

**Behavioural Tracking and the Effects of Responsible Gaming Tools and  
Personalized Feedback in Online Gambling**

**Michael Auer**

<b>List of publications</b> .....	4
<b>Abstract</b> .....	6
<b>Introduction</b> .....	8
<b>Chapter 1: Psychology of Gambling and Psychosocial Impacts of Online Gambling</b> .....	10
1.1 Psychological Models of Gambling.....	13
1.1.1 Addiction Model.....	13
1.1.2 Biopsychosocial Models.....	15
1.1.3 Learning Models.....	16
1.1.4 Cognitive-Behavioural Models.....	17
1.1.5 Psychodynamic Models.....	19
1.1.6 Integrated Models.....	21
1.2 Psychosocial Aspects of Online Gambling.....	23
1.2.1 Characteristics of Online Gambling.....	24
1.2.2 Demographic Characteristics of Internet Gamblers.....	27
1.2.3 Attitudes towards internet gambling.....	27
1.2.4 Motivations of internet gamblers.....	28
1.2.5 Situational Characteristics.....	28
1.3 Risk Factors of Online Gambling.....	29
1.3.1 Accessibility.....	29
1.3.2 Affordability.....	30
1.3.3 Anonymity.....	30
1.3.4 Escape.....	30
1.3.5 Structural Characteristics.....	31
1.4 Social Issues in Online Gambling.....	32
1.4.1 Protection of the vulnerable.....	33
1.4.2 Internet Gambling in the workplace.....	33
1.4.3 Electronic Cash.....	34
1.4.4 Unscrupulous Operators.....	34
1.5 Treatment and Prevention Issues.....	35
1.5.1 Psychological Treatments.....	35
<b>Chapter 2: Responsible Gaming measures in online gambling</b> .....	38
2.1. Voluntary (player choice) limits.....	39
2.2. Self-Exclusion Schemes.....	43
2.3. Personalised Feedback.....	44
<b>Chapter 3: Advantages and Disadvantages of Behavioural Tracking</b> .....	51
<b>Chapter 4: Study 1 -Theoretical Loss and Gambling Intensity: A Simulation Study</b> .....	59
4.1. Method.....	61
4.2. Results.....	63
4.3. Discussion.....	67

<b>Chapter 5: Study 2 -An Empirical Investigation of Theoretical Loss and Gambling Intensity.....</b>	<b>69</b>
5.1. Method.....	69
5.2. Results.....	70
5.3. Discussion.....	77
<b>Chapter 6: Study 3 - Voluntary player choice and limit setting in most intense players.....</b>	<b>80</b>
6.1. Method.....	80
6.2. Results.....	83
6.3. Discussion.....	92
<b>Chapter 7: Study 4 -Is “pop-up” messaging in online slot machine gambling effective as a responsible gambling strategy?.....</b>	<b>98</b>
7.1. Method.....	98
7.2. Results.....	101
7.3. Discussion.....	102
<b>Chapter 8: Study 5 -Testing normative and self-appraisal feedback in an online slot-machine pop-up in a real-world setting.....</b>	<b>104</b>
8.1. Method.....	104
8.2. Results.....	107
8.3. Discussion.....	111
<b>Chapter 9: Study 6 -The use of personalised behavioural feedback for online gamblers: An empirical study.....</b>	<b>116</b>
9.1. Method.....	116
9.2. Results.....	124
9.3. Discussion.....	131
<b>Chapter 10: Conclusion.....</b>	<b>137</b>
10.1. Introduction.....	137
10.2. Key Findings.....	137
10.3. Implications, Limitations and Future Research.....	146
<b>References.....</b>	<b>151</b>

## List of publications

Griffiths, M. D. & Auer, M. (2011). Approaches to understanding online versus offline gaming impacts. *Casino and Gaming International*, 7(3), 45-48.

Auer, M., Schneeberger, A., & Griffiths, M. D. (2012). Theoretical loss and gambling intensity: A simulation study. *Gaming Law Review and Economics*, 16, 269-273.

Griffiths, M. D. & Auer, M. (2013). The irrelevancy of game-type in the acquisition, development and maintenance of problem gambling. *Frontiers in Psychology*, 3, 621. doi: 10.3389/fpsyg.2012.00621.

Auer, M., & Griffiths, M. D., (2013). Voluntary limit setting and player choice in most intense online gamblers: An empirical study of gambling behaviour. *Journal of Gambling Studies*, 29, 647-660.

Auer, M., & Griffiths, M. D., (2013). Behavioral tracking tools, regulation and corporate social responsibility in online gambling. *Gaming Law Review and Economics*, 17, 579-583.

Auer, M. & Griffiths, M. D. (2014). An empirical investigation of theoretical loss and gambling intensity. *Journal of Gambling Studies*, 30, 879-887.

Auer, M. & Griffiths, M. D. (2014). Personalised feedback in the promotion of responsible gambling: A brief overview. *Responsible Gambling Review*, 1, 27-36.

Auer, M., Malischnig, D., & Griffiths M. D. (2014). Is 'pop-up' messaging in online slot machine gambling effective as a responsible gambling strategy? An empirical research note. *Journal of Gambling Issues*, 29, 1-10.

Auer, M., Littler, A., Griffiths, M.D. (2015). Legal aspects of responsible gaming Pre-commitment and personal feedback Initiatives. *Gaming Law Review and Economics*, 19, 444-456.

Griffiths, M. D. & Auer, M. (2015). Research funding in gambling studies: Some further observations. *International Gambling Studies*, 15, 15-19.

Auer, M. & Griffiths, M.D. (2015). Online gaming, regulation, and player tracking. *Lex and Gaming: European Gaming Law Journal*. Located at: <http://www.lexandgaming.eu/>

Auer, M., & Griffiths, M. D. (2015). Testing normative and self-appraisal feedback in an online slot-machine pop-up in a real-world setting. *Frontiers in Psychology*, 6, 339. doi: 10.3389/fpsyg.2015.00339.

Auer, M., & Griffiths, M. D. (2015). The use of personalized behavioral feedback for online gamblers: an empirical study. *Frontiers in Psychology*, 6, 1406 doi: 10.3389/fpsyg.2015.01406.

Auer, M. & Griffiths, M. D. (2015). Theoretical loss and gambling intensity (revisited): A response to Braverman et al (2013). *Journal of Gambling Studies*, 31, 921-931.

## **Abstract**

Interactive technology has helped online gambling to become a more popular leisure time activity over the last decade. Alongside this development, new forms of Responsible Gaming tools such as voluntary limit setting and personalized feedback have been introduced. These interventions require a gambling environment with identified play such as online gambling and card-based land-based gambling. This thesis investigates the effects of personalized Responsible Gaming tools on subsequent gambling behaviour and also introduces a novel measure of monetary gambling involvement (i.e., 'theoretical loss'). Following reviews of the relevant literature and methodologies used, Studies 1 and 2 in Chapters 4 and 5 introduce the concept of theoretical loss, a monetary measure of gambling intensity. Study 1 utilised a simulation experiment and concluded that the theoretical loss is advantageous over bet-size with regard to measuring monetary involvement. Study 2 validated the results of Study 1 based on real-world gambling data from a large sample of 100,000 online players. Study 3 is also based on a sample of players from a real-world gambling environment and concluded that the setting of voluntary time and money limits lead to positive changes in gambling behaviour. It was also shown that the effect of time and money limits depended upon the types of games played. For instance, slot players benefited from money limits whereas poker players spent less money playing if they set time limits. Studies 4 and 5 investigated the effects of a pop-up message that appeared after 1,000 consecutive slot games. Both studies showed that only a minority of playing sessions lasted longer than 1,000 consecutive games. Study 4 compared the number of sessions that lasted 1,000 games before the pop-up was introduced with the number of sessions that lasted 1,000 games after the pop-up was introduced. Results demonstrated that the pop-up prompted a small minority of players to cease their playing session. Study 5 investigated a modified pop-up message that was formulated in a motivational way and contained normative information. Almost twice as many players ceased to play as a consequence of the enhanced pop-up message compared to the previous simple pop-up message. This led to the conclusion that the way a message is formulated is a crucial aspect of behavioural change. The hypothesis that self-appraisal messages and normative feedback have an effect on behavioural change was supported.

In Study 6, players of an online gambling website who had voluntarily signed up to a behavioural feedback system (i.e., *mentor*) were subject to analysis. These players received elaborate visual and numerical information concerning the past six months of their gambling behaviour. The player front-end – which displayed various types of information (losses, types of games played, playing duration, etc.) – was in line with Human-Computer-Interaction (HCI) principles. Results indicated that the personalized feedback system achieved the anticipated effect and that the time and money spent gambling was significantly reduced compared to that of the control group. The main results were also validated by additional analysis showing that the individual players reacted similarly with respect to time and money spent when provided with personalized feedback. The studies in this thesis demonstrate for the first time that voluntary limit setting, interactive pop-up messages, and personalized feedback can affect player behaviour positively in a real-world environment. The studies also demonstrate differences among subpopulations of players. It is almost impossible to uncover such insights in laboratory settings or with self-recollected information because a longer history of playing behaviour is necessary in order to extract player profiles. However, this thesis did not consider cognitive information as it was purely based on behavioural tracking data. Also, the data mostly came from one operator and players were not randomly assigned to experimental conditions. Consequently, future research should try to overcome these limitations and combine cognitive and behavioural data.

## **Introduction**

Gambling is a popular activity across cultures. Lottery and land-based casinos are a common form of leisure activity in many countries. With the increasing popularity of the internet a new channel for gambling has been created. Apart from casinos, betting shops and other forms of land-based gambling the same types of games can now also be played online. Online gambling differs in a number of ways from land-based gambling. This includes accessibility, affordability, anonymity and specific features of online games. However online gambling also provides unique opportunities for researchers as the interaction between the player and the operators is can be tracked. This means that for each player the crucial behaviour such as time and wager for each game are stored along with many other useful pieces of information. Whereas many studies in gambling rely on self-recollected information of small samples in laboratory settings, this PhD utilizes objective behavioural information provided by online gambling companies. Tracking data also provide new possibilities with regard to player protection. One area of Responsible Gaming offers players tools to increase responsible play and self-awareness. These tools can roughly be categorised into ‘Voluntary Limit Setting’, ‘Self-Exclusion Schemes’ and ‘Personalised Feedback’. Those tools adhere to the “Reno Model” (Blaszczynski et al., 2004). The Reno model states that the decision to gamble is made by the individual. However the operator’s duty is to provide valuable information to support the player’s decision-making process (i.e., an informed choice). Such tools can only be applied if the player can be identified, and this is the case in online gambling. This PhD studies the effectiveness of these Responsible Gaming tools in real-world online gambling environments.

Chapter 1 of this PhD provides a general overview of the psychology of gambling. However, only a limited number these theories are directly relevant for this PhD as only objective behavioural information is analysed. Chapter 2 introduces Responsible Gaming measures such as spending limits and pop-up messages which are subject to the studies of later chapters. Chapter 3 discusses the advantages and disadvantages of behavioural tracking which is the cornerstone of all the empirical studies in this PhD. It is important to be aware of the disadvantages and limitations as none of the empirical

studies makes use of self-report or qualitative data. All the studies from Chapter 4 to Chapter 9 focus on behavioural tracking of player data in online gambling and the effects of Responsible Gaming tools on subsequent playing behaviour. Study 1 in Chapter 4 introduces the concept of Theoretical Loss which is one measure of monetary gambling intensity and is crucial to all subsequent studies. Study 2 in Chapter 5 argues the validity of study 1 via the application of the concept to real world data. Study 3 in Chapter 6 investigates the effects of voluntary limit setting on money and time spent in a real world gambling environment. One of the crucial questions of this PhD is whether personalized feedback impacts gambling behaviour. Dynamic pop-up messages are one form of personalized feedback and are subject to detailed analysis in Studies 4 and 5 in Chapters 7 and 8. Study 6 in Chapter 9 represents the most advanced research design and also tests the effects of broader aspects of personalized feedback.

