addition to more traditional forms may be necessary to counter misinformation on online gambling websites.

8.4.5 **Young Adults and Gambling Education**

Rates of problem gambling amongst young adults are considerably higher than those reported amongst adult populations and may be representative of high use in the early stages of legal access to commercial forms of gambling, followed by a subsequent reduction and plateauing of use and associated problems (Stinchfield, 2000, 2011; Stinchfield, Hanson, & Olson, 2006; Welte, Barnes, Tidwell, & Hoffman, 2009). However, gambling participation amongst the current sample of young adults was considerably lower than expected (34.5%), which may be an underlying product of the non-representative sample characteristics (full-time university students).

Although this group has legal access to EGM gambling, the young adults in Study 2 were not largely engaged in this form of gambling. Similar to adolescents, personal bets were the most commonly engaged in form of gambling, followed by casino games and then EGMs (10.3% of the sample). Young adults in this study also reported the Risk video to be more engaging than the Misconception video. This constitutes a difficult dilemma, because the risk-based education is the least likely to address key motivations for gambling at a time when gamblers are learning about the game and are vulnerable to developing misconceptions. In line with the adolescent sample, education around EGMs in general was not particularly relevant to this age group, and preventive or harm-reduction information may need to include more relevant examples of gambling misconceptions. However, because the current study sampled university students, it is not known if the educational videos may have been more relevant to a more representative sample of young adults in the general population.

Although the university setting represents a prime environment to educate young adults about gambling, it fails to reach a large proportion of society who do not attend tertiary education. Failure to reach those from more disadvantaged backgrounds may result in a lack of preventative effects as proximity to EGMs is closer in more disadvantaged areas of the country, which has been associated with an increased risk for gambling problems (Doran & Young, 2010). Government-funded resources such as television advertisements and interactive websites may be a beneficial alternative to educating the public about gambling misconceptions.

8.4.6 **Making Educational Information about EGMs Accessible to Gamblers**

The results of the gambler research study suggest that regular EGM gamblers may benefit from learning about misconceptions which motivate gambling play, and that this can be done using a brief animated video. However, it is essential that other researchers replicate the study to confirm the current findings.

Following this, policy makers and researchers should prepare to determine how gamblers can access this type of information. Collaboration between gaming machine developers and operators and researchers has led to innovative ecological studies involving pop-up messages on gaming machine screens which has demonstrated significant reductions in misconceptions and duration of game play (Auer & Griffiths, 2015; Auer, Malischnig, & Griffiths, 2014; Cloutier, Ladouceur, & Sévigny, 2006; Gainsbury, Aro, Ball, Tobar, & Russell, 2015; Preez, Landon, Bellringer, Garrett, & Abbott, 2016). This suggests it is possible to incorporate educational information about EGMs on the machine's screen for players to access. Another potential option is to have a URL link or digital QR scan code (optical label with black and white squares) to a website with this type of information available on machines for users to access. To the authors' knowledge, access to extensive educational information on gaming machines would represent a world first and evaluating the impact of such a proposal would create an innovative new line of research.

An anticipated concern from the gambling industry regarding introducing responsible gambling features into gaming machines is that they will reduce player enjoyment for recreational players. Reductions to maximum bet sizes have been criticised as likely to impact recreational player enjoyment without necessarily reducing harm as most problem gamblers choose to play the 'minimum bet size-maximum lines' method (Blaszczynski, Sharpe, & Walker, 2001). However, a study by Graydon et al. (2017) demonstrated that educating gamblers about the misleading game feature 'losses disguised as wins' did not affect players' enjoyment of the game. This suggests there are opportunities to alter gaming machine design features, including removal of misleading features and introduction of educational information in a way that may reduce harm players gambling to excess, while having little effect on recreational players' enjoyment. However, it is not clear if gamblers would be inclined to access this type of information outside of a research trial where they may be compensated to do so. Future research studies should aim to determine if this is a feasible option by employing ecologically valid research designs (such as with real gamblers in real venues).

Another consideration is that due to the lack of follow-up data it is not clear if the reduction in EGM gamblers' misconceptions is likely to be maintained over time. The positive effects of the educational animation that Wohl et al. (2010) developed to remedy the gambler's fallacy waned over the 30-day follow up period suggesting gamblers may need booster sessions to reinforce the newly learned information. Donati et al. (2018) reported that the improvements in probabilistic reasoning and superstitious thinking as a result of their school-based intervention with adolescents was successfully maintained six-months later. However, this was carried out on a small number (N=34) of adolescents reducing the reliability of the longer-term findings.

8.5 Conclusions and Future Directions

The current research suggests that exposing EGM-related misconceptions by teaching underlying game mathematics is an effective method to reduce misconceptions in those who have them but may not be aware. Young people who have not had many gambling experiences may prefer reductive information about EGMs as this form of gambling is less relevant to them. However, this type of information is less effective in producing important preventative effects, such as addressing the motivational beliefs which drive continued gambling. Current gambling education that focuses solely on raising awareness of the problem provides superficial explanations of complex gambling-related mathematical concepts. Consequences of failing to intervene with more complex accurate information may result in development of the very misconceptions early education is attempting to prevent.

Future research should first aim to determine what types of beliefs adolescents and young adults have with regards to the specific forms of gambling games they are engaging in. Determining the specific types of games adolescents engage with and are learning about for the first time will help to target early and relevant misconceptions which may be a risk factor for later problems. Adolescents in the current research engaged mostly in personal bets between friends, scratchcards, and sports betting. Although the former two are generally not associated with gambling problems, lessons may be learned in the early years about how formal or informal bets can be structured to ensure long-term outcomes favour one party or another. Sports betting on the other hand, has been associated with illusions of control and misattribution of skill and adolescents will likely benefit from understanding the commercial wagering system and its associated long-term favourable outcomes for bookmakers and betting companies. Despite increased participation in sports betting, there is a distinct lack of research on the particular cognitions which may motivate excessive gambling on sports, and confusion around how cognitive restructuring should address such cognitions in therapy (Chretien et al., 2017). This suggests there is also a need for research to determine the specific misconceptions unique to sports betting that may need to be incorporated into gambling education for adolescents.

Future gambling education programs should aim to promote an understanding of the mathematical principles which give rise to the long-term unprofitability of gambling games. Education amongst adolescents and young adults should expose problematic thinking patterns which can give rise to gambling problems, but these must relate to the forms of gambling the target audience is engaging with. Animations are an effective method of conveying such information because they allow incorporation of data visualisations and simulations which help learning the relevant and complex mathematical concepts. However, modifying the delivery of gambling education to include a blended learning environment may improve youth engagement with alternate forms of gambling outside of EGMs.

Gambling education for young people may need to be stratified in line with the mathematics curriculum so that foundational information about probabilities and statistics can be introduced alongside information about relevant gambling misconceptions; with information increasing in complexity as learners grow older and begin to engage with riskier commercial forms of gambling like sports betting. Gambling education that targets young adults should consider the fact that many do not gamble, however do have access to commercial forms of gambling like sports betting, casino games, and gaming machines. University settings are an ideal environment to distribute such information, however, may not be adequately targeting those who gamble more frequently and may be at risk of harm.

New lines of research should also aim to determine the unique harms adolescents may be facing relating to gambling, since it is unlikely that they are experiencing severe financial distress as seen in their adult counterparts. Participation in simulated gambling was higher than participation in for-money gambling in the current adolescent sample, and studies should continue to investigate how use of emerging technologies is changing the landscape of gambling for young people (Gainsbury, Russell, Hing, Wood, & Lubman, 2014).

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9 Appendices

9.1 Appendix A: Ethics Approval

17/07/2017

RESEARCH APPLICATION REF 201718: LETTER OF APPROVAL for: Evaluating a novel approach to problem gambling prevention

melanie.kehoe@syd.catholic.edu.au on behalf of Research ...

To: Brittany Keen

Dear Brittany,

Thank you for the submission of your application to conduct research in Archdiocesan Catholic Schools under the jurisdiction of the Sydney Catholic Schools.

Approval is given by Sydney Catholic Schools to conduct this study. This approval is granted subject to full compliance with NSW Child Protection and Commonwealth Privacy Act legislation.

It is the prerogative of any Principal or staff member whom you might approach to decline your invitation to be involved in this study or to withdraw from involvement at any time.

Any study involving the participation of students will require written, informed consent by parents/guardians.

Permission is given for you to approach the Principals of the schools nominated, listed below, requesting participants for your study: **Evaluating a novel approach to problem gambling prevention**

Please note: The starting date in October is inappropriate for Year 11 students as they will have left school or completing the HSC 12 months later.
Consider using Year 10 instead.
Please send us the final list of schools that agree to participate.

All Saints Catholic College LIVERPOOL 1831
All Saints Catholic Senior College CASULA 6733
Aquinas Catholic College MENAI 13864
Bethany College HURSTVILLE 13990
Bethlehem College ASHFIELD 1319
Brigidine College Randwick RANDWICK 1328
Casimir Catholic College MARRICKVILLE 5271
Champagnat Catholic College PAGEWOOD 1434
Clancy Catholic College WEST HOXTON 18144
De La Salle Catholic College, Caringbah CARINGBAH 1367
De La Salle Catholic College, Cronulla CRONULLA 13838
De La Salle College, Ashfield ASHFIELD 1365
De La Salle College, Revesby Heights REVESBY HEIGHTS 1373
Domremy Catholic College FIVE DOCK 1378
Freeman Catholic College BONNYRIGG HEIGHTS 5351
Good Samaritan Catholic College HINCHINBROOK 15429
Holy Cross College RYDE 1387
Holy Spirit Catholic College LAKEMBA 16321
LaSalle Catholic College BANKSTOWN 1366
Marcellin College RANDWICK 1422
Marist Catholic College Penshurst PENSHURST 1433
Marist College Eastwood EASTWOOD 1431
Marist College Kogarah BEXLEY 1429
Marist College North Shore NORTH SYDNEY 1437
Marist Sisters' College Woolwich WOOLWICH 1444
Mary MacKillop Catholic College WAKELEY 1505
Mount St Joseph Milperra MILPERRA 1462
Our Lady of Mercy Catholic College Burraneer CRONULLA 1491
Our Lady of The Sacred Heart College KENSINGTON 1512
Patrician Brothers' College Fairfield FAIRFIELD 1520
St Clare's College WAVERLEY 1622
St John Bosco College ENGADINE 2350

THE UNIVERSITY OF SYDNEY

Research Integrity & Ethics Administration
Human Research Ethics Committee

Friday, 23 June 2017

Prof Alex Blaszczynski
Psychology; Faculty of Science
Email: alex.blaszczynski@sydney.edu.au

Dear Alex

The University of Sydney Human Research Ethics Committee (HREC) has considered your application.

After consideration of your response to the comments raised your project has been approved.

Approval is granted for a period of four years from **23 June 2017** to **23 June 2021.**

Project title:	**Evaluating a novel approach to problem gambling prevention.**
Project no.:	**2017/392**
First Annual Report due:	**23 June 2018**
Authorised Personnel:	**Alex Blaszczynski; Fadi Anjoul; Brittany Keen; Dylan Pickering**

Documents Approved:

Date	Version Number	Document Name
2/05/2017	-	Gambler flyer
2/05/2017	-	Letter of support from SCS
3/06/2017	-	CDT script
13/06/2017	Version 3	CDT Storyboard
13/06/2017	Version 3	Info Only
3/06/2017	-	Operator Information script
3/06/2017	-	Risk Awareness script
13/06/2017	Version 3	Risk Awareness Storyboard
2/05/2017	Version 2	Consent form_adolescent
2/05/2017	Version 2	Consent form_adults
2/05/2017	Version 1	Letter of parental refusal

Special Condition/s of Approval

- It will be a condition of this approval that clean copies of the following study documents are submitted for our record via a Compliance with Special Conditions coversheet.
    - PIS_Adolescents_tracked
    - PIS_gamblers_tracked
    - PIS_Uni students_tracked
    - Adolescent questionnaires_tracked
    - Gambler quesitonnaires_tracked
    - Personal details_tracked
    - Uni students_questionnaire_tracked

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<u>Condition/s of Approval</u>

- Research must be conducted according to the approved proposal.

- An annual progress report must be submitted to the Ethics Office on or before the anniversary of approval and on completion of the project.

- You must report as soon as practicable anything that might warrant review of ethical approval of the project including:
  - Serious or unexpected adverse events (which should be reported within 72 hours).
  - Unforeseen events that might affect continued ethical acceptability of the project.

- Any changes to the proposal must be approved prior to their implementation (except where an amendment is undertaken to eliminate *immediate* risk to participants).

- Personnel working on this project must be sufficiently qualified by education, training and experience for their role, or adequately supervised. Changes to personnel must be reported and approved.

- Personnel must disclose any actual or potential conflicts of interest, including any financial or other interest or affiliation, as relevant to this project.

- Data and primary materials must be retained and stored in accordance with the relevant legislation and University guidelines.

- Ethics approval is dependent upon ongoing compliance of the research with the *National Statement on Ethical Conduct in Human Research*, the *Australian Code for the Responsible Conduct of Research*, applicable legal requirements, and with University policies, procedures and governance requirements.

- The Ethics Office may conduct audits on approved projects.

- The Chief Investigator has ultimate responsibility for the conduct of the research and is responsible for ensuring all others involved will conduct the research in accordance with the above.

This letter constitutes ethical approval only.

Please contact the Ethics Office should you require further information or clarification.

Sincerely

Professor Glen Davis
Chair
Human Research Ethics Committee

The University of Sydney HRECs are constituted and operate in accordance with the National Health and Medical Research Council's (NHMRC) National Statement on Ethical Conduct in Human Research (2007) and the NHMRC's Australian Code for the Responsible Conduct of Research (2007).