## **Chapter 1: Psychology of Gambling and Psychosocial Impacts of Online Gambling**

This chapter provides an overview of the psychology of gambling. However many theories outlined in are not directly relevant to this PhD as the sole focus of the present studies involves the analysis of objective behavioural data such as money or time spent gambling. Gambling is a popular activity in many cultures. Surveys have shown that most participants gamble infrequently (e.g., Wardle, Sproston, Orford, Erens, Griffiths, Constantine, & Pigott, 2007). Estimates based on survey data from countries all over the world indicate that the majority of people have gambled at some time in their lives (Meyer, Hayer, & Griffiths, 2009; Orford, Sproston, Erens, & Mitchell, 2003). Wardle, Griffiths, Orford, Moody, Volberg (2012) report that over two-thirds of the British population participate in some form of gambling over the past year. This includes offline and online gambling. The prevalence rate for online gambling (bingo, casino-style games) increased from 3% to 5% in Britain from 2007 to 2010. In 2013, Gambling Disorder was newly classified as a behavioural addiction to the latest (fifth) edition of the American Psychiatric Association's and Statistical Manual for Mental Disorders (DSM-5; American Psychiatric Association, 2013). Also included in the Appendix of the DSM-5 was another potential behavioural addiction – Internet Gaming Disorder. Pathological gambling results in adverse social, psychological, financial, and legal consequences that include depression, suicide, divorce, unemployment, and homelessness (Petry, 2005)

A common risk factor of problem gambling is getting a big win early in an individual's gambling history (Griffiths, King, & Delfabbro, 2013). It is thought that many problem gamblers are motivated to relive this winning experience (Griffiths & Wood, 2010). Impulsivity has also shown to be higher in internet and non-internet gamblers compared to non-gamblers (Griffiths Parke & Derevensky, 2011). Wardle, Moody, Spence, et al. (2010) included the first standardized measure of gambling motives – the Reasons for Gambling Questionnaire (RGQ) – in a national prevalence survey. The RGQ includes

five motivational factors: enhancement, recreation, social, coping and money. Canale, Santinello and Griffiths (2015) validated the RGQ using the 2010 British Gambling Prevalence Survey and reported that the recreational and motivational items loaded most strongly. They also showed that recreational and motivational motives were higher among mixed-mode gamblers (gamblers who play on the internet as well as in land-based venues) compared to land-based only gamblers (gamblers who only play in land-based venues only). A South-Korean online gambling study by Lee, Chung, and Bernhard (2014) questioned whether different types of gambling motivations are associated with different types of passion and different types of passion lead to different types of gambling consequences. They found that intrinsic gambling motivations (e.g., gambling for excitement) are related to harmonious passion, which in turn results in positive consequences. Positive consequences were categorized as “exciting”, “reducing stress”, “comfortable” and “pleasant”.

Gambling has undergone a “profound transformation” (Reith, 2003). From being regarded as economically marginal, politically corrupt and morally dubious, at the start of the 21<sup>st</sup> century, it has become a global phenomenon in Europe, North America, and Australasia. Formerly banned in Singapore, 44% of Singapore residents aged above 18 years report to have participated in at least one form of gambling in 2014 (National Council on Problem Gambling, 2015). Technological trends have heavily influenced gambling and the internet is now offering the possibility to play around the clock, seven days a week. With increased access and high frequency games the internet has the potential to increase gambling related harm (Griffiths, 2003; Griffiths & Parke, 2002). However little is still known about the differences between land-based and internet gambling with regard to problem gambling. Gainsbury, Russell, Hing, Wood, Lubman, and Blaszczynski (2014) report that problem gambling rates among interactive gamblers were three times higher than for non-interactive gamblers. However, problem and moderate risk gamblers were most likely to attribute problems to electronic gaming machines and land-based gambling, suggesting that although interactive forms of gambling are associated with substantial problems, interactive gamblers experience significant harms from land-based gambling.

In a study of online gamblers, McCormack, Shorter and Griffiths (2013) found that the majority of participants also gambled offline, but there was no relationship between problem gambling and whether or not a person also played offline. The same study has also showed that problem gambling was related to certain types of games. Across 32 popular gambling websites, poker was the most popular game. However, those who regularly gambled on poker were less likely to be problem gamblers. Regular gambling on roulette, sports betting, horse racing, and slot machines was associated with problem gambling. Although online gambling has increased, Wardle, Moody, Griffiths et al. (2010) reported that only 2.1% of past-year gamblers gambled online only.

It has further been argued that the addictive potential of games of chance is connected to their features, such as event frequency, payout rate, near wins, etc. (e.g., Griffiths, 1993; Parke & Griffiths, 2007). The classical boundaries between different game-types such as lottery, casino or bingo are slowly disappearing with the advent of new technologies and the hybridisation of games. For many new games it is not always possible to assign them to one of these categories. For that reason it is argued that games should rather be described via their characteristics (such as event frequency, payout rate, near wins, etc.), that also helps to understand their addictive potential (Griffiths & Auer, 2013).

Responsible gambling and player protection have become increasingly researched topics in the gambling studies field. Information about important aspects of gambling has become a cornerstone of responsible gambling that operators regularly offer. Gambling operators regularly display information about such things as the probability of winning or where to get help if the player thinks they may have a problem. Other popular 'information' features include the use of self-diagnostic tests (in which players can assess whether they show any behavioural signs related to problematic gambling) and warning messages (highlighting potential dangers of gambling) (Monaghan & Blaszczynski, 2010a; 2010b). The increasingly advanced technological environments of online gambling also come along with advantages and companies now allow for sophisticated ways of promoting responsible play among gamblers (see study 3;

Griffiths, Wood, & Parke, 2009). For this reason it is not surprising that over the last few years a large number of online gambling sites have incorporated specific responsible gambling measures that are only possible to apply in gambling environments where players can be identified and/or tracked behaviourally. In this thesis the effects of such advanced responsible gaming techniques on players' behaviour are empirically investigated.

## 1.1 Psychological Models of Gambling

Sociological, psychological and biological processes are all involved in the aetiology of problem gambling. There are various explanatory models of problem gambling which more or less emphasize one or more of these processes (e.g., Lesieur & Rosenthal, 1991; Jacobs, 1986; Blume, 1987; Bergler, 1958; Rosenthal, 1992; Wildman, 1997; Blaszczyński et al., 1986; Carlton & Goldstein, 1987; Rugle, 1993; Comings et al., 1996; Anderson & Brown, 1984; McConaghy et al., 1983; Sharpe & Tarrier, 1993; Ladouceur & Walker, 1996; Rosecrance, 1985a, Rosecrance, 1985b; Ocean & Smith, 1993).

### 1.1.1 Addiction Model

Pathological gambling was formally classified in DSM-III, DSM-III-R, and DSM-IV (American Psychiatric Association, 1980; 1987; 2000) as a disorder of impulse control. In the latest DSM-5 (American Psychiatric Association, 2013) gambling disorder was classed as a behavioural addiction. This model states that problem gamblers are addicted to gambling in the same way that others are addicted to substances. According to the addiction model, gamblers are thought to experience tolerance (the need to bet more and more in order to obtain the same excitement), cravings (a strong physiological desire to gamble), and withdrawal symptoms (anxiety, physiological symptoms) if they cut down or cease on gambling.

The addiction model is supported by comorbidity between pathological gambling and substance abuse (Petry, 2005). Similarities in neurobiological activity also suggest

common molecular pathways (Goudriaan et al., 2004). However, associations are correlational and not causal in nature. Most importantly, the disease model of addiction with its biological derivatives argues that problem gamblers are categorically distinct from their non-problematic counterparts as the model points out a biological source for addictions. In addition, a disease model states that these neurochemical adjustments are responsible for measurable tolerance and withdrawal. Rosecrance (1985b) describes the four major components of the disease model:

- There is a single phenomenon that can be labelled “problem gambling”. Problem gamblers are qualitatively different from other gamblers.
- Problem gamblers gradually lose control, and are eventually unable to stop gambling.
- Problem gambling is a progressive condition, beginning with initial success at gambling; then experiencing less success; irrational optimism about winning; psychological distress; chasing losses and possibly engaging in illegal activities to get money to gamble; unsuccessful attempts to cut down or quit gambling; and eventually hitting bottom.
- Problem gambling is a permanent and irreversible condition. The only cure is total abstinence. If the gambler were to resume gambling, all of the symptoms described above would manifest again.

However, an addiction and disease model of gambling is partly controversial. Blaszczynski and McConaghy (1989), for example, mention that there is not a specific kind of pathological gambler, but rather that gambling problems occur along a continuum. This does not support the disease model of gambling addiction. Furthermore, Slutske et al. (2010) showed that nearly all problem gambling recoveries were achieved in the absence of total abstinence. Thus controlled gambling is a common way of recovery. Two U.S. national surveys report that 36%-39% of former problem gamblers did not experience any gambling-related problems in the past year (Slutske, 2006). In a population survey in Ontario (Canada), Suurvali et al. (2008) found that only 6% of gamblers had accessed a service, including a self-help group or self-help materials. The latter findings do not support the disease model of gambling which

claims absolute abstinence as the only way to cope with the disease. Recovery without treatment also contradicts the disease model.

### 1.1.2 Biopsychosocial Models

Models that emphasise psychological as well as biological aspects are another approach towards the understanding of problem gambling (Westphal, 2008; Goudriaan et al., 2004; Skitch et al., 2004; Sharpe, 2004; Blaszczynski et al., 1986; Carlton & Goldstein, 1987; Lesieur & Rosenthal, 1991; Rugle, 1993; Comings et al., 1996). These models also state there are underlying biological traits and thus position themselves next to the disease models. Biological models are supported by similarities in neurobiological activity and genetic abnormalities found among gamblers and those who are substance dependent involving cortico-meso-limbic brain structures. These findings suggest common molecular pathways (Goudriaan et al., 2004). The significance of neurobiological mechanisms has been highlighted in several studies (e.g., Meyer et al., 2000; Potenza, 2001; Sharpe, 2002). Neurotransmitter genes and multiple neurotransmitters are believed to play a major role in mediating acute reinforcement effects in the brain (Comings et al., 2001; Potenza, 2001).

Meyer et al. (2004) compared groups of problem gamblers to a control group (of non-gamblers) when playing cards (but not for money) and found that the heart rate and cortisol levels increased significantly in the problem gamblers compared to the controls. This suggests that biochemistry in certain individuals contributes to the maintenance of gambling addiction, therefore supporting the biological approach. Westphal et al. (2008) concluded that pathological gambling may be related to a dimension of impulsivity and obsessive-compulsive disorders. This relationship prompted trials of medications shown to be efficacious with obsessive-compulsive disorder, such as the selective serotonin reuptake inhibitors (SSRIs). Other classes of medication such as opioid antagonists, mood stabilizers, and other antidepressants, have also shown promise in the treatment of pathological gambling. Pathological gambling may be a syndrome that includes features

of affect instability, impaired cognitive control of impulses, and addiction (Westphal et al., 2008).

Sharpe (2004) utilized a model to reformulate a cognitive-psycho-biological model of problem gambling. Sharpe's model posits that genetic vulnerability in the presence of negative early environments translates into impaired cognitive choices. This is operationalized by negative interactions involving the dopaminergic or reward system and the serotonergic or inhibitory system. Negative early environments favour immediacy and impulsivity (and thus relate to problem gambling). The model suggests that these psychological and biological vulnerabilities are especially sensitive to early gambling experiences such as early wins and imprinted cognitive biases resulting in behavioural patterns being established (Nussbaum et. al, 2010).

### 1.1.3 Learning Models

The basic concept of learning models is that gambling is a behaviour governed by contingencies of reinforcement operating under operant and classical conditioning mechanisms (Brown, 1987). Whereas earlier research focused on monetary reinforcement, recent research cites physiological arousal as one of the main components of the operant conditioning although other types of reinforcement can occur (e.g., social reinforcement) (Clark et al., 2012).