Research Integrity & Ethics Administration
Human Research Ethics Committee

Monday, 17 July 2017

Prof Alex Blaszczynski
Psychology; Faculty of Science
Email: alex.blaszczynski@sydney.edu.au

Dear Alex

Your request to modify this project, which was submitted on 29 June 2017, has been considered.

The project has been approved to proceed with the proposed amendments.

Details of the approval are as follows:

Project Title: **Evaluating a novel approach to problem gambling prevention.**

Project No.: **2017/392**

Next Annual Report due: 22 June 2018

New Approved Documents:

Date Uploaded	Type	Document Name
11/07/2017	Questionnaires/Surveys	Gambler questionnaires v3 clean
11/07/2017	Questionnaires/Surveys	Uni student questionnaires v3 clean
11/07/2017	Questionnaires/Surveys	Adolescent Questionnaires v3 clean

Please contact the Ethics Office should you require further information or clarification.

Sincerely

Dr Helen Mitchell
Chair
Modification Review Committee

The University of Sydney HRECs are constituted and operate in accordance with the National Health and Medical Research Council's (NHMRC) National Statement on Ethical Conduct in Human Research (2007) and the NHMRC's Australian Code for the Responsible Conduct of Research (2007).

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Research Integrity & Ethics Administration
Human Research Ethics Committee

Monday, 11 December 2017

Prof Alex Blaszczynski
Psychology; Faculty of Science
Email: alex.blaszczynski@sydney.edu.au

Dear Alex

Your request to modify this project, which was submitted on 06/11/2017, has been considered.

After consideration of your response to the comments raised the project has been approved to proceed with the proposed amendments.

Details of the approval are as follows:

Project Title: **Evaluating a novel approach to problem gambling prevention.**

Project No.: **2017/392**

New Approved Documents:

Date	Type	Document
06/11/2017	Participant Info Statement	PIS_Gamblers_V4_clean

Please contact the Ethics Office should you require further information or clarification.

Sincerely

Associate Professor Stephen Fuller
Chair
Modification Review Committee Chair (MCR 3)

The University of Sydney HRECs are constituted and operate in accordance with the National Health and Medical Research Council's (NHMRC) National Statement on Ethical Conduct in Human Research (2007) and the NHMRC's Australian Code for the Responsible Conduct of Research (2007).

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Research Integrity & Ethics Administration
Human Research Ethics Committee

Wednesday, 21 March 2018

Prof Alex Blaszczynski
Psychology; Faculty of Science
Email: alex.blaszczynski@sydney.edu.au

Dear Alex,

Your request to modify this project, which was submitted on 15/02/2018, has been considered.

After consideration of your response to the comments raised the project has been approved to proceed with the proposed amendments.

Details of the approval are as follows:

Project Title: **Evaluating a novel approach to problem gambling prevention.**

Project No.: **2017/392**

Next Annual Report due: 22/06/2018

New Approved Documents:

Date Uploaded	Type	Document Name
13/03/2018	Participant Info Statement	Uni_student_PIS_V4_clean
12/03/2018	Questionnaires/Surveys	Uni student questionnaire_V5_clean
15/02/2018	Questionnaires/Surveys	Adolescent questionnaire_V5_clean

Please contact the Ethics Office should you require further information or clarification.

Sincerely,

Dr Helen Mitchell
Chair, Modification Review Committee (MRC 1)

The University of Sydney HRECs are constituted and operate in accordance with the National Health and Medical Research Council's (NHMRC) National Statement on Ethical Conduct in Human Research (2007) and the NHMRC's Australian Code for the Responsible Conduct of Research (2007).

Research Integrity & Ethics Administration
Human Research Ethics Committee

Wednesday, 18 April 2018

Prof Alex Blaszczynski
Psychology; Faculty of Science
Email: alex.blaszczynski@sydney.edu.au

Dear Alex

Your request to modify this project, which was submitted on 21/03/2018, has been considered.

The project has been approved to proceed with the proposed amendments.

Details of the approval are as follows:

Project Title: **Evaluating a novel approach to problem gambling prevention.**

Project No.: **2017/392**

New Approved Documents:

Date Uploaded	Type	Document Name
21/03/2018	Questionnaires/Surveys	Adolescent questionnaire_V6_clean
21/03/2018	Participant Info Statement	Adolescent_PIS_V4_clean
21/03/2018	Questionnaires/Surveys	Uni student questionnaire_V6_clean
21/03/2018	Participant Info Statement	Uni student_PIS_V5_clean

Please contact the Ethics Office should you require further information or clarification.

Sincerely

Dr Cliffton Chan
Acting Chair
Modification Review Committee (MRC 2)

The University of Sydney HRECs are constituted and operate in accordance with the National Health and Medical Research Council's (NHMRC) National Statement on Ethical Conduct in Human Research (2007) and the NHMRC's Australian Code for the Responsible Conduct of Research (2007).

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9.2 Appendix B: CM video script

Cognitive Misconceptions

<u>INTRODUCTION</u>

Did you know that there are over 195,000 pokies in Australia? Across the country, in pubs, clubs, hotels and casinos, there are rows and rows of them set up to entice players with colourful graphics, splendid sounds and dreams of winning a jackpot.

The latest figures show that during the past year, Australians lost more than 22 billion dollars gambling. And just over half of those losses were on the pokies.

Unfortunately, there are individuals who develop gambling problems and find themselves unable to shake their costly habit. Perhaps this is due to myths, misunderstanding and misconceptions about how gaming machines work.

A misconception is when you believe that something is true, without realizing that your belief is actually false. For example, once upon a time, everyone believed the Earth was flat, which is obviously not correct. In modern times, there are mass misconceptions about how gaming machines work. Having misconceptions about gaming machines increases the risk of developing a gambling problem.

Purpose

This video presents common misconceptions about electronic gaming machines. It looks at how beginners luck can play a role in forming misconceptions and why having misconceptions can increase the risk of developing a gambling problem.

The video also explains how electronic gaming machines are designed in a way that ensures repeated play will add up to overall losses, or a 'downward drift' for players.

<u>THREE STAGES OF GAMBLING</u>

Individuals who develop gambling problems do so in stages. To understand how misconceptions can lead to a gambling problem stage, we need to start from the very beginning.

a. Non-Gambling Stage

During the non-gambling stage, the future problem gambler has not played gaming machines and has not formed misconceptions about how they work. You can't misunderstand something you haven't thought about.

b. Recreational Stage

Usually, the first time gambling occurs, it's at a social occasion that involves a gambling venue like a pub, RSL club or casino.

Interviewer: "How were you first introduced to the pokies?"
Female 30-35: "It was around the time I started dating my boyfriend. He first introduced me to the pokies on our 3rd or 4th date. We went to the local RSL club. At the time I had absolutely no idea how to play them. He showed me where to insert money and explained to me how to place a bet. I put in 5 dollars and started playing."
Male 18-25: "Yeah I was away at a conference and everybody went to the pub at the end of the day. After we got some beers one of my workmates went to where the machines were. I watched him play for a bit and decided to have a go. He showed me what to do and I had a few bets."

i. Early Wins

A gambling problem can innocently grow from an unexpected early win.

Female 30-35: "I think I was betting 1 credit on a few lines. It was a bit confusing at first. I couldn't work out exactly what was happening. Sometimes I would win and sometimes I would lose. After about 10 minutes of playing, I won something like $10 with a single spin. I thought wow, better quit while I am ahead. So I pulled the money out and watched my boyfriend keep playing. He ended up winning $500 dollars. I couldn't believe it. It was lots of fun."

Male 18-25: "I had a few coins in my pocket so I put them into the slot. I think I was betting something like 5 cents every spin when the machine started making all sorts of sounds. I got the "feature", not that I really understood how that happened. All I know is that I ended up with something like $30 dollars which I pulled out and bought drinks with."

So experiencing what it is like to win leaves a positive first impression. As the saying goes, first impressions can be lasting.

c. Problem Gambling Stage

Encouraged by early wins, the individual plays more. As they play more, they experience a mixture of outcomes; sometimes they win and sometimes they lose. Misconceptions develop when they try to make sense of the mixed patterns of wins and losses, in order to better understand *when* machines are more or less likely to produce winning outcomes.

MISCONCEPTION 1: PREDICTABLE CYCLES
Somewhere along the way, problem gamblers pick up a misunderstanding that the pokies are supposedly 'programmed' to take in a certain amount of money and then return a percentage of that money to players.

It is as if machines operate in a 'programmed sequence'. First, they 'fill' themselves with money and then tip a portion of that money back to players. This is a misconception that creates high risk for developing a gambling problem.
Let's see why.

Problem gamblers assume they can 'sense' if the machine is approaching a winning cycle by 'keeping track' of how much money has gone into a machine.
So problem gamblers strongly believe they should continue to play a machine if it has not "paid out" for a while, because it will probably pay out soon. They believe this to be true, without realizing that their belief is actually false, and make misinformed decisions to continue gambling. More often than not, continuing to play results in more losses than intended.

RANDOM SELECTION

Gaming machines are not programmed to payout in alternating winning and losing cycles. What comes up on the next spin is RANDOMLY selected, no matter what amount of wins or losses have previously occurred.
Although many are familiar with the concept of randomness, it is actually quite difficult to understand how gaming machines operate randomly.

Lets' break this down.

To say that something is random, means that keeping track of what has happened in the past cannot be used to predict what will happen next. For example, traffic lights are not random. The next colour to light up depends on – and can be predicted from – the previous one.

Gaming machines do not operate like traffic lights. What comes up next on a gaming machine does not depend on what has previously happened. Keeping track of previous wins and losses provides no information whatsoever that helps to predict what is likely to happen next.

Say Machine 1 has been played for six months without paying a jackpot. Say Machine 2 has just paid the jackpot. In both cases, there is no effect on what is likely to come up on the next spin.

Let's see why.

d. The Range

For both Machine 1 and Machine 2, what comes up on the next play is randomly selected from the game's 'range'. The range is like a list of all possible outcomes. For example, a coin toss has a range of 2 outcomes, heads or tails. A die has a range of 6 outcomes, a packet of crayons can have a range of 8 colours, and the English alphabet has a range of 26 letters.

The range for gaming machines is the number of different ways that the game's symbols can be displayed on the screen. The range can vary from tens of millions, to hundreds of millions, depending on two factors:

(i) the number of stopping positions on each virtual reel strip; and

(ii) the number of game symbols.

For example, the Lucky Leprechaun machine has 5 virtual reel strips. Each virtual reel strip has 64 numbered stopping positions. Each stopping position has one symbol. The game has ten different symbols to choose from: Wild, Leprechaun, Pot of Gold, Well, 7, A, K, Q, J, and 10.

After every play, the Lucky Leprechaun machine displays a portion of each virtual reel strip on the screen. The portion displayed is a sequence-of-three symbols, shown here in red, yellow, and green.

Keeping track of previous wins and losses provides no information whatsoever about which portion of each virtual reel strip will be displayed on the next spin. This is because what comes up on the next spin is randomly selected. So how does the Lucky Leprechaun machine randomly select 3 positions/symbols from each virtual reel strip?

e. Random Number-Reel-Position Selection

First, the Lucky Leprechaun machine generates five numbers between 1 and 64. These random numbers are shown in the yellow bar. Then each random number in the yellow bar is matched to a stopping position on the virtual reel strips. The symbol found in that matched position is then displayed in the middle, along with the symbol positioned above (red) and below (green). This is how the Lucky Leprechaun machine randomly selects a sequence of three symbols from each virtual reel strip. This is how all electronic gaming machines randomly select which portion of the virtual reel strip will be displayed on the screen.

f. Unequal number of symbols

Random generation means that every stopping position on the virtual reel strip has as equal chance of being selected – but, it does not mean that each symbol has an equal chance of appearing on the screen.

Virtual reel strips always have more of some symbols than others. Symbols that are matched with low prizes appear most on each reel strip. Symbols matched with higher prizes appear least.

For each virtual reel on the Lucky Leprechaun machine, the Wild or "substitute" symbol appears the least. Next least are the "free spin" or "feature" symbols: Leprechaun, Pot of Gold, and Well.

g. Number of Symbols Never Change

The unequal number of symbols on each virtual reel is permanent and fixed. It does not change from one spin to the next.

This means that from one spin to the next, the symbols that appear most on each virtual reel strip are always more likely to be randomly selected, for EACH and EVERY play of the game, no matter what has happened previously.

MISCONCEPTION 2: ADJUST TO PERCENTAGE

So, as you can see, the Lucky Leprechaun machine is not programmed to operate in predictable cycles which alternate between winning and losing. This is a misconception. Now, let's take a look at another misconception about how gaming machines work.

Many who play gaming machines are aware of a concept called the 'return to player percentage'. Unfortunately, this concept is highly misunderstood. Problem gamblers mistakenly believe that the machine will adjust winning and losing outcomes 'on the go' in order to maintain a set percentage of wins and losses. However, the machine makes no such adjustments during the course of being played, no matter what has occurred for the player. Again, this is because for every play, an outcome is randomly selected from the game's range.
To understand the machine's so-called 'return to player percentage' requires a breakdown of the games unfair mathematical design.

HOUSE EDGE | EXPECTED PAYOFF

Machines do not need to adjust winning and losing outcomes 'on the go' in order to maintain a programmed return to player percentage. This percentage refers to a built-in unfair mathematical game design feature called an Overall Negative Expected Payoff. This means that when you look at the game's range, which consists of a mixture of winning and losing outcomes, the total number of ways to lose, or total cost of play, will always be greater than the total of all possible prizes. Although there is random selection from the range of prizes, so long as the game is repeatedly played, 'overall' losses will inevitably outweigh random gains.

Using a simple coin toss, we can demonstrate how to design a game that has a mixture of winning and losing outcomes and an overall negative expected payoff.
How to do so can be broken-down into five steps: A,B,C,D and E.

In step A. we set the COST for each play of the game
In step B. we work out the PROBABILITY for each and every possible outcome
In step C. we set a PRIZE value for each and every outcome
D. Next, we calculate the PAYOFF (cost + prize) for each and every outcome
And finally, in step E. we compute what is the overall EXPECTED payoff for REPEATED play

The simple coin toss game works like this. Heads the player wins, tails the player loses. Let's suppose the cost to play the game is $1. We assign the number 1 to A and use a negative sign to indicate that it is a cost to play the game.
A coin toss can have a range of two outcomes; heads or tails. The probability of heads and tails is the same. This means we assign the number 0.5 to the probability of both heads and tails.
Suppose we assign a prize value of 1.9 for Heads and 0 for Tails. This means that the payoff for heads is 0.9, because remember, the cost is $1, so we really only win back 90 cents. The payoff for tails is -1, because we have lost our dollar, and won nothing back. In other words, half the time we can expect to win 90 cents and half the time we can expect to lose a dollar. Needleless to say, that's an unfair game for the player.

h. Expected Payoff and Return to Player Percentage

Next, we can compute the expected overall payoff for repeated play. We can see that the overall expected payoff, is negative.
When expected gains for repeated plays are divided by expected losses, the expected payoff converts into 'a return to player percentage'. Anything less than 100% ensures the inevitability overall profits for the operator, and overall losses for regular players. Let's now take a look at how an Overall Negative Expected Payoff is built-in to gaming machines.

i. Symbol-Probability and Prize Level

The game's overall negative expected payoff is not affected by the constantly changing random number generator. Although game outcomes are random from one spin to the next, the expected payoff of a machine is highly predictable because it applies to repeated plays of the game, not to single plays or single gambling sessions.

Although each stopping position on a virtual reel strip has equal chance of being randomly selected, unequal symbol counts on each virtual reel means that symbols matched with lower prizes always have more of chance of being selected compared to symbols matched with high prizes.
So, in effect,

(i) "no prize" and "prize less than bet" are designed to have the highest probability-and are expected to be randomly selected most frequently from spin to spin

(ii) the higher the prize, the lower the probability- so big wins have the smallest chance of being randomly selected from one spin to the next

<u>SUMMARY</u>

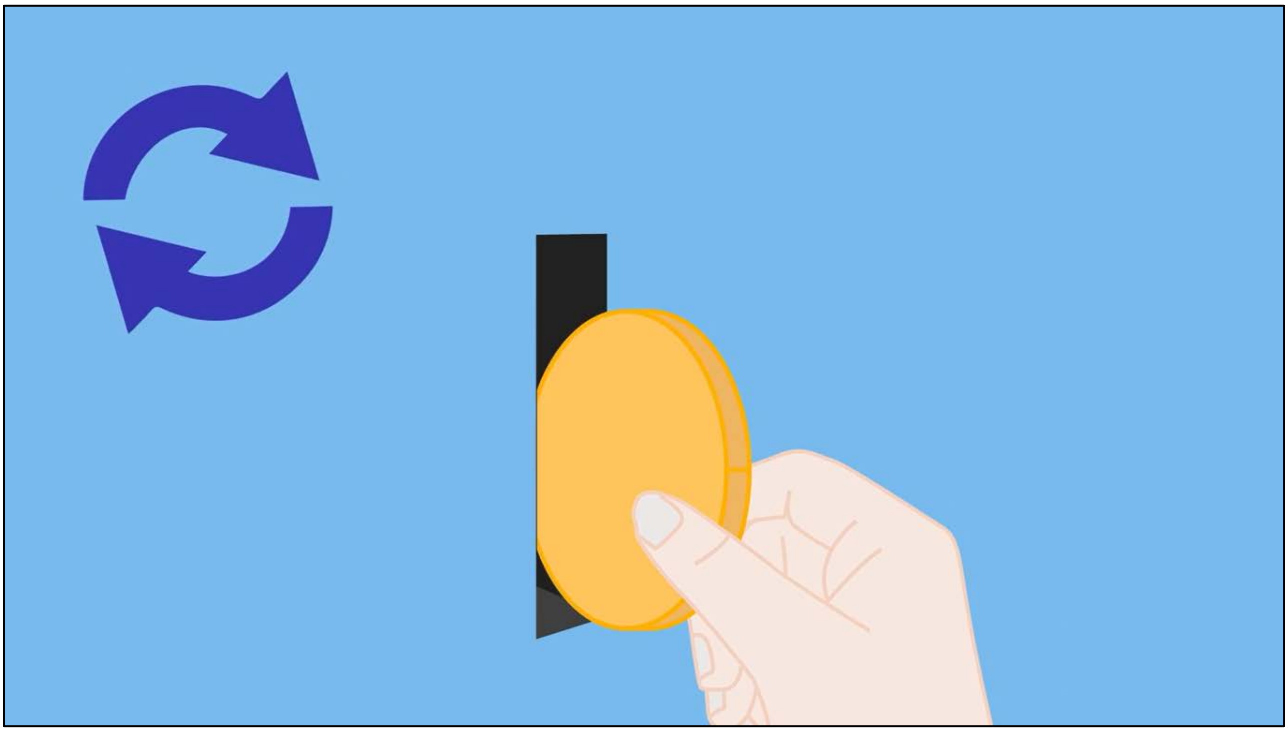
When it comes to gaming machines, what has happened in the past has no bearing on the future outcomes. Machines do not operate in predictable cycles nor do they adjust

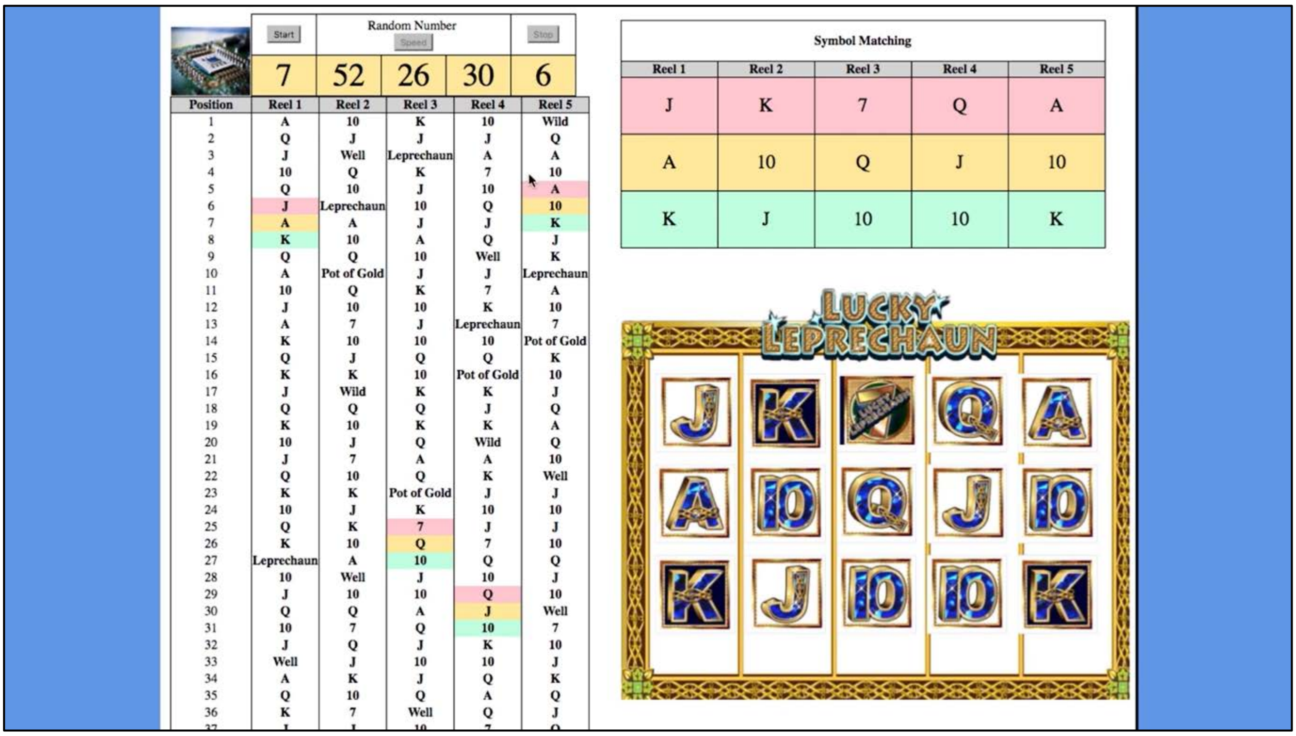
outcomes ‘on the run’ to achieve a return to player percentage. These are misconceptions and they misinform decisions to continue gambling.
The games built-in unfair mathematical design, the Overall Negative Expected Payoff, is about what will happen in the future. When the randomness of single plays is combined with a negative expected payoff for repeated plays of the game, there will be a mixture of outcomes. Big wins will randomly occur, but with frequencies low enough to ensure that the sum of random gains in the future will not make up for the constantly increasing cost of repeatedly playing the game.
Regardless of past outcomes, as play increases, a ‘downward drift’ will inevitably occur. The ‘downward drift’ created by the games unfair mathematical design can be boiled down to three points:

Positive payoff is possible in the short-term, but negative payoff is more likely.
Negative payoff is very likely in the medium term.
Negative payoff is certain long-term

So, don’t be fooled by misconceptions about how gaming machines work and greatly reduce your risk of developing a gambling problem.