Skinner (1953) hypothesized that problem gambling is a function of the individual reinforcement history. With experiments on rats and pigeons he showed that gambling behaviour continued although the reinforcement schedule declined (less winnings). Later, Custer (1984) emphasized the importance of an early big win in the development of gambling problems. The reason for continued gambling could lie in the effectiveness of intermittent reinforcement schedules. Players are persistent because eventually they will win. These rare wins facilitate and reinforce continued gambling. On the other hand, states of physical arousal can be responsible for continued gambling. Brown (1987) incorporated these physical aspects into the social learning model. In addition to

arousal, Brown (1987b) proposed that there are six mechanisms involved in the development of gambling problems:

- Affective states, like anxiety or depression
- Cognitive distortions about gambling
- Behavioural reinforcement schedules
- Social and institutional determinants, such as the opportunity to gamble
- Subcultural conditions, such as the prevailing attitude toward gambling, and the prevailing values of the individual's social context and reference groups.
- Internal fantasy relationships with personifications such as 'Lady Luck' and the gambler's parents

In the learning model, gambling is acquired through a complex interaction between internal and external factors. In contrast to the binary view of the disease model, the learning model assumes a continuum from problem-free gambling to various degrees of problem gambling. There are no fixed stages of problem gambling and there are no irreversible or permanent states. Stein (1989) added that problem gambling might result from a failing development of problem-solving strategies at the transition from adolescence to adulthood.

#### 1.1.4 Cognitive-Behavioural Models

According to Ferris, Wynne and Single (1999), the cognitive-behavioural model is one of the best developed learning models. It assumes that behaviour is a consequence of imitation, observational learning, schedules of reinforcement, and cognition. Sharpe and Tarrier (1993) proposed that gambling behaviour is a consequence of both classical and operant conditioning. Additionally, cognitions play an important role as players develop a system of cognitive misbeliefs that support continuous gambling. Whether the player continues to gamble depends on their ability to control increased arousal, analyse distorted cognitions, delay reinforcement, and apply problem solving and coping skills

(Sharpe & Tarrier, 1993). Various studies have stressed the fact that problem gamblers are characterized with a lack of coping skills (McCormick, 1994; Farrelly et al., 2007).

The cognitive-behavioural model emphasizes erroneous beliefs, cognitive distortions and misunderstanding of concepts related to randomness, probabilities and mutual independence of chance events, and drawing faulty causal associations between events (Ladouceur & Walker, 1996; Petry, 2005). Although the origin of irrational and erroneous cognitive beliefs and schemas remains unknown, social learning experiences exposure to familial and peer-related gambling, media representations, religiosity and cultural influences, and personal experiences have all been hypothesized to play significant roles (Blaszczynski & Nower, 2002; Griffiths, 1994; Petry, 2005).

Cognitive factors that underpin persistence in gambling include: the gambler's fallacy (belief that a win is due following a series of losses); cognitive regret (regret over ceasing prematurely and missing out on the next win); and entrapment or chasing losses (motivation to maintain a course of action having already invested so much to date). In relation to slot machines, studies have shown that frequent gamblers show higher levels of erroneous beliefs (Griffiths, 1994; Strickland et al., 2006). Regular slot machine gamblers believe that there is a significant level of skill at slot machine gambling. They are more prone to the 'illusion of control' as well as the gambler's fallacy. The gambler's fallacy (Winefield, 1966) is a belief that future wins or losses can be predicted on the basis of past events. The illusion of control has been defined as holding an unrealistic belief about one's ability to positively influence an outcome, and therefore win in a chance situation (e.g., Coventry & Norman, 1998; Langer, 1975; Langer & Roth, 1975). Whether skill really improved sports bettors' results was investigated by Cantinotti et al. (2004). They suggested that the information used by bettors, along with near misses, reinforces their perception of expertise. The results of their experiment suggest that the so-called "skills" of the sports bettors are in fact cognitive distortions.

### 1.1.5 Psychodynamic Models

The psychodynamic model proposes that problem gambling is just a way of expressing personal problems. These problems lie within the psyche and are the result of a personal conflict that eventually has to be resolved. Griffiths (1995) states that gambling is a medium for continued enactment (but not resolution) of psychological conflict. There are several psychodynamic theories that attempt to explain psychopathological behaviour and summarized by Griffiths (1995).

- Gambling as an unconscious substitute for masturbation
- Gambling as an unconscious desire to lose and such to be punished
- Gambling as a medium for continued enactment (but not resolution) of psychological conflict.

Rosenthal (1986) also claims that the majority of problem gamblers are narcissistic. They have feelings of inadequacy that lead to the creation of a fantasy world in which gambling is seen as the solution to their problems. This fantasy allows them to feel important, respected, powerful and independent, and many gamblers report such feelings of power and respect while 'in action'. Rosenthal notes that the narcissistic personality is susceptible to swings of arousal and depression, and that gambling behaviour is an attempt to regulate these swings. Related to the psychodynamic model is the personality (i.e., trait) theory of gambling.

A great deal of research has been directed towards the identification of personal traits that may be related to problem gambling (Ferris, Wynne & Single, 1999). Problem gambling has been linked to high scores of depression (Blaszczynski & McConaghy, 1989) although it is unclear whether depression is a reason or a consequence of problem gambling. Various studies have pointed out correlations between problem gambling and personality traits (Wildman, 1997; Taber et al., 1987; Griffiths, 1995; Selzer 1992; Knapp & Lech, 1987). Concepts like the psyche and the unconscious are speculative and theoretical which makes the model untestable. Furthermore, much of the evidence is based on single case histories and elaborate conjecture (Ferris, Wynne & Single, 1998).

#### 1.1.5.1 Gamblers with mood disorders

Blaszczynski et al. (1986) have argued that at least two subsets of gamblers exist who differentially seek to reduce or augment arousal states. Reducers suffer anxiety and select low skill activities to narrow their focus of attention and produce states of dissociation, while augmenters may choose high skill games to overcome states of dysphoria, a view consistent with Jacobs' general theory of addictions (Jacobs, 1986). Farrelly et al. (2007) also describe two types of gamblers. Those with confrontative coping strategies and those with distancing tendencies. Both mood states lead to problem gambling. Gamblers who tend to distance themselves also have increased degrees of depression and dissociation. Depression has also shown to be a frequent comorbidity among problem gamblers (Graham & Lowenfeld, 1986; McCormick, 1994; Castellani & Rugle, 1995). Furthermore a group of action seeking gamblers, who are in a state of hypertension and unable to relax have also been identified (Custer, 1984; Peck, 1986; McCormick & Taber, 1987)

#### 1.1.5.2 Binge Gambling

Binge gamblers show irregular episodes of problem gambling. Long periods of no gambling are followed by binges that can be very costly financially, emotionally and damaging to relationships. There is an illusion of being in control that is a function of the ability of extended periods of not gambling. Griffiths (2006) presented a case study of a problem gambler who's gambling occurred in binges. He states that the gambling was caused by significant events (e.g., relationship breakup) and lasted for a short period of time. When the underlying reason for the gambling was dealt with the gambling disappeared. This form of gambling is less serious, yet it can cause extensive problems. Nower and Blaszczynski (2003) developed a 6-item screening measure for binge gambling. Binge gambling is supposed to start with a sudden, uncontrollable urge to gamble (Nower & Blaszczynski, 2003). This screening instrument was re-investigated by Gupta et al. (2013).

### 1.1.6 Integrated Models

In response to the multiplicity of environmental, familial and intrapsychic variables identified, several integrated explanatory models have been advanced. The most influential of these are highlighted in the following sections.

#### 1.1.6.1 Pathway Model of Problem Gambling

None of above described explanatory models can explain all forms of problem gambling. Learning models (e.g., Dickerson, 1979) that assume reinforcement schedules to be the single most important aspect fail to explain those gamblers that do not lose control of their gambling behaviour. Cognitive models (Sharpe & Tarrier, 1993; Ladouceur & Walker, 1996) emphasize irrational schemas. However, these do not seem to be causal. The pathway model of problem gambling (Blaszczynski & Nower, 2002) is a multidisciplinary model taking into account biological, psychological, sociological, and ecological variables. The model assumes that pathological gamblers represent a heterogeneous group that could be subtyped according to underlying motivation and benefits derived from gambling.

Various research findings point towards distinct groups of problem gamblers (Rugle, 1993; Steel & Blaszczynski, 1998; Gonzalez-Ibanez et al., 2009). The pathway model differs between three types of gamblers: (i) behaviourally conditioned problem gamblers, (ii) emotionally vulnerable problem gamblers and (iii) antisocial impulsivity problem gamblers.

#### *Behaviourally conditioned problem gamblers*

Essentially, these gamblers fluctuate between the realms of regular/heavy and excessive gambling because of the effects of conditioning, distorted cognitions surrounding probability of winning, and/or a series of bad judgments or poor decision-making rather than because of impaired control (Blaszczynski & Nower, 2002). This group of gamblers may also engage in alcohol abuse, chasing, and suffer from anxiety as well as

depression. Most importantly, these aspects are the consequence not the cause of the gambling.

#### *Emotionally vulnerable problem gamblers*

In addition to conditional learning, the distorted beliefs and the ecological environment this group of gamblers suffers from premonitory anxiety and depression as well as poor coping and problem solving skills and a dysfunctional family background.

#### *Antisocial impulsivist problem gamblers*

This group describes highly disturbed individuals suggesting neurological and neurochemical dysfunctions. Similar to the emotionally vulnerable gamblers, this group possesses psychosocial as well as biological vulnerabilities. Clinically, gamblers with a background history of impulsivity engage in a wider array of behavioural problems independent of their gambling, including substance abuse, suicidality, irritability, low tolerance for boredom, and criminal behaviours (Blaszczynski & Nower, 2002).

The three subtypes of gamblers show different pathways towards pathological gambling. The model partly explains which factors are involved and consequently helps find appropriate counter measures. The validity of the pathways model was re-investigated among a cohort of 109 adolescent problem gamblers and the pathways model was found to be valid (Gupta et al., 2013).

#### 1.1.6.2 Other integrated approaches

Donati et al. (2013) integrate cognitive, dispositional, and social factors into a single perspective as predictors of gambling behaviour. Sensation seeking and superstitious thinking were consistent predictors across gender, while probabilistic reasoning ability, the perception of the economic profitability of gambling, and peer gambling behaviour were found to be predictors only among male adolescents, whereas parental gambling behaviour had a predictive power in female adolescents (Donati et al., 2013). Nussbaum et al. (2010) describe an eight component decision-making model of problem gambling.

Their model is an integrative attempt that incorporates potential causal factors across levels of organisation. They state that components systematically bias decisions in favour of immediate rewards. Dopamine, testosterone and endogenous opioids favour immediacy, while serotonin and cortisol favour inhibition (Nussbaum et al., 2010).

## 1.2 Psychosocial Aspects of Online Gambling

Online gambling describes ways of engaging in gambling on the internet, mobile devices, or interactive television (Williams et al., 2012). The rise of the internet and mobile devices has arguably changed the landscape for online gambling. First of all, online gambling is subject to complicated and partly unclear regulations. Normally the freedom to provide services in the European Union means that one Member State cannot make a service provider “*subject to restrictions for safeguarding the public interest in so far as that interest is already safeguarded by the rules to which the provider is subject in the Member State where he is established*” (Tony, 2012).

However, a different rule applies in the context of internet gambling. Because of the particular dangers associated with this activity, mutual recognition is not required. If an operator lawfully offers internet gambling services in one Member State it is not assumed that members of another member state will be protected against the risks of fraud and crime in the same way. This means that member states do not have to recognise the controls imposed on the activities of internet gambling providers which are (for example) established in Malta (Auer, Littler, Griffiths, 2015).

Internet gambling has grown greatly since its inception in 1995. All traditional forms of gambling are now widely available online anytime. As already mentioned, the rapidly changing nature of online gambling has left behind policy makers and regulators leaving online gambling partly unregulated. However, over the past few years, a growing amount of research has highlighted the potential risks of online gambling as well as ways to protect vulnerable groups. These findings have yet to be incorporated into regulation.