9.3 Appendix C: CM Video screenshots

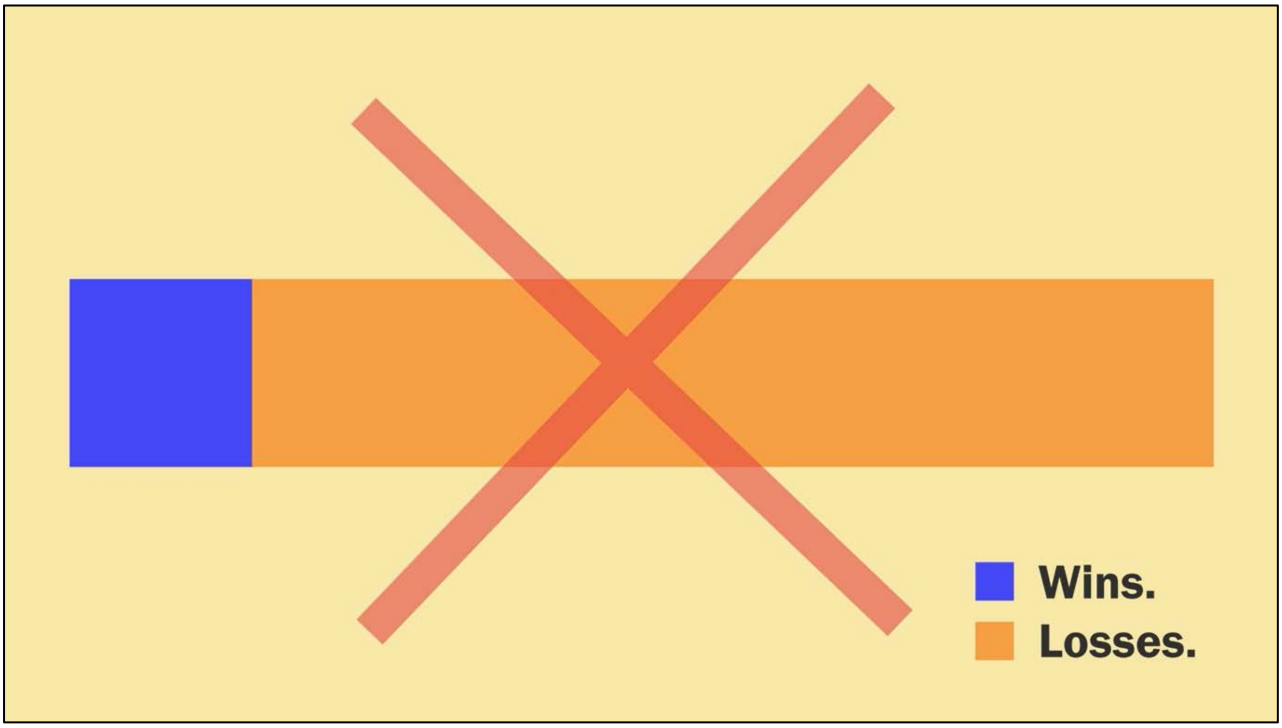


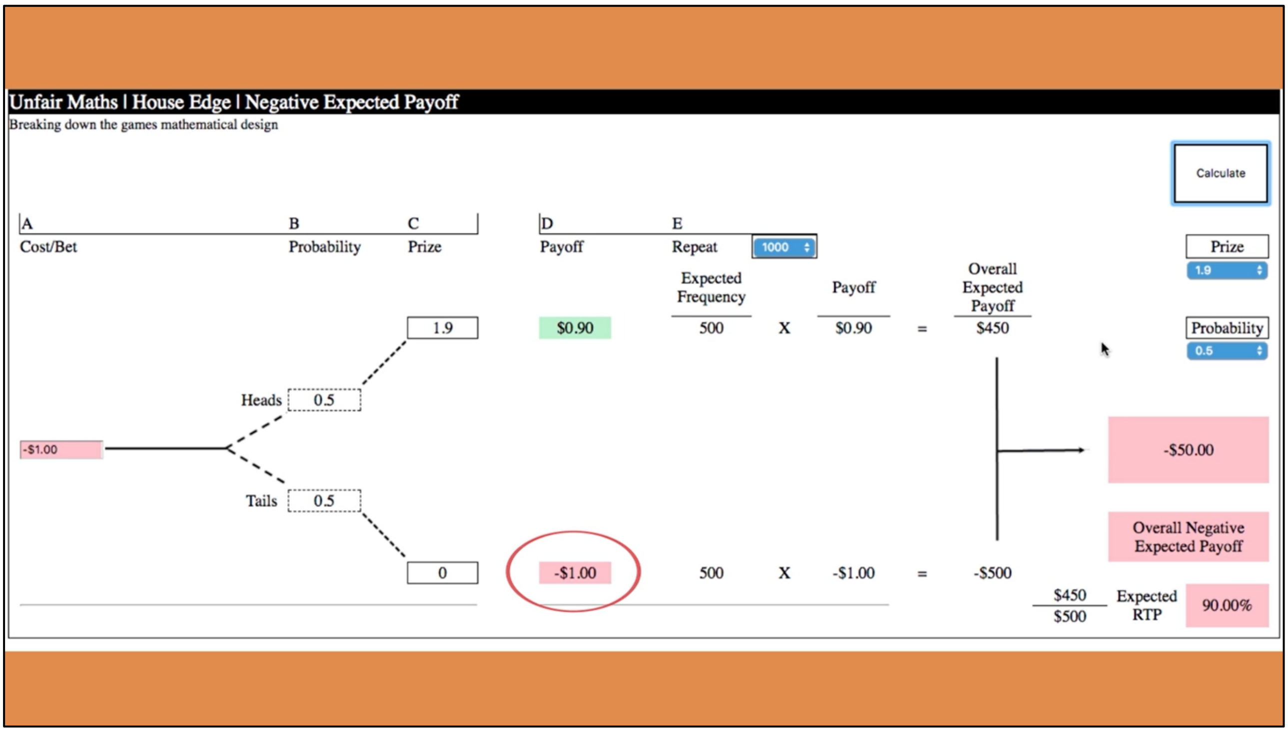


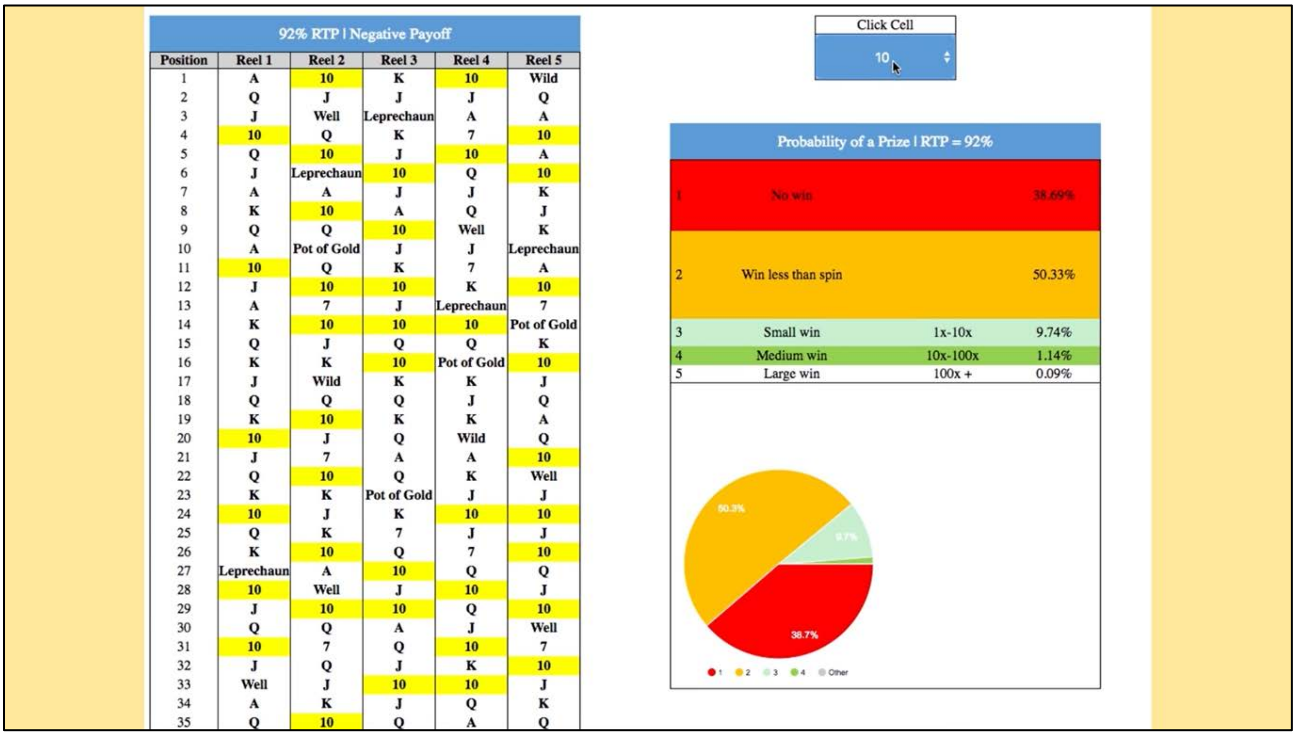
	7	52	26	30	6
Position	Reel 1	Reel 2	Reel 3	Reel 4	Reel 5
1	A	10	K	10	Wild
2	Q	J	J	J	Q
3	J	Well	Leprechaun	A	A
4	10	Q	K	7	10
5	Q	10	J	10	A
6	J	Leprechaun	10	Q	10
7	A	A	J	J	K
8	K	10	A	Q	J
9	Q	Q	10	Well	K
10	A	Pot of Gold	J	J	Leprechaun
11	10	Q	K	7	A
12	J	10	10	K	10
13	A	7	J	Leprechaun	7
14	K	10	10	10	Pot of Gold
15	Q	J	Q	Q	K
16	K	K	10	Pot of Gold	10
17	J	Wild	K	K	J
18	Q	Q	Q	J	Q
19	K	10	K	K	A
20	10	J	Q	Wild	Q
21	J	7	A	A	10
22	Q	10	Q	K	Well
23	K	K	Pot of Gold	J	J
24	10	J	K	10	10
25	Q	K	7	J	J
26	K	10	Q	7	10
27	Leprechaun	A	10	Q	Q
28	10	Well	J	10	J
29	J	10	10	Q	10
30	Q	Q	A	J	Well
31	10	7	Q	10	7
32	J	Q	J	K	10
33	Well	J	10	10	J
34	A	K	J	Q	K
35	Q	10	Q	A	Q
36	K	7	Well	Q	J

Symbol Matching

Reel 1	Reel 2	Reel 3	Reel 4	Reel 5
J	K	7	Q	A
A	10	Q	J	10
K	J	10	10	K


Wins.
Losses.


Unfair Maths | House Edge | Negative Expected Payoff
Breaking down the games mathematical design
Calculate
A
Cost/Bet
B
Probability
C
Prize
D
Payoff
E
Repeat
1000
Expected Frequency
Payoff
Overall Expected Payoff
Prize
1.9
Probability
0.5
1.9
$0.90
500
X
$0.90
=
$450
Heads
0.5
-$1.00
Tails
0.5
-$50.00
Overall Negative Expected Payoff
0
-$1.00
500
X
-$1.00
=
-$500
$450
$500
Expected RTP
90.00%



92% RTP | Negative Payoff					
Position	Reel 1	Reel 2	Reel 3	Reel 4	Reel 5
1	A	10	K	10	Wild
2	Q	J	J	J	Q
3	J	Well	Leprechaun	A	A
4	10	Q	K	7	10
5	Q	10	J	10	A
6	J	Leprechaun	10	Q	10
7	A	A	J	J	K
8	K	10	A	Q	J
9	Q	Q	10	Well	K
10	A	Pot of Gold	J	J	Leprechaun
11	10	Q	K	7	A
12	J	10	10	K	10
13	A	7	J	Leprechaun	7
14	K	10	10	10	Pot of Gold
15	Q	J	Q	Q	K
16	K	K	10	Pot of Gold	10
17	J	Wild	K	K	J
18	Q	Q	Q	J	Q
19	K	10	K	K	A
20	10	J	Q	Wild	Q
21	J	7	A	A	10
22	Q	10	Q	K	Well
23	K	K	Pot of Gold	J	J
24	10	J	K	10	10
25	Q	K	7	J	J
26	K	10	Q	7	10
27	Leprechaun	A	10	Q	Q
28	10	Well	J	10	J
29	J	10	10	Q	10
30	Q	Q	A	J	Well
31	10	7	Q	10	7
32	J	Q	J	K	10
33	Well	J	10	10	J
34	A	K	J	Q	K
35	Q	10	Q	A	Q

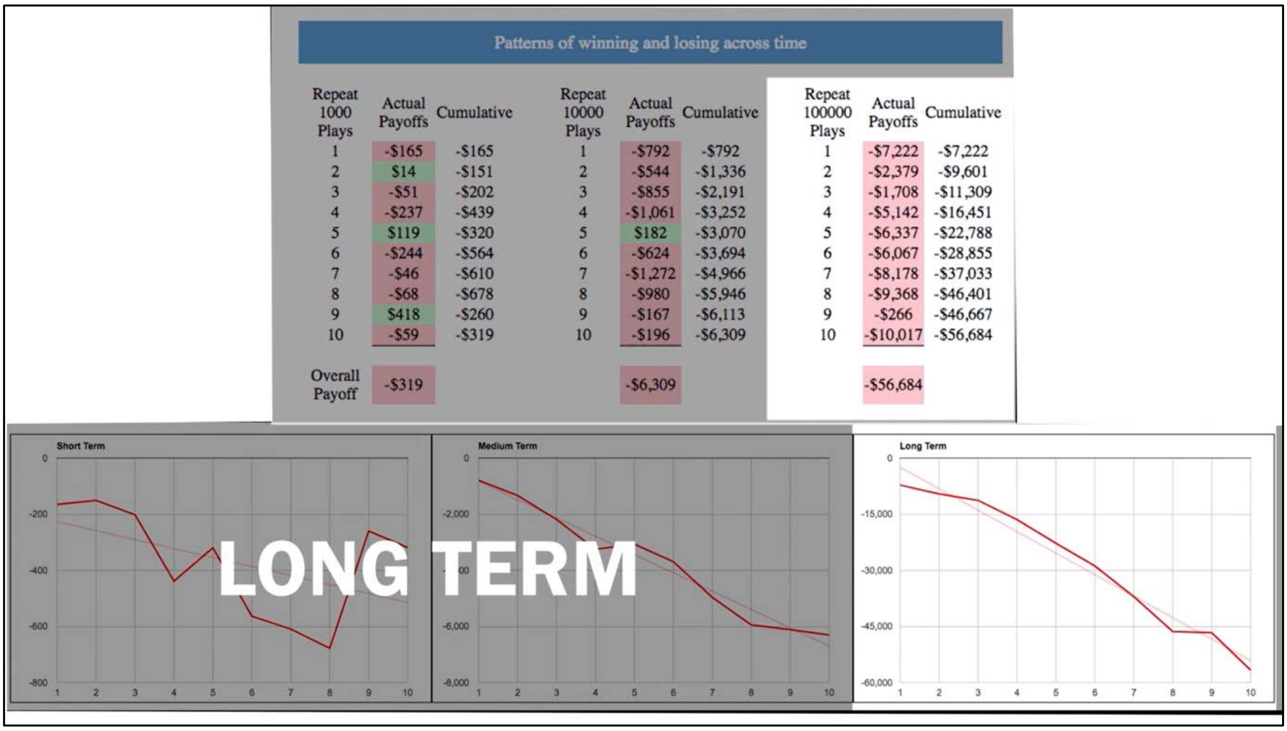
Probability of a Prize | RTP = 92%			
1	No win		38.69%
2	Win less than spin		50.33%
3	Small win	1x-10x	9.74%
4	Medium win	10x-100x	1.14%
5	Large win	100x +	0.09%

Patterns of winning and losing across time

Repeat 1000 Plays	Actual Payoffs	Cumulative
1	-$165	-$165
2	$14	-$151
3	-$51	-$202
4	-$237	-$439
5	$119	-$320
6	-$244	-$564
7	-$46	-$610
8	-$68	-$678
9	$418	-$260
10	-$59	-$319
Overall Payoff	-$319	

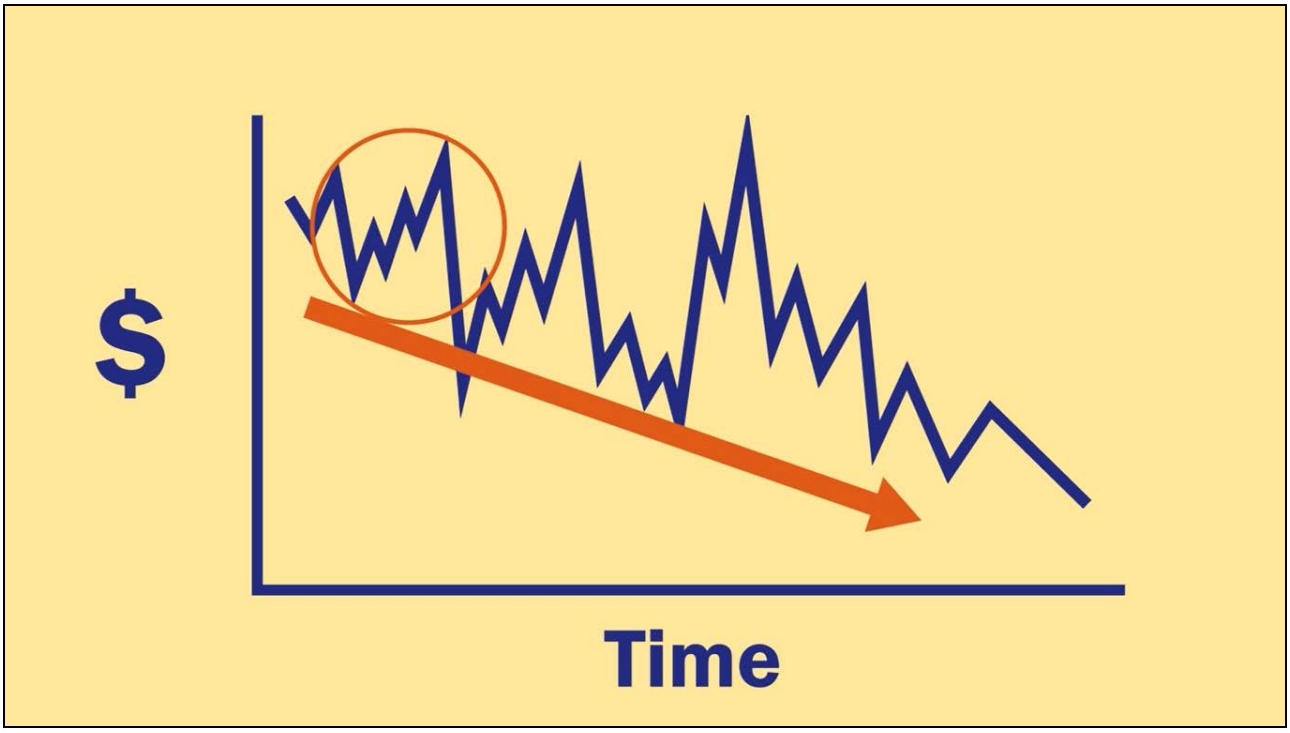
Repeat 10000 Plays	Actual Payoffs	Cumulative
1	-$792	-$792
2	-$544	-$1,336
3	-$855	-$2,191
4	-$1,061	-$3,252
5	$182	-$3,070
6	-$624	-$3,694
7	-$1,272	-$4,966
8	-$980	-$5,946
9	-$167	-$6,113
10	-$196	-$6,309
	-$6,309	

Repeat 100000 Plays	Actual Payoffs	Cumulative
1	-$7,222	-$7,222
2	-$2,379	-$9,601
3	-$1,708	-$11,309
4	-$5,142	-$16,451
5	-$6,337	-$22,788
6	-$6,067	-$28,855
7	-$8,178	-$37,033
8	-$9,368	-$46,401
9	-$266	-$46,667
10	-$10,017	-$56,684
	-$56,684	



Patterns of winning and losing across time

Repeat 1000 Plays	Actual Payoffs	Cumulative	Repeat 10000 Plays	Actual Payoffs	Cumulative	Repeat 100000 Plays	Actual Payoffs	Cumulative
1	-$165	-$165	1	-$792	-$792	1	-$7,222	-$7,222
2	$14	-$151	2	-$544	-$1,336	2	-$2,379	-$9,601
3	-$51	-$202	3	-$855	-$2,191	3	-$1,708	-$11,309
4	-$237	-$439	4	-$1,061	-$3,252	4	-$5,142	-$16,451
5	$119	-$320	5	$182	-$3,070	5	-$6,337	-$22,788
6	-$244	-$564	6	-$624	-$3,694	6	-$6,067	-$28,855
7	-$46	-$610	7	-$1,272	-$4,966	7	-$8,178	-$37,033
8	-$68	-$678	8	-$980	-$5,946	8	-$9,368	-$46,401
9	$418	-$260	9	-$167	-$6,113	9	-$266	-$46,667
10	-$59	-$319	10	-$196	-$6,309	10	-$10,017	-$56,684
Overall Payoff	-$319			-$6,309			-$56,684	



9.4 Appendix D: VRGF Copyright permission

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5 May 2017

To: The office of Commercial Development & Industry Partnerships at the University of Sydney

I hereby give permission for the Victorian Responsible Gambling Foundation's publication titled *The Responsible Gambling Guide* (2013) to be used in part, in the form of an audio script for an animated video in The University of Sydney's research study titled *Evaluating a novel approach to problem gambling prevention*.

Please note the following terms:

Attribution - Give appropriate credit in your study to the Victorian Responsible Gambling Foundation as the source of the material (but not in any way that suggests the foundation endorses you or your use of the content).

Non-Commercial - You may not use the material for commercial purposes.

No Derivatives - If you remix, transform, or build upon the material, you may not distribute the modified material.

Signed

Craig Swift
Acting Chief Executive Officer

9.5 Appendix E: RA Video Script

Risk awareness

INTRODUCTION

Did you know that there are over 195,000 pokies in Australia? Across the country, in pubs, clubs, hotels and casinos, there are rows and rows of them set up to entice players with colourful graphics, splendid sounds and dreams of winning a jackpot.

They are everywhere and they are out to get your hard-earned money.

The latest figures show that during the past year, Australians lost more than $22billion dollars gambling. And just over half of those losses were on the pokies.

Australia's obsession with the pokies shows no signs of easing, which means the losses will continue to mount.

The sad reality is that some gamblers are severely impacted by their losses and find themselves unable to shake their costly habit.

Purpose
This video explains how a harmless interest with the pokies can turn into a misguided obsession that costs a lot of money and causes lot of unnecessary misery.

TYPES OF GAMBLING

There are a many ways to gamble and all involve various levels of chance with the odds of losing more than the likelihood of winning. Essentially however there are two types of gambling:

a) **Games of pure chance** where the odds cannot be affected by anything the player does or thinks they know. This includes games like:
   i. Electronic Gaming Machines, or ‘Pokies’,
   ii. Various forms of lotto including Keno; and
   iii. Casino games (like roulette)

There are also…

b) **Games involving skill** where some knowledge and judgment may increase your chances of guessing a winning outcome. These include:
   i. Card games (like poker and blackjack), and
   ii. Betting offered by bookmakers (such as betting on horses, sport, or other events)

While skill is a component in these games, chance still plays a large role in determining the result and the odds are always in the operator's favour.

Games of pure chance are mathematically constructed to make it inevitable that the operator will make more money than gamblers will win. You might be lucky at times, but over time continual gambling will result in net losses for the player.

RISK FACTORS FOR PROBLEM GAMBLING

Why do people gamble?

People gamble for many reasons. Some people gamble for excitement, the thrill of winning or to be social. Most people enjoy a flutter without losing control.

Responsible gambling is where you:

- Are in control of how much time and money you are spending
- See gambling as a form of entertainment
- Don't bet more than you can afford to lose
- Know and accept the odds; and
- Keep sight of your chances of winning and losing

But for some people, there might be reasons that lead them to gamble in a way that is not responsible.

Some people gamble to 'zone out' or escape from problems. For example, someone who is lonely and withdrawn might see gambling as a safe way to get out and be among people without having to talk to anyone. People's reasons for gambling can also change.

Someone might gamble regularly at the TAB to win money but join the Melbourne Cup sweep to be sociable. They might usually play the pokies alone but share a machine when they go out with family and friends.

For some people, gambling can become a habit. The reasons they started have been forgotten and the habit just goes on.

Betting because you need to win, or because you are sure you can win, could be warning signs. Ultimately, gambling odds are designed to work against you so if you gamble, you should be prepared to lose.

Gambling should be treated as an entertainment expense, just like going to a movie or out for dinner, and not considered a way to make money or solve deeper problems.

If this is not how you, a friend or family member gambles, you may need to talk about how to get back on track.

Pokies

Poker machines are computers that use randomised mathematical programming. This means the machine will pay out prizes at random intervals, keeping a percentage of the money put into them.

Poker machines are designed to maximise the excitement factor to entice players to spend longer on the machine and make it possible to bet quickly.

The pokies light and music show along with random prize delivery can make it hard to keep track of how much money you are spending.

Free spins, or even just the promise of a free spin, can be a powerful incentive to keep playing.

The Australian Productivity Commission found 80 per cent of people with severe gambling problems spent most of their money on poker machines.

Setting limits on time and spending and taking regular breaks are good strategies to controlling gambling.

Winning and losing on the pokies

Let's look at the real chances of winning on a poker machine.

The chance of winning more than 500 credits is one in over ten thousand.

The chance of winning a smaller prize, like 100 credits is one in approximately fifteen hundred.

The chances of getting 5 of a kind are one in nearly five thousand. The

chances of 4 of a kind are one in nearly five hundred

And the chances of getting just two of a kind drop to one in nine

CONSEQUENCES

Gambling can impact a person's life in many different areas. Some of these include:

- Financial harm – like not being able to pay for essential items
- Criminal activity – such as stealing or fraud
- Declining mental health – like depression, anxiety or suicidal thoughts; as well

as

- Declining physical health
- Relationship disruption, such as conflict or breakdown between family or friends
- Cultural harm – such as disengaging from cultural activities; and
- Reduced performance at work or study

James' story

Let's take a look at how gambling on the pokies started out as a bit of fun for 18- year-old James, but soon turned into something far worse [play video of James].

SIGNS AND SYMPTOMS

How does problem gambling start?

So how does problem gambling start?

People often start playing for fun with friends and have some early wins.

Some people keep playing in the hope they will repeat the win but can get caught up in 'chasing their losses'. Without support or help, some people get stuck in this mindset for years.

Studies have shown people who've had a major stressful change in their life such as an illness, divorce or children moving away from home can be more vulnerable to developing a problem with the pokies.

Going to play the pokies may be an escape from everyday worries such as stressful relationships or money troubles. Some people play so they can 'zone out'.

People who are socially isolated can also be more likely to develop problems with the pokies. They say it is somewhere they can go to get out of the house and be with people without having the stress of socialising.

Warning signs

Think yourself or someone else might have a problem with gambling? Here are some signs to look out for:

- Feelings of depression, including isolation from friends
- Obsession with simulated gaming apps and games
- Spending lots of time talking or thinking about gambling
- Experiencing mood swings, or feeling stressed when not gambling
- Having fights with your family about gambling
- Lying or being secretive about gambling activities
- Missing school or grades falling due to time being spent gambling

- Borrowing or taking money from family and friends; and
- Continuing to gamble to win back money you have lost

Responsible gambling means:

- People may gamble for pleasure and entertainment but are aware of their likelihood of losing, and understand the associated risks
- It means exercising control over your gambling activity
- And, responsible gambling occurs in balance with other activities in your life and is not causing problems or harm for yourself or others.