Another trend that has occurred over the last few years is online social gaming. However there is a lack of a clear definition of online gambling-themed activities opposed to social gaming. Gainsbury, Hing, Delfabbro, and King (2014) proposed a taxonomy to distinguish between many types of online activities with gambling-themed content. This taxonomy suggests that the principal features that differentiate online gambling games include the requirement for payment, the role of skill, the type of platform and the centrality of the gambling theme. In a study of ten adult users of social casino games, Gainsbury et al. (2014) found that the involvement in social casino games did not appear to affect the likelihood of gambling or the risk of problem gambling. However, some people did report that the games could sometimes trigger the desire to gamble. Furthermore, social games were commonly perceived as safe activity.

### 1.2.1 Characteristics of Online Gambling

The American Gaming Association (2008) reported that 2% of the American population engaged into internet gambling in 2007. The U.K. Gambling commission reported that 8.6% of the population gambled on the internet in 2009 and the Ministry of Community Development Youth and Sports in Singapore (2008) reported that 1% of the population gamble on the internet. *RSe Consulting* (Ranade, Bailey, & Harvey, 2006) reported that half of all Internet gamblers are from Asia, one-third are from the United States, and one-quarter from Europe. Back in 2008, poker appeared to be the preferred online game by both Canadians and the international community (Wood & Williams, 2008). Furthermore, playing poker online rather than other games of chance has been linked to problematic gambling (Gaming Intelligence Group, 2007). In their study of gender differences in online gambling, McCormack et al. (2014) reported that compared to males, females tended to play for shorter time periods, had different motivations (i.e. practice for free and to spend less money out of boredom), and experienced increased levels of shame.

A number of studies have noted that there the prevalence of problem gambling is higher amongst those that gamble on the internet compared to those who gamble in land-based venues only (Griffiths & Barnes, 2008; Griffiths, Wardle, Orford, Sproston, & Erens, 2009; Wood, Williams, & Lawton, 2007; Petry, & Gonzalez-Ibanez, 2015; Dowling et al., 2015). A few empirical studies have explicitly compared internet and land-based gambling in nationally based studies (i.e., Gainsbury, 2015a; Griffiths, Wardle, Orford, Sproston, & Erens, 2009). When compared to non-Internet gamblers, Internet gamblers were more likely to be male, relatively young adults, single, well educated, and in professional/managerial employment. Further analysis showed that the problem gambling prevalence rate (using DSM-IV criteria) was significantly higher among Internet gamblers than among non-Internet gamblers (Griffiths, Wardle, Orford, Sproston, & Erens, 2009).

Gainsbury (2015b) recently conducted a literature review focusing on the relationship between internet gambling and disordered gambling. She reported that the reviewed evidence does not suggest internet gambling to cause gambling problems in and of itself. However, the use of internet gambling is more common among highly involved gamblers. Internet gamblers are a heterogeneous group and the usage is moderated by a range of individual, social and environmental factors.

Wardle et al. (2011) also came to the conclusion that drawing a blunt distinction between online and offline gamblers is increasingly problematic. This is because, by and large, individuals who gamble online also gamble offline and tend to regularly take part in a range of gambling activities. Their study demonstrated that the majority of online only gamblers were people who simply used the Internet to purchase their National Lottery tickets online. For this reason, Wardle et al. (2011) stated that there may be a qualitative difference between people who purchase access to certain types of gambling activity online (such as lotteries, football pools and betting with a bookmaker) and those who spend greater amounts of time online playing casino games, bingo or slot-machine-type games. In an experimental study, Cole et al. (2011) found online roulette players to place higher and riskier bets compared to land-based roulette players.

Furthermore gamblers who gambled online in the presence of others made the riskiest bets.

In a systematic review, Kuss and Griffiths (2012a) identified a total of 39 studies that met their inclusion criteria. The prevalence of internet gambling varied significantly across the investigated studies. In general, it appears that 2-6% of the general population gambled on the Internet, with higher prevalence rates in medical and dental patients (7.5%). Young people (i.e., high school and university students) appeared to gamble online most with prevalence rates above 20%. Gainsbury (2015b) reported that the internet gambling prevalence in Australia rose from less than 1% in 1999 to more than 8% in 2011 due to the legalisation of the activity. In secondary analysis of the British Gambling Prevalence Survey 2010, Wardle, Moody, Griffiths et al. (2011) reported that 14% of respondents were past year internet gamblers (7% if purchasing of online lottery tickets was excluded). Of past-year gamblers, only 2% reported that they had only gambled online.

Wardle, Moody, Griffiths et al. (2011) described four groups of gambler: those who gambled in-person (land-based gambling) only, those who gambled online only, mixed mode gamblers – different activities (this includes those who reported gambling on a range of activities both in-person and online, but did not gamble online and in-person on the same activity), and mixed mode gamblers – same activities (they gambled both online and in-person for at least one activity). Problem gambling prevalence (i.e. a DSM-IV score of three or more) was significantly higher among mixed mode gamblers than among in-person only gamblers. Rates were 0.9% for in-person only gamblers, 2.4% for mixed mode same activity gamblers and 4.3% for mixed mode different activity gamblers. Rates of pathological gambling (i.e. a DSM-IV score of 5 or more) were significantly higher also among the latter group, being 3.4% among mixed mode same activity gamblers and in- person only gamblers, rates were 0.8% and 0.4% respectively. Likewise, mean DSM-IV scores were highest among mixed mode different activity gamblers (0.4) and lowest among online only and in-person only gamblers (0.0 and 0.1 respectively).

### 1.2.2 Demographic Characteristics of Internet Gamblers

In their review study, Kuss and Griffiths (2012a) cited a number of studies that have investigated socio-demographic characteristics of online gamblers (Corney & Davis, 2010; Griffiths, Wardle, Orford, Sproston & Erens (2009); Ialomiteanu & Adlaf, 2001; Ladd & Petry, 2002; Petry, 2006; Petry & Weinstock, 2007; Wong, 2010; Wood, Williams & Lawton, 2007). Physical illness, having caring responsibilities both for children as well as for impaired relatives and friends (Corney & Davis, 2010), and being disabled (Corney & Davis, 2010; Wood, Williams & Lawton, 2007) were correlated with gambling on the internet. Kuss and Griffiths (2012a) also found that being male appeared to be strongly associated with gambling on the Internet in numerous studies (Griffiths, Wardle, Orford, Sproston & Erens, 2009; Petry, 2006; Petry & Weinstock, 2007; Wong, 2010). Another risk indicator for internet gambling was being of relatively young age (Griffiths, Wardle, Orford, Sproston & Erens, 2009; Ladd & Petry, 2002; Petry, 2006). Low social involvement as well as being divorced and single were found to be more likely to gamble on the Internet (Corney & Davis, 2010; Griffiths, Wardle, Orford, Sproston & Erens, 2009; Ialomiteanu & Adlaf, 2001). Online gambling was more likely than land-based gambling to be engaged in by higher educated individuals (Griffiths, Wardle, Orford, Sproston & Erens (2009).

### 1.2.3 Attitudes towards internet gambling

Three of the studies that were taken into account by Kuss and Griffiths (2012a) also assessed attitudes (Corney & Davis, 2010; Griffiths, 2001; McCormack & Griffiths, 2013). In 2001, Griffiths investigated a representative sample of UK residents' attitudes towards gambling. A total of 8% viewed gambling on the internet more addictive than gambling offline, 5% viewed it healthier, 9% more dangerous, 13% less unregulated and 21% more likely to attract children. In a qualitative interview study including 40 adults (McCormack & Griffiths, 2013), of which 14 were offline and 15 were online gamblers, Internet gambling was generally perceived to be more addictive than offline gambling. Using the Internet for gambling was likewise viewed as increasing the

prevalence of problematic gambling. In qualitative interviews female Internet gamblers revealed that they viewed the Internet as less dominated by males relative to traditional land-based gambling (Corney & Davis, 2010). In sum, researching into people's attitudes about gambling on the Internet sheds light upon why they prefer the Internet to traditional land-based venues.

#### 1.2.4 Motivations of internet gamblers

Kuss and Griffiths (2012a) found five studies (Corney & Davis, 2010; Griffiths & Barnes, 2008; Matthews, Farnsworth, & Griffiths, 2009; Wong, 2010; Wood & Griffiths, 2008) to have assessed the motivations for gambling on the Internet. Two samples of UK university students questioned by Mathews et al. (2009) found online gambling fairly energetic and exciting and they were enthusiastic about doing it. Griffiths and Barnes (2008) found that peer and family behaviour played an important role for reasons to gamble online. A group of 24 online poker players reported to gamble online because it was convenient, easy to learn, and the stake sizes were relatively low. Escaping boredom and enabling social interactions with others (Wood & Griffiths, 2008) were other reasons for poker players to play online. Fun and social activity were mentioned by female gamblers as reasons to play online (Corney & Davis, 2010). Kuss and Griffiths (2012a) concluded that the findings with regards to motivations to gamble online indicate that in general, gambling on the Internet is an enjoyable pastime activity, and which includes a social component.

#### 1.2.5 Situational Characteristics

Kuss and Griffiths (2012a) found three studies to refer to the physical and social environments individuals find themselves in while gambling online (i.e., Cole, Barrett, & Griffiths, 2011; McBride & Derevensky, 2009; Valentine & Hughes, 2008). Cole et al. (2011) conducted an experiment including 38 university student gamblers. They found that the presence of other people during gambling resulted in more chips per bet being made and riskier bets over all. Also, the physical environment seems to play an important role. McBride and Derevensky (2009) found that those people who gambled

from school or work were more likely to have gambling problems. Valentine and Hughes (2008) found that gambling online in the workplace was relatively uncommon and that a majority of Internet gamblers gambled alone (59%). Moreover, it was found that some individuals rearranged their relational lives in order to fit their gambling behaviours (Valentine & Hughes, 2008). Kuss and Griffiths (2012a) concluded that it seems valid to claim that situational characteristics have an impact on gambling behaviour.

### 1.3 Risk Factors of Online Gambling

According to Griffiths (2003) there are a number of characteristics that make online gambling risky. Those are among others accessibility, affordability, anonymity and specific features of online games.

#### 1.3.1 Accessibility

Accessibility to gambling products directly influences the opportunity to gamble. The number of opportunities to gamble appears to be an important factor in gambling prevalence and the development of problem gambling. For instance, internet gambling prevalence in Australia rose from less than 1% in 1999 to more than 8% in 2011 due to the legalisation of the activity (Gainsbury, 2015b). Accessibility to the internet is high in developed countries. Also numerous legal as well as illegal internet sites exist. Those sites offer all sorts of games ranging from lottery, poker to casino games. Many sites also offer table games with live dealers. In a large scoping study, McCormack and Griffiths (2013) noted that another structural characteristic of internet gambling is that players can engage in multiple sessions, playing several games at the same time, which is not easily possible in land-based gambling. Internet gambling also tends to be a more continuous activity because players do not have to wait long for further gambling sessions to begin.

### 1.3.2 Affordability

Griffiths, Parke and Wood (2006) report that through the saturated markets and the high competition among online operators, gambling is becoming increasingly affordable. Also, online operators offer their customers attractive bonuses based on stakes and loyalty programs that are standard features at renowned operators. Players can also choose from various stakes starting at as low as 1 cent (€). Betting exchange sites offer very attractive odds as there is no 'mark up' on the betting odds or 'house advantage'

### 1.3.3 Anonymity

Griffiths and Wood (2007) assumed that the anonymity of the internet may provide the user with a greater sense of control of the content, tone and nature of the online experience. Disapproval and judgment are not given in the online setting and for that reason some players might feel more comfortable. Other gamblers who prefer the social interaction might feel less comfortable in the online setting. The latter group might rather engage in social games like poker for that reason. Wood and Griffiths (2008) believe that the anonymity decreases the barrier to gamble, especially for social skill games like poker. A poor performance is not felt as embarrassing in an anonymous context for online gamblers.