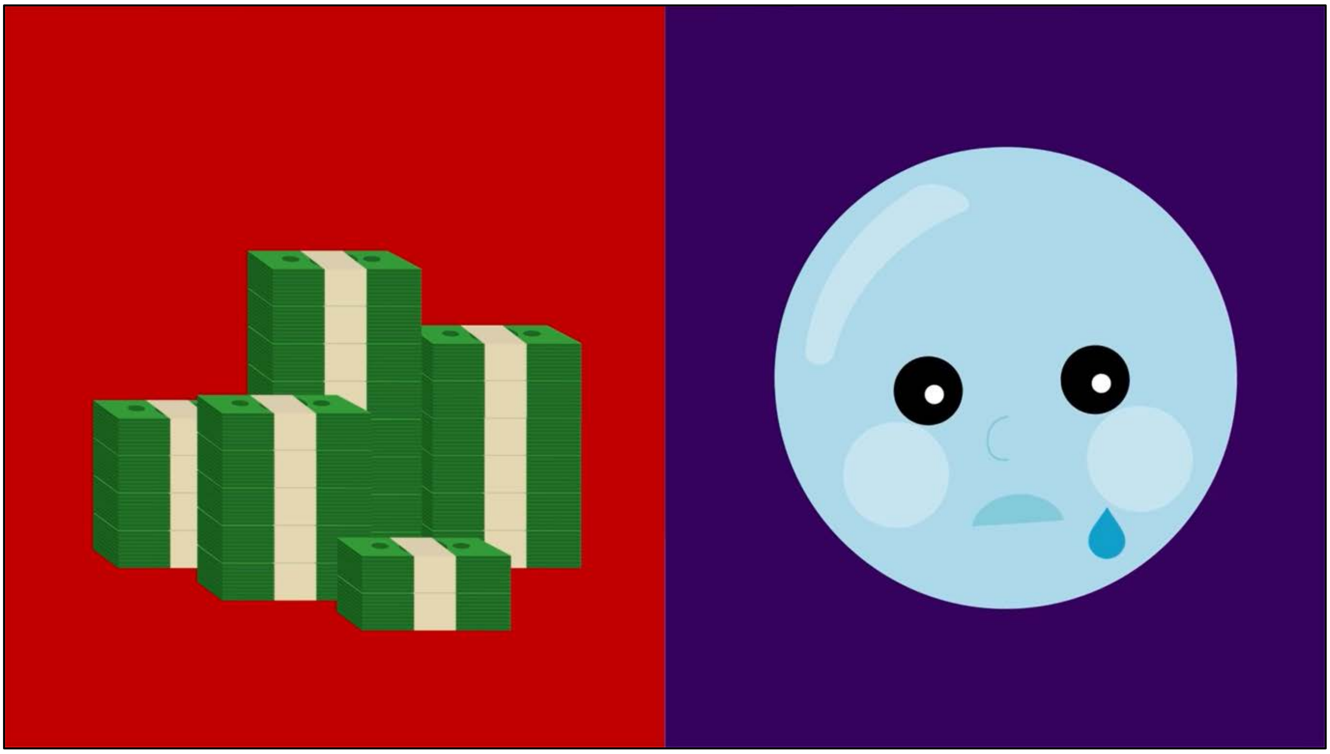
WHERE TO GET HELP

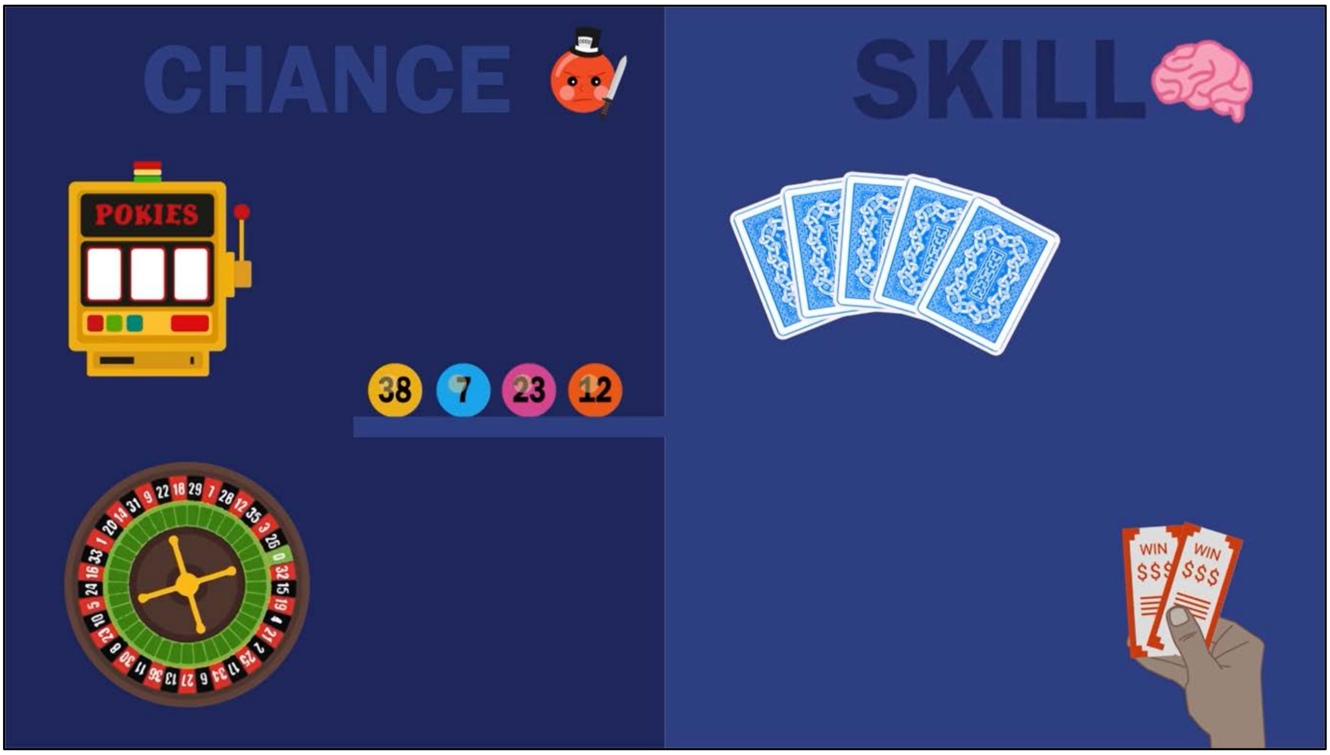
If you think you or someone you know has a gambling problem there are lots of services available to help.

Gambling Help is a free and confidential help line for people affected by gambling problems

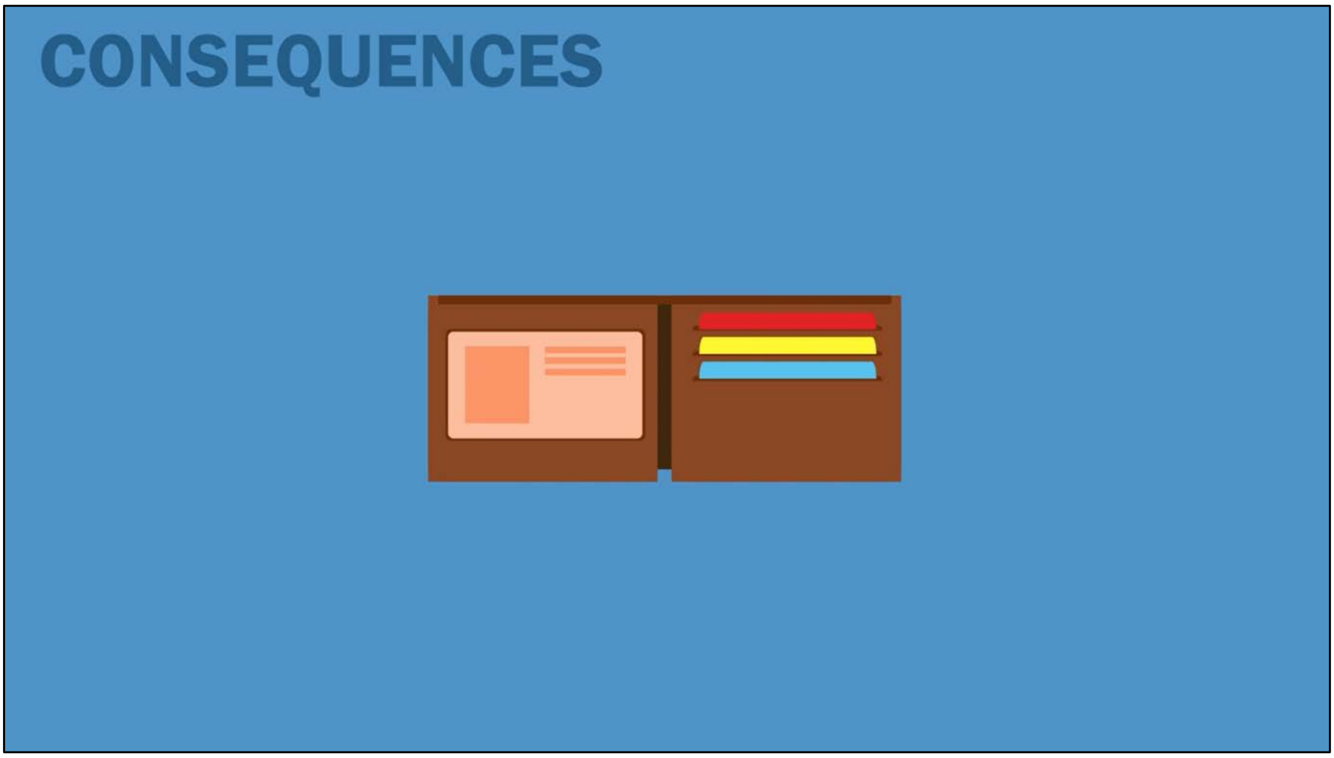
And Gambling Help Online is an online service that has resources and support available.

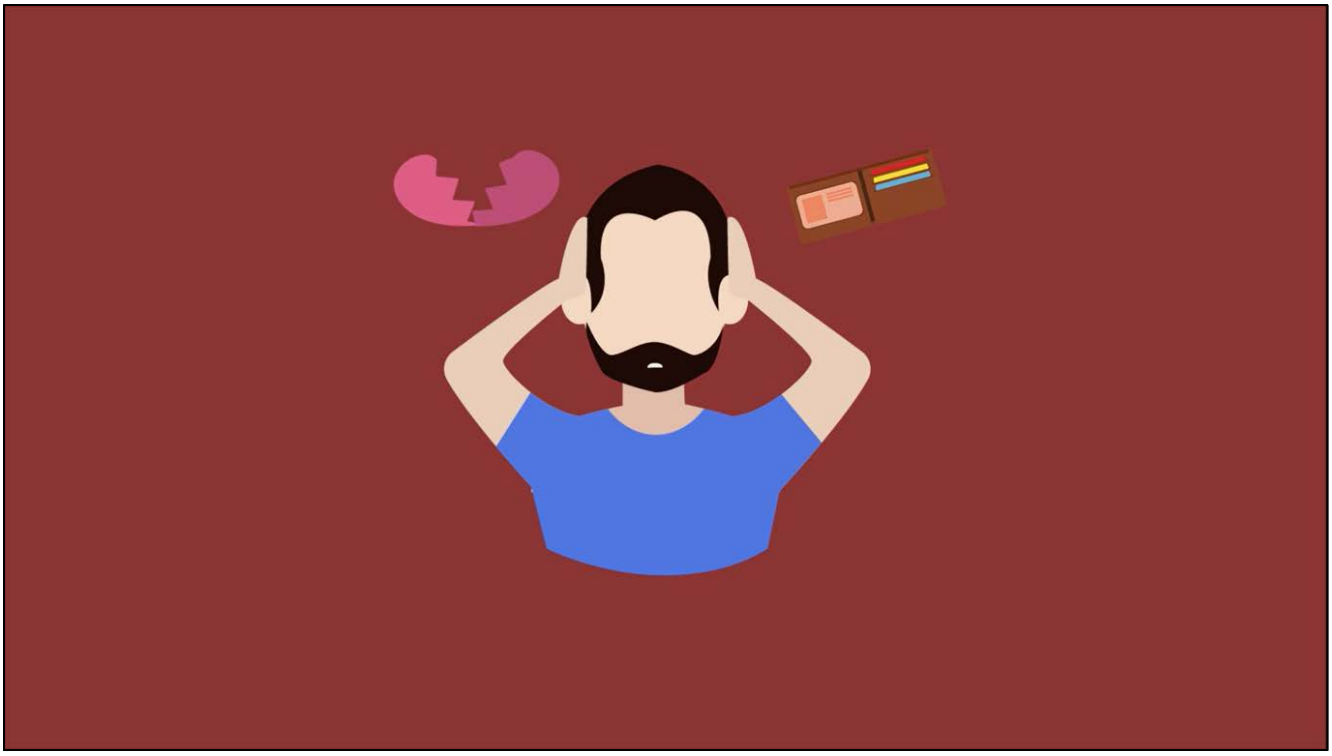
9.6 Appendix F: RA Video screenshots






RESPONSIBLE GAMBLING


CONSEQUENCES




WARNING SIGNS

WHERE TO GET HELP

gambling HELP

gambling help Online

1800 858 858

Counselling, information and support 24/7

9.7 Appendix G: GTA Copyright Approval

GAMING TECHNOLOGIES ASSOCIATION

9 May 2017

Brittany Keen
Research Assistant, PhD Candidate
Gambling Treatment and Research Clinic
Level 2, Brain and Mind Centre
94 Mallett Street
Camperdown NSW 2050
School of Psychology, Faculty of Science
THE UNIVERSITY OF SYDNEY

Dear Brittany

Re: Evaluating a novel approach to problem gambling prevention

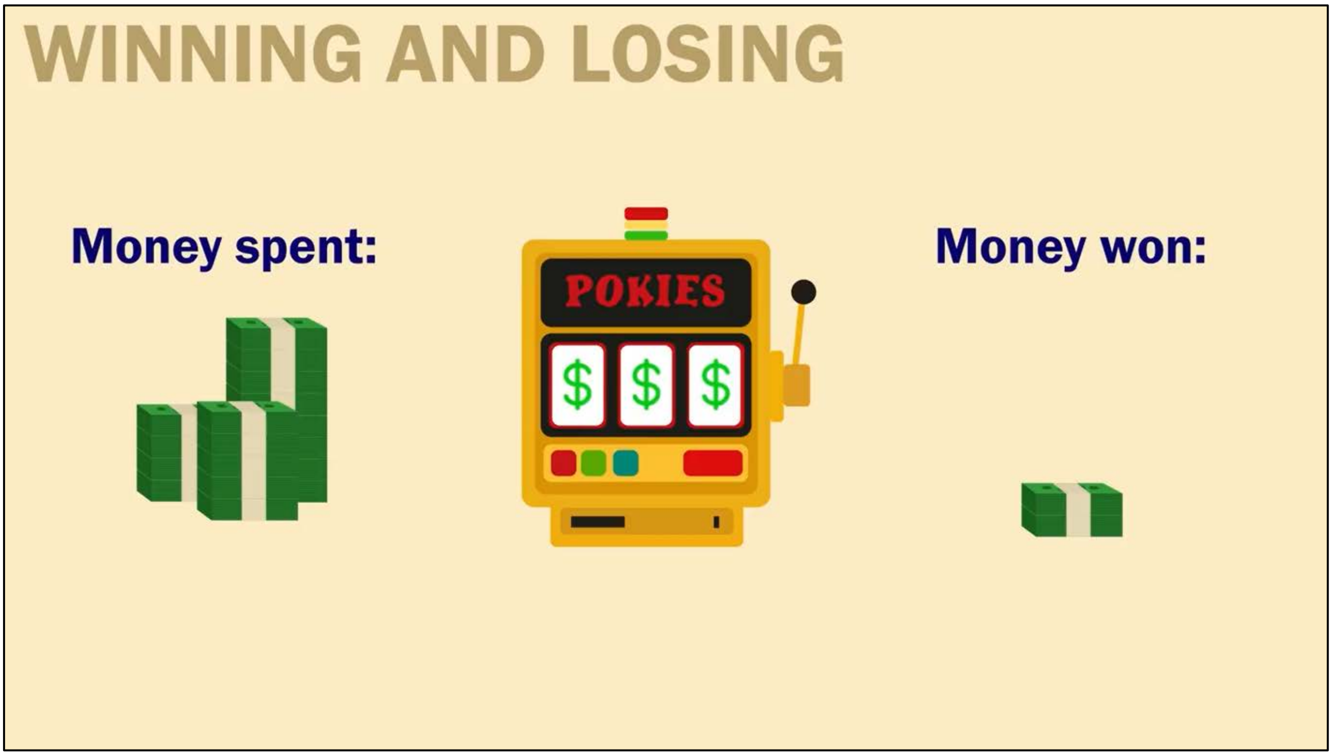
This is to advise that the Gaming Technologies Association waives copyright for you to utilise the content of its Player Information Booklet or any other content on its website (www.gamingta.com) for the purposes of the above research project including quoting or reproducing such content in any form as you see fit.

Yours sincerely

Ross Ferrar
Chief Executive Officer

Level 34, 50 Bridge Street Sydney, NSW 2000 Australia T (02) 82160931 F (02) 82160701 E info@gamingta.com www.gamingta.com ABN 70 060 130 770

9.8 Appendix H: OI Video Screenshots



Win - Lose Table

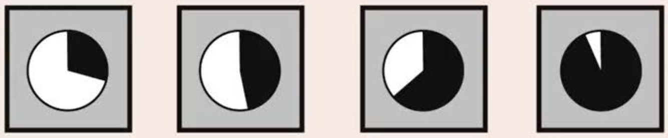
A	B	C	D	E
Total units (coins) staked in a single play session **	Proportion of Players who experienced better than 100 per cent return of total amount staked	Proportion of Players who experience between 80 & 100 per cent return of total amount staked	Proportion of Players who experience between 60 & 80 per cent return of total amount staked	Proportion of Players who experience less than 60 per cent return of total amount staked
2,000	29%	46%	22%	3%
3,000	25%	54%	20%	1%
4,000	22%	61%	17%	0%
5,000	19%	66%	15%	0%
6,000	17%	71%	12%	0%
8,000	14%	77%	9%	0%
10,000	11%	82%	7%	0%

** Assumes all games played on a single line with one coin staked per game

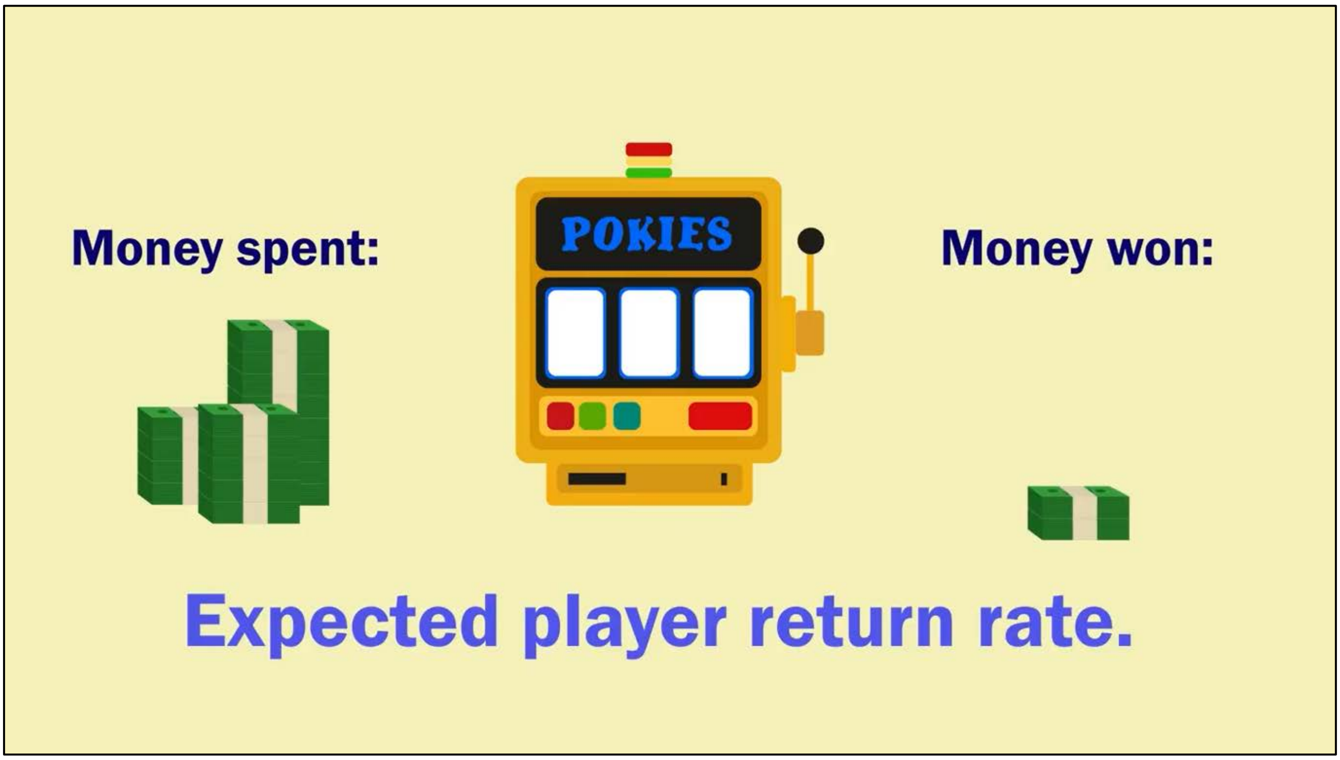
[sd 7.4: mean.91]
[Bet :1 unit, one line]

Playing Methods

	Method 1	Method 2	Method 3	Method 4
		Reduce speed of play	Reduce bet per game	Reduce speed of play AND bet per game
Games Played per minute	12	8	12	8
Average amount bet per game $	0.90	0.90	0.45	0.45
Player's Session Budget $	20.00	20.00	20.00	20.00
Average TIME taken to lose total Budget (minutes)	19	28	37	58



A symbol assigned to only one position:
1: 52 M



Money spent:
POKIES
Money won:
Expected player return rate.

Player return percentage.

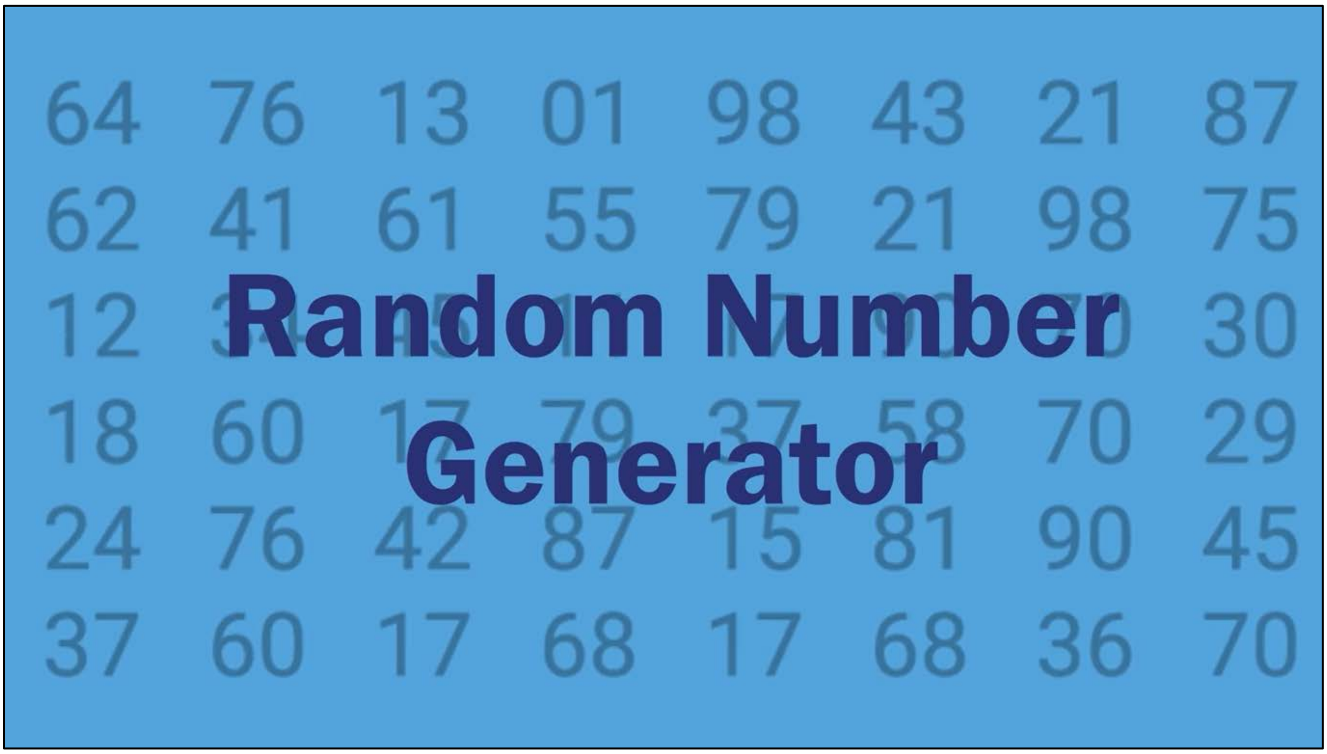
Expected proportion of wins to bets:

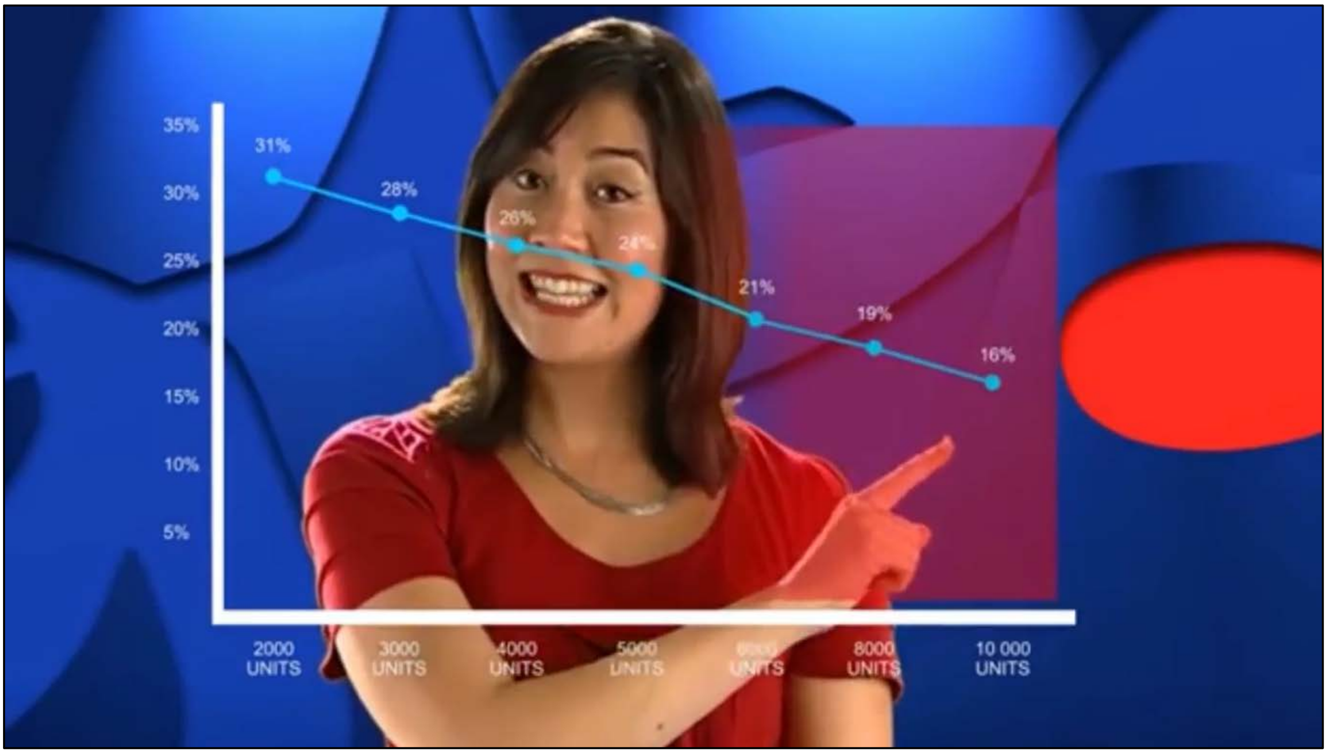
Australian Government

85%

WINNING AND LOSING


WINNING AND LOSING
POKIES
FALSE


Random Number Generator


35%
30%
25%
20%
15%
10%
5%
31%
28%
26%
24%
21%
19%
16%
2000 UNITS
3000 UNITS
4000 UNITS
5000 UNITS
8000 UNITS
10 000 UNITS

9.9 Appendix I: OI Video Script

Operator Information

INTRODUCTION

Did you know that there are over 195,000 pokies in Australia? Across the country, in pubs, clubs, hotels and casinos, there are rows and rows of them set up to entice players with colourful graphics, splendid sounds and dreams of winning a jackpot.

The latest figures show that during the past year, Australians lost more than $22billion dollars gambling. And just over half of those losses were on the pokies.

Unfortunately, some individuals develop gambling problems, and end up spending far more money than intended.

Purpose
This video aims to inform people about gaming machines so that they can increase their understanding of their operation.

WINNING AND LOSING ON THE MACHINES

Let’s look at winning and losing on electronic gaming machines.

People who play gaming machines to increase their income are either misinformed about the nature of the machines or just plain foolish.

Gaming machines are not designed to enable people to supplement their incomes.

Gaming machines are designed as recreational amusement devices on which people can spend money. Players are not forced to play machines nor are machines designed to be addictive. They are designed to be entertaining and attractive.

Use of gaming machines should accordingly be careful, moderate and within the limits of each individual’s discretionary spending.

It is possible to win money on the machines.

In fact, the machines are set to return to players a proportion of all moneys bet. This characteristic needs to be properly understood and we will explain this later.

In practical terms, however, players can only ‘get ahead’ of a machine on a short-term basis at best. Many players will experience sessions of play when prizes won exceed the amount spent. In the long term, however, in all but the most unusual and extraordinary circumstances, this outcome is virtually impossible.

Table 1:

The following table gives an indication of how players will fare on a typical machine. The table should be read carefully, and the following points should be borne in mind:

- Players whose experience is described in columns C, D and E, are players who have **LOST** money

- Each gaming machine is as unique as a fingerprint in respect to the experiences it will generate for players. This table is merely typical. It does not describe the characteristics of all games

- The table estimates SINGLE sessions of play only. The unalterable rule is that the more sessions a player engages in, the lower the chance becomes of winning more than is staked. In fact, it tends to become impossible to win more than is staked as play sessions increase.