### 1.3.4 Escape

Numerous studies point out that there is a group of gamblers who seek to distance themselves and partially to suppress and underlying anxiety. This group of gamblers also prefers to play low skill games. Slot machines (or video lottery terminals, electronic gaming machines or fruit machines) require low levels of skill (if any at all), have a high event frequency, and can cause high levels of dissociation (Noseworthy & Finlay, 2009). In the anonymous context of internet gambling, it is easier to play these kinds of games for longer time periods and experience dissociative states (Stewart & Wohl, 2013). The extent of dissociation increases with increasing severity of problem gambling (Jacobs, 1986; Powell, Hardoon, Derevensky, & Gupta, 1996). This lack of self-control may lead to extended playing sessions with more money lost than planned

(Monaghan, 2009). Griffiths (1991, 1994) reported that the majority of UK slot machine gamblers play on 'automatic pilot'. Griffiths' (1994) research on cognitive biases of slot machine players using the 'thinking aloud' method and also came to similar conclusions.

### 1.3.5 Structural Characteristics

Structural characteristics are game properties that "facilitate the acquisition, development, and/or maintenance of gambling behaviour irrespective of the individual's psychological, physiological, or socioeconomic status" (Parke & Griffiths, 2007, p.212). In a comprehensive scoping study, McCormack and Griffiths (2013) noted that internet gambling has a number of unique structural and situational characteristics compared to offline gambling (e.g. availability, accessibility, comfort, anonymity) The online activities most commonly associated with problem gambling were poker, spread betting, slot machines, and roulette. The results showed that problem gamblers were more likely to engage in two or more activities than non-problem gamblers. This may also be because online gamblers can easily access a wide range of games.

They also observed that on the internet, the event frequency of slot-machines can be up to three times higher compared to land-based slot machines. Online roulette games have very short event frequencies, and for some online games, the actual spin can be skipped that reduces the event duration even more. Typical online gaming sites offer a variety of games that can roughly be categorised into casino games and social and/or skill games like poker. Some operators, mostly monopolists or state licensed operators, also offer lottery type games. Lottery games can be divided into draw games and instant games. It is also specific to Internet operators that players can play several games simultaneously simply by opening several sessions within one operator or playing simultaneously at different operators.

The online environment offers all the characteristics that are correlated with a high addictive potential (Griffiths, 2003). Due to the increased competition between

operators, the payback percentage (i.e., the payout amounts relative to losses), is often very high in online slot machines and is believed to reinforce gambling behaviour (Griffiths, 2003). The single most important feature is the event frequency. This is the time between two games and it can be as low as one second in the online environment. Schultz (2006) assumed an event frequency of two seconds as the optimal reward contiguity of reinforcement.

The technical possibilities of remote gaming means that in-play betting has become reality. It refers to the wagering on an event that has started but has not yet finished. This means gamblers can continue to bet on an event (e.g., a soccer or cricket match) and perhaps more importantly, adapt their bets according to how the event is progressing. For instance, in the UK, during the playing of almost any soccer match, a gambler can bet on everything from who is going to score the first goal, what the score will be after 30 minutes of play, how many yellow cards will be given during the game and/or in what minute of the second half will the first free kick be awarded (Griffiths, 2012b).

What the 'in-play' gambling activities have done is take what was traditionally a discontinuous form of gambling – where a gambler made one bet every weekend on the result of the game – to one where a player can gamble continuously again and again (Griffiths, 2012b). In short, the same game has been turned from what was a low event frequency gambling activity into a potentially high frequency one (and gone from an activity that had little association with problem gambling to one where problem gambling is far more likely among excessive in-play gamblers).

#### 1.4 Social Issues in Online Gambling

As internet gambling is virtually accessible 24 hours a day, psychosocial impacts are an almost inevitable consequence. With the additional risks of internet gambling such as accessibility, affordability, anonymity, vulnerable groups have to be protected.

#### 1.4.1 Protection of the vulnerable

Vulnerable groups such as youth, adolescents, drug/alcohol abusers, and/or problem gamblers would normally be protected in a land-based gaming setting. This is often not the case in the online environment where a face-to-face setting is not given. Griffiths Parke and Derevensky (2011) reported that while virtually all online gambling sites have age restrictions, the enforcement is variable. In a study examining the impacts of internet gambling on adolescents and young adults, Brunelle, Gendron, Leclerc et al. (2008) found that 93.5% of adolescents had gambled in the previous 12 months. Approximately one-third had played free games, and males were more likely to gamble than females. About 3% were problem gamblers and those who gambled on the internet were significantly more likely to be problem gamblers (11%) than those who had not gambled on the internet (1.57%). Those with substance abuse were also more likely to gamble on the internet. Arguably, the convergence of online gambling and online video-gaming poses another risk factor towards adolescents and youth (Yousafzai et al., 2014).

Corney and Davis (2010) found other factors such as physical illness, having caring responsibilities both for children as well as for impaired relatives and friends were risk factors for problem gambling. Internet operators who are licensed in locations like Malta, Gibraltar or similar locations and act from there under EU law of the freedom to provide services do not have to verify if their customers are underage or problem gamblers or in financial trouble. Other operators that are licensed in specific states in Europe have to apply a specific verification processes. They have to check if a person exists and they have check if they are underage (Auer, Littler & Griffiths, 2015). Other aspects such as intoxication, psychological issues, or problem gambling cannot be verified at all.

#### 1.4.2 Internet Gambling in the workplace

Internet gambling is a newer form of gambling in the workplace. In most office settings each and every employee has his/her own PC or Laptop and can easily access internet

gambling sites within the working hours. This of course has potentially large implications on efficiency and productivity.

#### 1.4.3 Electronic Cash

The use of electronic cash in online gambling environments can have psychological impacts on the perceived value of money. It is typical in business to loosen the relationship between expenditure and real money. It is also likely that people spend more if they use electronic cash than real money (Griffiths, 1999). Also, this is one of the reasons why casinos use chips and tokens instead of real money. Tokens and chips are often re-gambled without hesitation as the psychological value is much less than the real value. Evidence would seem to suggest that people will gamble more using e-cash than they would with real cash (Griffiths, 1999). Griffiths (2003) has identified the use of virtual cash, unlimited accessibility, and the solitary nature of internet gambling as risk factors for online problem gambling development. In a study of 40 poker-players, Lapuz and Griffiths (2010) found that participants gambled significantly more with chips than with real cash. In the electronic world, tools like mint.com help people to handle their finances as it is easy to lose track of all types of expenditures (accounts, credit/debit cards, cash, etc.).

#### 1.4.4 Unscrupulous Operators

Distinguishing between trustworthy and unscrupulous operators is difficult for gamblers. Many internet operators operate from remote locations in the Caribbean and lawmakers are not 100% sure about the legal situation of gambling. There are a few main issues that have been described by Griffiths and Parke (2002).

1. *Embedding*: Search engines track users' browsing behaviour and they incorporate that knowledge into future search results. This means that search results returned are based on past browsing behaviour. Internet gambling operators seemingly tag their sites with key words that should make it easier for potential users to learn about their site. They do this via the use of meta-tags. A meta-tag is a command hidden in the

web page to help search engines categorise sites (i.e., telling the search engine how they want the site indexed). Griffiths and Parke (2002) noted that some Internet gambling sites appear to have used the word ‘compulsive gambling’ embedded in their web page. Someone looking for help with a gambling problem will get these sites popping up in front of them. This is a particularly unscrupulous practice, which at the moment is legal.

2. *Circle jerks*: Griffiths and Parke (2002) describe another technique used by both Internet sex and gambling sites. They make use of telescoping windows often referred to as circle jerks. If someone online accesses a particular type of site and tries to get out of it, another box offering a similar type of service will usually pop up. Many people find that they cannot get out of the never-ending of sites and the likelihood of people playing another game might be higher.
3. *Behavioural Tracking*: Loyalty programs and rewards are commonplace in most retail and entertainment businesses. With the advent of e-commerce, customer behaviour can be tracked in much more detail. Operators are analysing their customers’ behaviour and try to offer them better services and products. Of course, these methods can be applied unscrupulous in a way that at-risk, problem, and even pathological gamblers are exploited. Loyalty clubs for high rollers are common in the online gaming market. On the other hand, behavioural tracking can be used responsibly in order to support players and prevent them gambling irresponsibly as their behaviour can be detected by behavioural tracking. Griffiths and Auer (2011) described how behavioural tracking can be utilised to better understand gamblers behaviour in the context of problematic gambling.

## 1.5 Treatment and Prevention Issues

### 1.5.1 Psychological Treatments

Although gambling is mostly regarded as a recreational activity, there are inherit risks involved. Higher risks exist for specific social groups and have been noted in various

studies (e.g., Corney & Davis, 2010; Griffiths, Wardle, Orford, Sproston & Erens (2009); Ialomiteanu & Adlaf, 2001; Ladd & Petry, 2002; Petry, 2006; Petry & Weinstock, 2007; Wong, 2010; Wood, & Williams, 2007, Kuss & Griffiths, 2012a). In other studies there are associations between problem gambling and being male, low social involvement, as well as having caring responsibilities. Also, alcohol abuse and smoking is highly correlated with the onset of problem gambling (Gupta & Derevensky, 1998).

In general, one of the most common symptoms is time distortion (Greenfield, 1999). Greenfield found that online addicts feel a sense of displacement when online and are unable to manage central aspects of their lives. They start to perform poorly at work, neglect their families, and their social involvement decreases significantly. Their lives become more and more preoccupied with gambling. In studies specific to the use of the internet, Young (1998) found that social isolation was directly associated with compulsive internet use in nearly 56% of the investigated cases. However, gambling addicts who also play online should be regarded as gambling addicts not internet addicts. They are gambling addicts using the medium of the internet to fuel their gambling addiction. Therefore, they need to be treated as gambling addicts not internet addicts.

In a review of 68 epidemiological studies Kuss, Griffiths, Karila and Billieux (2014) reported that there is no gold standard of Internet addiction classification and that 21 different assessment instruments were identified. Criteria for substance use disorders or pathological gambling, no or few criteria relevant for an addiction diagnosis, time spent online, or resulting problems have been being applied. The prevalence rate of internet addiction also varies from 0.8% in Italy to 28% in Hong Kong depending on the instruments used and cut-off values applied. The study concluded that there is a need for nosological precision so that those in need can be properly identified and helped.

Researchers have suggested using cognitive-behavioural therapy (CBT) as the treatment of choice for Internet addiction, and addiction recovery in general has utilised CBT as

part of treatment planning. Young (2007) investigated the efficacy of using CBT with Internet addicts. She took into account client motivation, online time management, improved social relationships, improved sexual functioning, engagement in offline activities, and ability to abstain from problematic. The results suggested that clients were able to sustain their symptoms over a 6 months treatment period.

Hedman et al. (2012) conducted a meta-study of internet-based cognitive-behavioural therapy. Evidence status for each clinical application was determined using the American Psychologist Association criteria for empirically supported treatments. They found 103 studies that reported on clinical efficacy and eight on cost-effectiveness. ICBT was effective in the treatment of gambling as well as depression, anxiety disorders, severe health anxiety, irritable bowel syndrome, female sexual dysfunction, eating disorders and cannabis. Compared to face-to-face Cognitive-Behavioural Therapy Internet-based Cognitive-Behavioural Therapy produces equivalent results. Although ICBT is a promising treatment option for several disorders, it can only be regarded as a well-established treatment for depression, panic disorder and social phobia. It seems that ICBT is as effective as conventional CBT for respective clinical disorder, that is, if conventional CBT works then ICBT works. In a personalised feedback study among at-risk gambling college students, Martens et al. (2015) report that simply receiving personalised-feedback about their own behaviour in the absence of clinical contact can have a positive impact in subsequent gambling.

## Chapter 2: Responsible Gaming measures in online gambling

This PhD aims to evaluate whether Responsible Gaming tools such as voluntary limits and personalized feedback have an impact on reducing gambling behaviour. This Chapter introduces the most important Responsible Gaming measures which are currently used by online operators. Over the last decade, responsible gambling (RG) has emerged as a philosophy to help minimise harm caused through increased opportunities to gamble. RG has been successfully applied in land-based gambling venues as well as online gambling. RG encompasses a code of conduct that helps to create a safe gambling environment. Operators and software suppliers alike can apply RG in their line of business. The goal of RG is to protect vulnerable groups and prevent players from running into problems. But are online operators socially responsible? To date, only one peer-reviewed study has investigated to what extent operators are protecting their players. The study by Smeaton and Griffiths (2004) investigated a representative sample of 30 UK-based internet operators. At the time of the study, only half of the internet operators asked if their players were over 18 years. Though only one-third showed some sort of social responsibility practices, almost all of them had credit limits in place. As internet gambling is becoming increasingly regulated across the world, RG practices will improve as operators are forced to incorporate these measures by law. For example, in Europe several countries (e.g., Italy, France, Spain, Belgium, Denmark) have issued licenses for operators to offer their services under their respective laws. What do players think about these RG features and are these features effective?

The Global Online Gambler Survey (International Gaming Research Unit, 2007) conducted for *eCOGRA (eCommerce and Online Gaming Regulation and Assurance)* analysed gamblers opinions (n=10,865) about specific RG features (i.e., self-set spending limits, self-set time limits, self-exclusion, provision of regular financial statements, and self-assessment problem gambling tests). It was reported that 51% to 75% stated that they would consider some RG elements at least 'quite useful'. The most

popular option was receiving regular financial statements with 75% of respondents considering this option to be at least quite useful and the least popular feature was self-set time limit with 51% reporting this as at least quite useful. Those players who were younger, female, gambled out of boredom, and reported losing more money, were significantly more likely to consider RG features to be useful.

Griffiths, Wood, and Parke (2009) studied 2,348 Swedish online gamblers' attitudes towards using the social responsibility tool *PlayScan* (developed by the Swedish gaming company *Svenska Spel*). Over half of *PlayScan* users (52%) said it was useful; 19% said it was not. Many features were seen as useful by online gamblers, including limit setting (70%), viewing their gambling profile (49%), self-exclusion facilities (42%), self-diagnostic problem gambling tests (46%), information and support for gambling issues (40%), and gambling profile predictions (36%). In terms of actual (as opposed to theoretical) use, over half of *PlayScan* users (56%) had set spending limits, 40% had taken a self-diagnostic problem gambling test, and 17% had used a self-exclusion feature.

One area of RG offers players tools to increase responsible play and self-awareness. These tools can roughly be categorised into 'Voluntary Limit Setting', 'Self-Exclusion Schemes' and 'Personalised Feedback'. Those tools adhere to the "Reno Model" (Blaszczynski et al., 2004). The Reno model states that the decision to gamble is made by the individual. However the operator's duty is to provide valuable information to support the player's decision-making process (i.e., an informed choice).

### 2.1. Voluntary (player choice) limits

Social responsibility in gambling has become a major issue for the gaming industry (Griffiths, Wood, Parke & Parke, 2007). To date, there has been little research on the extent to which gaming companies are using social responsibility tools and engaging in socially responsible practices (Griffiths & Wood, 2008). Social responsibility practices within the gambling industry typically involve policies, procedures, and practices that

promote RG and minimise problem gambling (Griffiths & Wood, 2008). A number of the social responsibility tools that have been incorporated by gaming companies have involved innovation in both information technology and technology more generally. In a recent study, Parke and Griffiths (2012) reported that regular gamblers endorse information technology developments as being helpful in reducing negative consequences associated with gambling.

One such social responsibility practice is the opportunity for players to pre-set limits for the amount of time and money they spend on gambling per day and/or per calendar month. This is a practice that is now widespread among online gaming operators (Wood & Griffiths, 2010). Self-limiting options are viewed by some gambling companies and some researchers as a method of putting informed player choice into place at gaming sites (Griffiths & Wood, 2008). Spending limit practices operated by current gaming operators come in a variety of forms. For instance, Wood and Griffiths (2010) reported that players' spending can be restricted in terms of deposit limits, play limits, loss limits, and bet limits. More specifically:

- *Deposit limits* – This refers to the maximum amount of money that a player can deposit into their play account at any given time. Winnings can either be included or excluded from this figure.
- *Play limits* – This refers to the maximum amount of money that a player can actually play with at any given time. As with deposit limits, winnings can either be included or excluded from this figure.
- *Loss limits* – This refers to the maximum amount of money that a player is allowed to lose at any one session.
- *Bet limits* – This refers to the maximum amount of money that can be bet on a single game, or on concurrent games.

In addition to this, Wood and Griffiths (2010) also noted that mandatory limits can either be *fixed* so that all games have the same limit, and/or all players have the same limit, or limits can be *variable* depending upon factors such as the type of game played,

or the demonstrable wealth of the individual player. Furthermore, Wood and Griffiths (2010) have argued that fixed limits do not necessarily encourage and facilitate gamblers to take individual responsibility for managing and monitoring their own gambling expenditure.

In a review of 50 online gambling sites, Lucar et al. (2013) found that monetary limit-setting features have the potential to help gamblers reduce excessive gambling expenditure, albeit over the long run and in conjunction with other responsible gambling measures that elicit self-reflection (e.g., player history reports, responsible gambling and problem gambling information, pop-up messaging, normative feedback). They found deposit limit features were the most common on the websites examined. They also found that daily, weekly, and monthly limit setting options were available. However, they also found that some Internet sites are falling short of their potential. This is partly because monetary limit setting features were seldom promoted on the site, and therefore went unused by players. While online gambling operators provide players with monetary limit-setting options, the majority of sites do not require players to mandatorily set monetary limits. In fact, limit-setting features are often only accessible to players after having registered and deposited funds into their gambling account, and few sites impose limits, either by requiring players to set a limit or set a limit on their behalf.

In case limits are increased, at most sites the value only changes after a specific period of time (typically 24 hours). If limits are decreased, they are changed immediately. This asymmetric setting helps players not to increase their spending limit while gambling. In land-based gambling, voluntary daily, weekly or monthly money limits can only be chosen if player cards are being used. This is the case in Norway and Sweden where the use of player cards is mandatory. A trial of a voluntary player card in Nova Scotia was discontinued in 2014 and a voluntary player card system that also allows the setting of money limits was recently introduced in Victoria (Australia) (Willingham & Dowling, 2015). As for the effectiveness of voluntary money limits very few studies have been conducted. Despite an increasing number of gaming operators utilizing social

responsibility tools and practices, there has been very little empirical research showing that either higher mandatory spend limits or voluntary spend limits are associated with decreased levels of problem gambling in either online or offline settings.

Broda, LaPlante, Nelson, LaBrie, Bosworth and Shaffer (2008) examined the effects of player deposit limits on Internet sports betting by customers of *bwin Interactive Entertainment*. Overall, the study found that less than 1% of the players (0.3%) attempted to exceed their deposit limit. However, Wood and Griffiths (2010) argued that the large mandatory limit (€1,000 per 24 hours and €5,000 per 30 days) may be the main reason for this finding as Broda et al. (2008) noted that the majority of online gamblers never reached the maximum deposit limit. A Canadian study among Nova Scotian video lottery players with player cards found that RG features (including player set spend limits) generally reduced the overall levels of player expenditure (Focal Research, 2007). However, as Wood and Griffiths (2010) note, the specific impact of the player set spend limit was not separated from the impact of the other RG features.

A study of 10,865 online gamblers from 96 different countries by the International Gaming Research Unit (2007) reported that over two-thirds of players (70%) thought that voluntary spending limits would be a useful RG feature. Further focus group work from the same study found that the majority of players were opposed to mandatory spend limits. Bernhard, Lucas and Jang (2006) reported similar findings in their focus groups of Las Vegas gamblers. In this study, mandatory spend limits were strongly opposed, whereas voluntary limits were more widely regarded as useful. However, problem and pathological gamblers who are increasingly losing control of their time and money spending are not susceptible to voluntary RG features. As noted earlier, Griffiths, Wood and Parke (2009) carried out a study among *Svenska Spel* clientele examining players' attitudes and behaviour towards using social responsibility tools among 2,348 online gamblers who completed an online survey. The most useful feature was the setting of spending limits with over two-thirds of respondents (70%) reporting the feature to be 'quite useful' or 'very useful'. Respondents were also asked which

social responsibility features (if any) they had used. Over half (56%) had used spending limits.

## 2.2. Self-Exclusion Schemes

Self-exclusion schemes give problem gamblers the option to prevent further gambling by excluding themselves from gambling venues (both online and offline). Research has shown that individuals do not typically seek help for problem gambling until they reach serious crisis (Suurvali, Hodgins, Cunningham, 2010). Given this, self-exclusion may be an important tool for players to control their spending on gambling. An important aspect for self-exclusion to be effective is the identification of players. This is relatively straightforward in the case of online gambling and especially in such environments where registration is only possible with a thorough identity check. For that reason, self-exclusion is common among online gambling operators.

Self-exclusion is also offered by land-based operators without player cards, but preventing players from re-entering remains difficult. In Europe, where identity checks in land-based casinos are common, patrons can also regularly self-exclude. In Austria, self-exclusion has been offered to casino-players since 1934 (Hayer & Meyer, 2011). For self-exclusion programs to be effective, it is important to be valid across venues and operators. In the newly liberalised online gambling market in Denmark since January 2012 (Sand, 2012), the Danish gambling authority has kept a register of self-excluded individuals that every licensed online gambling operator has to query and thus prevent self-excluded players from engaging into any gambling activity. Self-exclusion is usually offered over different periods of time. Players can choose whether they would like to self-exclude for weeks, months, or forever.

Apart from giving players the possibility to exclude from gambling activities, several jurisdictions (in land-based gambling) also enforce third-party exclusions. This means that operators can ban individuals from playing mostly for welfare related reasons. Singapore is an example where players are excluded from the two existing casinos if

they receive financial aid from the government or have declared bankruptcy. As in the case of mandatory spending limits, this helps problem gamblers from further harm if they are not able to stop gambling themselves. Exclusions initiated by operators are found in land-based gambling environments whereas in online gambling environments players might not be allowed to register if credit checks fail. Mandatory exclusions of active players are not common in online gambling environments. In some land-based gambling environments, exclusions can also be triggered by family members, such as in Singapore. Applications for Family Exclusion Orders do not immediately take action but are reviewed by an official panel.

Research on the effectiveness of voluntary self-exclusion in online gambling is rare. Hayer and Meyer (2011) investigated a sample of 256 internet gamblers who self-excluded and also submitted follow-up surveys one, six and 12 months later. They found that self-exclusion had favourable effect on possible gambling-related problems. While 80% of the participants were classified as potential problem internet gamblers at the time of self-exclusion, this percentage decreased over the following year to 30%. Haefeli et al. (2011) did not directly investigate the effects of self-exclusion but tried to predict future self-exclusion via analysing player correspondence. They were able to correctly predict 76.6% of future self-exclusions. In another study of 347 online self-excluders, results showed no clear distinctive pattern compared to a control group of 306 gamblers who did not self-exclude (Dragicevic et al., 2013). Self-excluders were younger than the control group, more likely to suffer losses, and more likely to adopt riskier gambling behaviours (e.g. bet size per session). Hayer and Meyer (2011) also found players to self-exclude for various reasons (e.g., dissatisfaction with the operator).

### 2.3. Personalised Feedback

Personalised feedback describes the giving of information to players that incorporates their own gambling behaviour. One example is player spending summary reports that are commonly offered by online gambling operators. Players have the possibility to retrieve a summary of their spending over longer periods of time. Other feedback

interventions include dynamic pop-ups that are triggered by behavioural aspects of their gambling behaviour.