The TIME Factor Table 2

Apart from the overriding CHANCE element, there are a number of other factors that will affect the amount of playing time a player has with a given amount of money.

The player has control over some of those elements.

The speed with which games are played and the amount staked for each spin of the reels have a substantial impact on the TIME purchased.

The impact is illustrated in the four playing methods in which changes are made to the play speed and the amount bet per game.

Clearly, the more slowly games are played, and the less credits (coins) staked per game, the more TIME players will purchase with the same budget.

HOW THE MACHINES WORK

a. *Chance*

To play a gaming machine is to play a game of CHANCE.

Tossing a coin involves chance -- there are two outcomes each with an equal chance of occurring (that is, ‘Heads” or ‘Tails’).

In the language of chance, we say that the chance of ‘Heads’ is one in two (1:2), or 0.5, or 50% -- they all mean the same thing.

Gaming Machines have far more than two possible outcomes. There are often many millions of different possible outcomes of a game.

The chances of getting any particular prize outcome can vary markedly for each game. In addition, not all machines or games have the same number of possible outcomes.

One essential element that all machines share is that the outcome of any particular game is determined by CHANCE ONLY.

Some people believe that machines are programmed to produce losing games if there have been too many wins, of that machines are more likely to payout at certain times or the day, or that machines can be 'ticked' into producing winning outcomes by altering play patterns or touching the machine in some way. Some people believe that after a run of losing games, a player should continue playing because the machine will 'compensate' by producing a rub of wins.

All of these beliefs are FALSE.

The CHANCE ONLY characteristic is extremely important to a proper understanding of how the machines work. Because CHANCE ONLY determines the outcome of any game, the following statements are absolutely true:

1. There is no play method or play pattern that can have any effect on whether a game is a winning or losing one.
2. Machines do not 'adjust' to compensate for a string of losing games or for a string of winning games. In other words, machines do not become 'due' to 'loosen up' or 'dry up' because of past events.
3. It is not possible to predict the outcome of the next game.

*b. **Randomness***

Modern gaming machines use computer technology to control and operate all functions from coin or note insertion, bets, button use by players, and so forth, INCLUDING determining the outcome of each game.

Determining the outcome of each game involves what is called a Random Number Generator.

In short, the selection of all symbols that appear at the end of each spin of the reels is the result of chance and CHANCE ONLY.

As noted earlier, the outcome of each game, irrespective of any other factor, is UNPREDICTABLE and is ALWAYS UNPREDICTABLE.

This is a constant. It is always the case, no matter how many games have been played, no matter what previous wins or losses have happened, no matter how fast or slow the player chooses to play, no matter how many coins have been bet or how many lines are played.

Nothing can influence the chance selection of symbols that appear when the reels stop spinning.

i. Random number generator (RNG)

Let’s watch a quick video to explain how the random number generator works.
Video – how gaming machines work (1min)

Suppose that a machine has 5 reels and there are 35 possible stopping positions on each reel. The symbols assigned to each of these possible 35 stopping positions are programmed into the game.

That is, if there is a “King” symbol assigned to positions 1,4,13,18,22 and 31, that assignment is permanent -- it does not change from game to game.

In this example, then, there are 6 “King” symbols placed on the reel in the positions mentioned. Other symbols are assigned to other positions on the reel so that all 35 stopping positions have a symbol assigned.

It may be, and this is often the case, that the ‘Jackpot’ symbol is only assigned to one stopping position on the reel.

The important thing to remember is that once the symbols are programmed on to the stopping positions, they remain programmed to those stopping positions.

For each game played, one of those stopping positions is selected by the Random Number Generator to stop on the centre line at the end of the reel spin.

Each of the 35 stopping positions on the reel, as in this example, has an EQUAL chance of being selected by the RNG as the chosen symbol to stop on the centre line of the display.

The second, third, fourth, and fifth reels may have the same number of stopping positions with symbols assigned.

In almost all instances, the symbols will be assigned differently to the first reel. For example, there may be only two “Kings” on reel 2 on stopping positions 15 and 19.

The number of particular symbols placed on each reel, and the stopping position to which they are assigned is determined by the mathematical design requirements of the game.

AGAIN, the important point is that the symbol chosen for stopping on the centre line is randomly determined separately for each reel by the RNG.

This random choice of symbol is done separately, AND INDEPENDENTLY, for each reel.

So, If a machine has 5 reels and 35 possible stopping positions on each reel, there are 52,521,875 possible combinations of stopping positions.

Each possible stopping position therefore has one chance of occurring in 52.5 million games.

If a symbol is assigned to only one position on each reel, the chances of getting 5 of those symbols on the centre line is one in 52.5 million (1:52.5m). That chance always remains the same no matter how many times it may have appeared (or not appeared) in the past.

This stopping position is determined entirely randomly --- all possible stopping positions have exactly the same chance of being selected by the RNG and the stopping position selected for each reel is totally INDEPENDENT of selections made for the other reels.

c. *Return to player per cent (RTP)*

Standard gaming machines have an expected player return rate. This means that, of the total value bet, a certain proportion is expected to be returned to players in winnings.

Let’s look at the player return rate a little closer
**Video – probability of winning* (1 min 25 sec)*

The “Player Return Percentage” depicts the expected proportion of wins to bets. Note the use of the word ‘expected’ --- it underlines a very important concept in understanding how machines work.

Government regulations in Australia set this expectation at a minimum of 85%. Some jurisdictions set the figure at 87%.

In practice, most venues operating the machines have them ‘set’ at a higher level than the regulated minimum. This “setting” is not a rule or an outcome that will always be perfectly satisfied for play sessions.

Care should accordingly be taken in dealing with the figure and the concept.

Gaming machines function in this regard on the basis of PURE CHANCE. The Player Return ‘setting’ is an expectation that comes from the rules of CHANCE --- it is not a guaranteed outcome.

To say that a machine is ‘set’ to return 90% to players simply means that the game mathematics are structured in a way that gives the EXPECTATION that over a long period of time the machine is likely to average a return to players of 90% of the total bets made on the machine.

For individual games, the figure is not very useful. This is so because of the enormous number of possible outcomes that can occur in any one game on a gaming machine.If we look at a simple game of tossing a coin, there are only two possible outcomes.

It might be expected that after 100 ‘games’, or tosses of the coin, “Heads” will tend to have occurred in half the outcomes.

Using the rules of chance, “Heads” can be expected to have occurred at a rate of 50%

because there are two, equally likely, possible outcomes.

There is no guarantee that 50 “Heads” will occur. In fact, it is easily possible to get more than 50 or less than 50. The CHANCE factor simply means that, if a sufficient number of trials of 100 games take place, “Heads”, as an average over all trials, will have tended to occur in 50% of the results.

For gaming machines, however, the total possible outcomes are almost astronomical by comparison.

For a game with, say, 144 million different possible outcomes, there can be no reasonable expectation that it will be tending to operate according to its averages in 100 games — or even 1,000 games; or even 10,000 games.

An individual player will almost certainly not play a sufficient number of games to have any reasonable expectation of experiencing the ‘set’ Player Return Percentage.

This is why, in the long term, the machine will always win.

WHERE TO GET HELP

If you think you or someone you know has a gambling problem there are lots of services available to help.

Gambling Help is a free and confidential help line for people affected by gambling problems

And Gambling Help Online is an online service that has resources and support available.

9.10 Appendix J: Understanding Independence of Events (IE)

Independence of Events (Adolescents)

Tim is on a night out with a group of friends. Although he has money to spend, he would feel more comfortable if he had a bit more. His group arrives at a venue that has electronic gaming machines (pokies).

He decides he is going to play the machines in the hope of winning some money. Now he must decide which machine to play.

Suppose machines A, B, C, and D are vacant and Tim knows the following:

Machine A: Someone just lost $800
Machine B: Someone just won $800
Machine C: He has won big on this machine before.
Machine D: He has lost big on this machine before.

Tim has already decided that he is going to play one of the machines; he just needs to decide which one.

Using the scale below, please indicate how much you agree with the following statements.

	Strongly Disagree				Neutral				Strongly Agree
Tim should choose machine A	1	2	3	4	5	6	7	8	9
Tim should choose machine B	1	2	3	4	5	6	7	8	9
Tim should choose machine C	1	2	3	4	5	6	7	8	9
Tim should choose machine D	1	2	3	4	5	6	7	8	9

Independence of Events (EGM gambles)

Imagine yourself on a night out with a group of friends. Although you have money to spend, you would feel more comfortable if you had a bit more. Your group arrives at a venue that has electronic gaming machines (pokies).

You decide you are going to play the machines in hope of winning some money. Now you must decide which machine(s) to play.

Suppose machines A, B, C, D, E and F are vacant and you know the following:

Machine A: Someone just lost $800
Machine B: Someone just won $200
Machine C: Someone just lost $250
Machine D: Someone just won $700
Machine E: You have won big on this machine before
Machine F: You have lost big on this machine before

You have already decided that you are going to play one of the machines; you just need to decide which one.

Using the scale below, please answer the following questions as honestly as you can.

	Highly unlikely				Neutral				Highly likely
How likely are you to play machine A?	1	2	3	4	5	6	7	8	9
How likely are you to play machine B?	1	2	3	4	5	6	7	8	9
How likely are you to play machine C?	1	2	3	4	5	6	7	8	9
How likely are you to play machine D?	1	2	3	4	5	6	7	8	9
How likely are you to play machine E?	1	2	3	4	5	6	7	8	9
How likely are you to play machine F?	1	2	3	4	5	6	7	8	9

9.11 Appendix K: Understanding Long-term Negative Expected Payoff (NP)

Negative Expected Payoff (Adolescents)

Tina and her friend Ben are at the pub playing the electronic gaming machines. They have both been playing for one hour. Tina is really excited because she just won $1000 on her machine. Ben has not had much luck and has lost $200 on his machine.

Ben has been going through a tough time lately, he lost his job, and could really use some extra cash. He is deciding whether or not he should stop playing, or continue playing in the hope of winning some money like his friend.

	Highly Unlikely (stop playing!)				Neutral				Highly Likely (keep going!)
How likely would you be to recommend Ben keeps playing?	1	2	3	4	5	6	7	8	9

Negative Expected Payoff (EGM gamblers)

Tina and her friend Ben are at the pub playing the electronic gaming machines. They have both been playing for one hour. Tina is really excited because she just won $1000 on her machine. Ben has not had much luck and has lost $200 on his machine.

Ben has been going through a tough time lately, he lost his job, and could really use some extra cash. He is deciding whether or not he should stop playing, or continue playing in the hope of winning some money like his friend.

	1 Highly Unlikely	2 Unlikely	3 Somewhat Unlikely	4 Somewhat Likely	5 Likely	6 Highly Likely
How likely would you be to recommend Ben **keeps** playing?	1	2	3	4	5	6
How likely would you be to recommend Ben **stops** playing?	1	2	3	4	5	6

9.12 Appendix L: Descriptive data for adolescent IE and NP scores at all time points

Adolescents' IE Mean scores over time

	T1		T2		T3		T4	
	N	**M (SD)**	**N**	**M (SD)**	**N**	**M (SD)**	**N**	**M (SD)**
RA	56	1.38(1.41)	53	1.32(1.49)	6	1.50(1.68)	7	0.74(1.14)
OI	52	1.40(1.30)	50	1.04(1.30)	2	0.00(0.00)	2	1.73(2.45)
CM	56	1.51(1.41)	53	1.28(1.44)	6	0.33(0.51)	5	0.76(1.05)

Adolescents' NP Mean scores over time

	T1		T2		T3		T4	
	N	**M (SD)**	**N**	**M (SD)**	**N**	**M (SD)**	**N**	**M (SD)**
RA	56	2.55(2.72)	53	2.17(1.70)	6	2.50(2.81)	7	1.29(0.76)
OI	52	2.31(1.88)	50	2.40(1.86)	2	1.00(0.00)	2	5.00(0.00)
CM	56	2.11(1.61)	53	2.19(1.86)	6	1.83(1.60)	5	2.20(1.80)

9.13 Appendix M: EGM gambler descriptive follow-up data for ECS, IE, and NP

Gamblers' IE Mean scores over time

	T1		T2		T3		T4	
	N	**M (SD)**	**N**	**M (SD)**	**N**	**M (SD)**	**N**	**M (SD)**
RA	26	2.38(1.26)	26	1.73(1.43)	7	1.99(1.25)	11	2.15(0.75)
OI	21	2.43(1.02)	21	1.54(1.36)	7	2.26(0.98)	5	2.06(1.33)
CM	26	2.05(1.52)	26	0.87(1.22)	7	1.63(1.23)	7	1.09(1.37)

Gamblers' NP Mean scores over time

	T1		T2		T3		T4	
	N	**M (SD)**	**N**	**M (SD)**	**N**	**M (SD)**	**N**	**M (SD)**
RA	26	2.12(1.53)	26	1.92(1.50)	7	1.14(0.38)	11	1.73(0.79)
OI	21	1.81(1.44)	21	1.38(0.67)	7	1.43(1.13)	5	1.00 (0.00)
CM	26	1.58(0.95)	26	1.50(1.14)	7	1.57(0.79)	7	1.57(0.79)

Gamblers' ECS Mean scores over time

	T1		T2		T3		T4	
	N	**M (SD)**	**N**	**M (SD)**	**N**	**M (SD)**	**N**	**M (SD)**
RA	26	37.81(4.62)	26	35.77(6.00)	7	33.43(7.09)	11	33.91(6.76)
OI	21	36.95(6.64)	21	33.24(7.55)	7	30.00(9.76)	5	35.80(2.39)
CM	26	35.69(6.64)	26	29.77(6.26)	7	32.14(5.87)	7	28.71(8.06)