Providing specific information in the form of messages to players while gambling (within session pop-ups) is one way of intervening and helping gamblers who play excessively. It is believed that information that is given to people to enable behavioural change should encourage reflection, as research has shown that self-monitoring changes behaviour in the desired direction (e.g., Gilberts, Agran, Hughes & Wehmeyer, 2001; Hardeman et al., 2002; Schwedes, Siebolds & Mertes, 2002). At present, several RG accreditation organisations (e.g., *GamCare*) mandatorily require operators to use pop-ups.

Warning messages are a common form of consumer protection against threats to health and safety (Mayer & Scammon, 1992). They are commonly mandated for display in relation to electronic gaming machines (EGMs), due to the association between this type of gambling and gambling problems (Dowling, Smith, & Thomas, 2005). Experimental studies on gamblers playing slot machines (e.g., Monaghan, Blaszczynski & Nower, 2009; Monaghan & Blaszczynski, 2010a) have shown that giving players messages that encourage self-appraisal (e.g., “*Do you know how long you have been playing? Do you need to think about a break?*”) result in a significantly greater effect on self-reported thoughts during playing sessions and subsequent playing behaviour compared to pure informative messages. Pop-up messaging has also been used to help gamblers set limits while gambling.

Stewart and Wohl (2013) showed that adherence to monetary limits was significantly more likely among participants that received a monetary limit pop-up message compared to participants who did not receive one. In another study, Wohl, Gainsbury, Stewart and Sztainert (2013) simultaneously investigated two RG tools that targeted adherence to monetary limits among 72 EGM (electronic gaming machine) players. These tools comprised an animation-based educational video (used previously by Wohl et al., 2010) and a pop-up message. In this experiment, EGM gamblers were required to

set a monetary limit before commencing play and half the participants were informed when they had reached their money limit via a pop-up message. Both, single and additive effects in addition to possible linear or non-linear interactions were subject to analysis. Confirming previous findings, both RG tools showed the anticipated single effects. A monetary pop-up reminder helped gamblers to stay within the pre-set limits. However, no synergy between the monetary pop-up reminder and the animation-based educational information was found. EGM gamblers that received animation-based information in addition to a monetary pop-up reminder did not adhere to the pre-set limit more often compared to EGM gamblers that only received a monetary pop-up reminder. Another more recent study from the same team also found that pop-up messages can help gamblers keep within their spending limits (Kim, Wohl, Stewart, Sztainert & Gainsbury, 2014).

Studies have also investigated the optimum time at which pop-up messaging should occur within a gambling session. Cloutier et al. (2006) reported the most effective social responsibility feature was a pop-up message after 60 minutes of gambling (compared to 15, 30, and 45 minutes) and resulted in an overall decrease in the length of time spent gambling among players. One study reported that exposure to a warning banner informing players of the randomness of outcomes of video lottery terminal (VLT) games decreased faulty gambling beliefs in both problem and non-problem VLT gamblers (Gallagher, Nicki, Otteson & Elliot, 2011).

An important component of any performed behaviour is self-efficacy. Self-efficacy reflects the extent to which a person feels capable of performing a behaviour, and is the focus of social cognitive theory in which individuals learn by observing the behaviour of other individuals (Bandura, 2001). Furthermore, self-efficacy is central to almost all information-processing models found in the health communication literature including the Theory of Planned Behaviour (Ajzen, 1985), the Health Belief Model (Maiman & Becker, 1974; Janz & Becker, 1984), the Extended Parallel Process Model (Witte, 1992), and Protection Motivation Theory (Rogers, 1983). All of these theories posit that if a message can strengthen self-efficacy beliefs, behavioural change is more likely to

happen. More specifically, these theories posit that for information to change behaviour, the messages must possess efficacy components, including both self-efficacy (the belief that an individual can do an action) and response efficacy (the belief that a recommended action will have a desired outcome for the individual) (Perloff, 2008; Witte, Meyer & Martell, 2001). To change a health behaviour after exposure to a specific message, individuals must believe there is an action that they are capable of carrying out and that the action will help them adhere to the message (Witte et al., 2001). In any form of persuasive communication with the aim of changing behaviour, all of these theories note that it is important to specify which constructs and processes (i) are the most relevant to the target group, (ii) are predictive of the behaviour in question, and (iii) can be influenced to promote the desired change in behaviour (Donovan & Henley, 2010).

Just like other consumption patterns (e.g., drinking alcohol, smoking cigarettes), gamblers may hold the normative belief that others spend as much as or even more than they do themselves. Normative feedback is designed to correct those misconceptions. Normative beliefs have significantly influenced the behavioural outcome in studies getting individuals to quit smoking (Van den Putte, Yzer, Willemsen, & de Bruijn, 2009), use condoms (Yzer, Siero, & Buunk, 2000) and reduce marijuana consumption (Yzer, Fishbein, & Cappella, 2007). In a study of American college student gambling, Celio and Lisman (2014) demonstrated that personalised normative feedback decreased other students' perceptions of gambling and lowered risk-taking performance on two analogue measures of gambling. They concluded that a standalone personalised normative feedback intervention may modify gambling behaviour among college students.

In the use of motivational interviewing, Miller and Rollnick (1991) have also emphasised normative feedback as an important aspect in facilitating behavioural change. In a study investigating personalised feedback interventions (Cunningham et al., 2009) found that participants who received a personalised feedback summary along with other Canadians of the same gender showed a reduction in the amount of money

they spent in a 3 months follow-up survey. Very few online gambling operators offer their players normative feedback.

The main goal of pre-commitment tools is to change human behaviour and yet their designs have only recently been linked to the principles of human–computer interaction (HCI) and persuasive system design (PSD). Wohl et al. (2014) found a HCI and PSD inspired monetary limit pop-up tool to be significantly more effective compared to a tool that did not incorporate these principles. HCI is a field of research that investigates the interaction of people with interactive technology and tries to increase usability and uptake. Persuasive technology has been defined as interactive computing systems designed that attempt to change people’s attitudes and behaviours (Fogg, 2003). Apart from user-feedback, HCI principles relevant for the design of pre-commitment measures are an aesthetic visual design, the incorporation of system-status updates, a sense of control over functionality, and the use of simple language (Hewett et al., 1992; Shneiderman et al., 2009; Preece et al., 2011).

Fogg (2003) outlined seven types of persuasive tools in designing systems that intend to motivate attitude or behaviour change. These are: (i) reduction which states that tasks should be as simple as possible, (ii) tunnelling in which users should be led through a series of steps to achieve their goals, (iii) tailoring in which users are provided with specific design and information, (iv) suggestions which describe interventions at the right moment to suggest action, (v) self-monitoring which empowers users to monitor their own progress toward achieving a desired attitude or behaviour, (vi) surveillance which allows an external party to monitor user behaviour with the intent to motivate change, and (vii) conditioning which employs principles of operant conditioning to bring about change. The principles of PSD have been successfully applied to various domains including obesity (Toscos et al., 2006; Tsai et al., 2007), Borderline Personality Disorder (Rizvi et al., 2011), smoking cessation (Lehto and Oinas-Kukkonen, 2009), and alcoholism (Lehto and Oinas-Kukkonen, 2009; Cohn et al., 2011).

Some researchers argue that early warning signs of problem gambling could be detected in online-gambling environments via analysing player behaviour (e.g., Haefeli et al., 2011). In a real-world study of online gamblers, Braverman et al. (2013) found several risk factors to be highly associated with future problem gambling. Among others, players who engaged in more than two different gambling activities in their first month of gambling and who also demonstrated high variability in their casino wager amounts were eight times more likely to exhibit gambling related problems. The possibility of the detection of early signs related to future gambling related problems naturally raises the question of possible interventions such as appropriate player messages. Such messages could potentially address players who are predicted to develop gambling-related problems and provide helpful advice and assistance. Such messages act in a preventive way.

If future problematic gambling can be predicted, then questions arise as to whether operators are obligated to take action beyond messaging (e.g., banning players). For that reason it has to be clarified that such systems being statistical in nature can never achieve 100% accuracy. Players who will not develop problems in the future will always partly be predicted to do so and vice versa. Consequently such algorithms should not be used as the sole source in leading operators to actively ban players from gambling.

Personalised messages have shown to change behaviour in several areas such as smoking cessation (Stotts et al., 2009; Obermayer et al., 2004), diabetes management (Cho et al., 2009, Farmer et al., 2005) and fitness activity (Buttussi et al., 2006). Personalised messages that address players who exhibit playing patterns that are presumed to be correlated with future gambling-related problems are exceptionally rare among online gambling operators. This might be due to the fact that research in this area is limited and on the other hand sophisticated behavioural tracking systems have to be deployed. On the other hand, the same technologies are being used to entice players to gamble and increase profit. Only two commercially available RG systems (*PlayScan*,

*mentor*) provide these kind of messages and are being used by several European gambling operators.

### **Chapter 3: Advantages and Disadvantages of Behavioural Tracking**

Given that the studies carried out in this thesis solely utilize behavioural tracking data to study the effects of responsible gambling tools and personalized feedback in online gambling, this short chapter introduces behavioural tracking and outlines its main features. It also highlights the advantages as well as the disadvantages of this data-driven approach and how some of the disadvantages can be overcome.

A question that is often asked by policymakers is whether online gambling is more ‘dangerous’ or ‘harmful’ than offline gambling. The answer to this question depends on what the definitions are of ‘harmful’ or ‘dangerous’ or (more importantly) whether online gambling is more harmful or dangerous to particular kinds of people (i.e., problem gamblers). There has been much debate in both the media and academic research outlets related to this question.

There have been a number of different approaches to collecting information about online gamblers. To date, most published studies concerning online gambling have used one of two approaches – behavioural tracking studies (e.g., studies that collect data based on real online gamblers’ data typically supplied by online gaming operators to academic researchers) and self-report studies (e.g., studies that collect data via surveys, focus groups and/or interviews). Studies using self-report methods have tended to argue that problem gambling is more prevalent among online gamblers compared to offline gamblers. Studies using behavioural tracking data have tended to argue that online gambling is no more dangerous than offline gambling. At face value, this suggests that findings (relating to ‘dangerousness’ of the gambling medium) appear to depend upon the methodology used.

Both of these approaches have advantages and disadvantages. Griffiths and Auer (2011) report key differences between these two methods:

- Behavioural tracking data provides a totally objective record of an individual's gambling behaviour on a particular online gambling website (whereas individuals in self-report studies may be prone to social desirability factors, unreliable memory, etc.).
- Behavioural tracking data provide a record of events and can be revisited after the event itself has finished (whereas self-report studies cannot).
- Behavioural tracking data usually comprise very large sample sizes whereas self-report studies are based on much smaller sample sizes.
- Behavioural tracking data collects data from only one gambling site and tells us nothing about the person's Internet gambling in general (as Internet gamblers typically gamble on more than one site)
- Behavioural tracking data always comes from unrepresentative samples (i.e., the players that use one particular internet gambling site) whereas the very best self-report studies (e.g., the *British Gambling Prevalence Surveys* in Great Britain) use random and nationally representative samples
- Behavioural tracking data does not account for the fact that more than one person can use a particular account
- Behavioural tracking data tell us nothing about *why* people gamble (whereas self-report data can provide greater insight into motivation to gamble)
- Behavioural tracking data cannot be used for comparing online and offline gambling or for making comparisons about whether online gambling is safer or more dangerous than offline gambling as data are only collected on one group of people (i.e., online gamblers).
- Self-report methods can be used to compare two (or more) groups of gamblers and is the only method we currently have to infer to what extent one medium of gambling may or may not be more or less safe.
- Some self-report studies have the potential to use nationally representative samples of gamblers whereas behavioural tracking studies rely on self-selected samples of gamblers who use the online gambling website in question.

- Behavioural tracking data tell us nothing about the relationships between gambling and other behaviours (e.g., the relationship between gambling and alcohol or the relationship between gambling and tobacco use).
- Behavioural tracking data cannot examine problem gambling using current diagnostic criteria (whereas self-report studies can). In fact, behavioural tracking data studies cannot tell us anything about problem gambling as this is not a variable that has been examined in any of the published studies to date.

A team of researchers affiliated to Harvard University have been given access to a large behavioural tracking data set of over 47,000 online gamblers by the Austrian gaming company *bwin*. This has led to many papers examining the actual behaviour of online gamblers based on behavioural tracking data (e.g., Broda, LaPlante, Nelson, LaBrie, Bosworth & Shaffer, 2008; LaBrie, Kaplan, LaPlante, Nelson & Shaffer, 2008; LaBrie, LaPlante, Nelson, Schumann & Shaffer, 2007; LaPlante, Schumann, LaBrie & Shaffer, 2008; LaPlante, Kleschinsky, LaBrie, Nelson & Shaffer, 2009; Xuan & Shaffer, 2009). These data have been used to make claims along the lines that online gambling is no more problematic than offline gambling. However, comparative statements relating to whether one medium of gambling is more problematic than another can only be made if actual gambling behaviour is studied across different forms of gambling (e.g., direct comparison of internet gambling with [say] land-based casino gambling).

In a study of 2,259 respondents to a survey at the *bwin.party* internet gambling site, Braverman et al. (2014) compared actual expenditure with estimated expenditure. They found that gamblers were more accurate when asked about short-term (i.e., three-month) losses than long-term (i.e., six-month) losses. Players with gambling related problems showed higher discrepancies between the estimated loss and the real loss (both favourable and unfavourable) than players without gambling related problems. The results did not support any hypothesis towards favourable misperceptions, nor did gambling experience correlate with favourable misperceptions. However, the results clearly show that there is a large discrepancy between estimation and actual behaviour

that in turn clearly supports the use of behavioural tracking data over self-reported information for specific studies.

In contrast to behavioural tracking studies, a number of self-report empirical studies have reported that problem gambling is more prevalent among internet gamblers than non-internet gamblers (e.g., Ladd & Petry, 2002; Wood & Williams, 2007; Griffiths & Barnes, 2008; Wardle et al., 2011; Gainsbury, Russell, Hing, Wood, Lubman, and Blaszczynski, 2014; McCormack and Griffiths, 2013 – these need to be in alphabetical order). However, only two studies have ever compared Internet gamblers and non-Internet gamblers using a nationally representative sample. This was the secondary analysis of the 2007 *British Gambling Prevalence Survey* data (i.e., Griffiths, Wardle, Orford, Sproston & Erens, 2009; 2011). Griffiths, Wardle, Orford, Sproston & Erens (2009; 2011) showed that DSM-IV problem gambling prevalence rate was significantly higher among Internet gamblers than non-Internet gamblers (5% versus 0.5%). However, there are many considerations to take into account. For instance, it may be that the medium of the Internet is a less protective environment for vulnerable players (e.g., problem gamblers).

Wardle, Moody, Griffiths et al. (2011) reported that the majority of online gamblers were also offline gamblers, and that a broader taxonomy of gambling subgroups was needed when comparing online versus offline gamblers. As noted in the previous chapter, this included those who chose different mediums of access for different activities and those who gambled online and offline on the same activity (mixed mode gamblers). These mixed mode gamblers had the highest rates of gambling involvement and higher problem gambling prevalence rates (6.8% of participants were mixed mode gamblers who gambled online and land-based on different activities; 2.3% of this group showed a DSM-IV score of three or more, compared to 0.9% for pure land-based gamblers). Those who used the Internet to gamble, be it online only or mixed mode, fared better on a range of socio-economic indicators than those who were in-person only gamblers. Those who were online only or mixed mode gamblers were more likely to have higher levels of personal income. Over 50% of online only and mixed mode same

activity gamblers were in the highest personal income percentile compared with 36% of those who were in-person only gamblers.

Another possibility that has been subject to academic discussion is the data assisted prediction of problem gambling (e.g., Schellink & Schrans, 2002; Haefeli et al., 2011). Predictive models are complex mathematical formulas that are not transparent to the individual. Using self-excluded players to build predictive models may not be a particularly helpful approach. Self-exclusions can happen for many reasons and are not perfectly correlated with problem gambling. Different reasons might lead to the classification as a risky gambler. However, changes in behaviour can only be achieved if operators provide gamblers personalised feedback about their actual behaviour and specific significant changes that might have occurred. For that reason binary predictive models are neither sufficient in helping players to better understand their gambling, nor are they helping to change behaviour if necessary.

The findings of Lapham et al. (2012) also support this point of view. In their study of web-based alcohol intervention they suggested that feedback needs to be transparent, as participants are nearly universal in their wish to know how they were assigned to their particular risk category. In offline settings using surveys or clinical interview, players can be classified according to screens such as the South Oaks Gambling Screen (Lesieur & Blume, 1987), DSM-IV (American Psychiatric Association, 2000), and/or the Canadian Problem Gambling Index (Ferris, 2001). However, in real gambling settings, gaming operators only observe players' gambling behaviour. Griffiths and Whitty (2010) have described the drawbacks of online behavioural tracking compared to self-reflected information.

When it comes to RG, players should be handled individually, taking into account their individual gambling behaviour. Furthermore identification of playing patterns is not enough. In order to change behaviour, online gaming operators have to communicate with their players. Consequently, behavioural tracking tools (e.g., commercially

available tools like *mentor* (*neccton ltd.*) and *PlayScan* (*PlayScan AB*), or company-developed tools like *Observer* (888) can help in this regard.

Behavioural tracking tools tend to be customer-centric that supports players' gaming decisions. Some of these tools provide players with personalised information about their gambling behaviour. Such systems typically utilise personalised behavioural tracking data in order to give personalised feedback. Here are some of the main reasons why behavioural tracking can be important to online gaming operators.

- *The psychology of gambling*: Players have different motivations for gambling. Some players gamble primarily to relax, whereas other gamblers seek action and excitement. (Meyer, Hayer & Griffiths, 2009). These, along with several other motivators, lead to specific playing patterns. Behavioural tracking tools can help extract those patterns and advise gamblers accordingly about how they can change their behaviour if they so wish.
- *Motivational self-efficacy enhancement*: Studies have shown that messages during or after play have beneficial harm minimisation effects on gambling behaviour (Monaghan, 2009; Monaghan & Blaszczynski, 2007; Monaghan & Blaszczynski, 2010a, Monaghan & Blaszczynski, 2010b). The best tools should be able to personalise communication with players. Such communication plans should be based on the concept of motivational interviewing, that has proven to be successful in a wide range of areas for instigating behavioural change.
- *Recovery in the absence of abstinence*: Studies have shown that up to 90% of recovered problem gamblers still occasionally gamble. Behavioural tracking tools should aim to keep gambling safe and fun (Slutske et al., 2010). However, such systems should also support the small percentage of gamblers who financially (or temporally) overextend themselves.
- *Identification of high-risk sub-groups*: Behavioural tracking tools should be able to identify subgroups of gamblers and provide gamblers with the right information at the right point in time. Furthermore, personalised messages should follow the

concept of motivational interviewing to ensure a higher likelihood of behavioural change.

- *Satisfied players:* The main objective of any behavioural tracking tool should be player protection. For most players, gambling is an enjoyable leisure activity. However, a small minority of players can encounter problems. Behavioural tracking tools should be able to detect undesirable behavioural tendencies and initiate personalised communication with players with the aim of preventing problematic gambling. Consequently, players can continue to enjoy their gambling, and customer satisfaction increases.
- *Increased loyalty:* The gaming market – especially the online market – is a highly competitive environment. Attracting new players can be expensive, and every customer lost impacts negatively on the financial investment made through marketing and advertising. Loyalty is the key to repeat custom over the player's lifetime. The longer that players use an operator's product, the higher the revenue per player. However, once players run into gambling problems, they are typically lost forever. Behavioural tracking tools can help players to enjoy gambling within limits, while extending their lifespan as a player. This gives online gaming operators the opportunity to build up a stable and profitable customer relationship (benefitting both players and operators).
- *Increased trust:* Attracting players in a highly competitive gaming market requires extensive marketing investment. But how can players distinguish trustworthy operators? Behavioural tracking tools indicate both objectivity and transparency and help empower trust. It signals a strong customer-centric approach. A high level of trust increases and strengthens existing customer relationships, and helps to attract new customers. Behavioural tracking tools also signal transparency to regulators and the community, that in turn increases confidence in online gaming operators.

Good behavioural tracking tools should be able to support informed player choice, and also help online gaming operators gain more insight into their players' behavioural patterns. Such tools have the potential to supply gaming operators with valuable

information through standardised reports. This knowledge can in turn be used to optimise the player experience and keep gambling both safe and enjoyable.

Very few studies that involve actual player data have been conducted so far. As noted in the previous chapter, a series of papers have resulted from a set of 47,000 *bwin* online gamblers (e.g., Broda, LaPlante, Nelson, LaBrie, Bosworth & Shaffer, 2008; LaBrie, Kaplan, LaPlante, Nelson & Shaffer, 2008; LaBrie, LaPlante, Nelson, Schumann & Shaffer, 2007; LaPlante, Schumann, LaBrie & Shaffer, 2008; LaPlante, Kleschinsky, LaBrie, Nelson & Shaffer, 2009; Xuan & Shaffer, 2009). Their claims towards the harmlessness of internet gambling compared to land-based gambling have to be regarded with caution as those two modes of play have not been directly compared.

In their study of video lottery terminal (VLT) players, Schellink and Schrans (2002) identified some helpful RG features (i.e., on-screen clock, pop-up reminders) in playing VLTs. The majority of players (54%) in their sample saw at least one pop-up reminder during play. In summary, behavioural tracking can be a useful approach towards understanding player behaviour and the tailoring of specific responsible gambling interventions. As mentioned above, behavioural tracking studies such as those outlined in Chapters 6-9 of this PhD are limited as conclusions about players attitudes, beliefs, and/or reasons for gambling cannot be drawn. In order to make such assumptions self-report data from surveys, focus groups, and/or interviews are necessary.

## **Chapter 4: Study 1 -Theoretical Loss and Gambling Intensity: A Simulation Study**

The simulation study in this Chapter introduces the concept of Theoretical Loss. This measure of gaming intensity is crucial as an outcome for studies 3 and 4 of this thesis. Many recent studies of internet gambling – particularly those that have analysed behavioural tracking data have used variables such ‘bet size’ and ‘number of games played’ as proxy measures for ‘gambling intensity.’ (Broda, LaPlante, Nelson, LaBrie, Bosworth & Shaffer, 2008; LaBrie, Kaplan, LaPlante, Nelson & Shaffer, 2008; LaPlante, Kleschinsky, LaBrie, Nelson & Shaffer, 2009; LaPlante, Schumann, LaBrie & Shaffer, 2008; Nelson, LaPlante, Peller, Schumann, LaBrie & Shaffer, 2008; Dragicevic, Tsogas & Kudic, 2011) However, neither bet size nor the number of games played takes into account the house advantage of a game. Players are risking less when they play games with low house advantages. A low house advantage, therefore, corresponds to a high payout. Furthermore, data presented from these studies have typically been presented by game type (*e.g.*, data are only presented from online sports bettors or online poker players). However, using a concise simulation analysis of online gamblers playing a variety of games, this study argues that bet size cannot be reliably used across games and/or game types as a measure of Gambling Intensity.

As noted in the previous chapter, Griffiths and Auer (2011) outlined the many advantages and disadvantages of using behavioural tracking data in the gambling studies field. The main advantages of behavioural tracking data are that it (a) provides a totally objective record of an individual’s gambling behaviour on a particular online gambling website; (b) provides a record of events and can be revisited after the event itself has finished; and (c) usually comprises very large sample sizes. These are the main reasons that such data will be used here.

In this study it is argued that the best and most stable measure for ‘gambling intensity’ is ‘theoretical loss.’ In the long run, outcomes in games of chance are always dependent on the house advantage: games with a great house advantage lead to higher losses for the gambler, while games with a lesser house advantage lead to lower losses. For

instance, lottery games typically have relatively high house advantages (e.g., 50%), whereas casino games typically have relatively low house advantages: roulette games with a single ‘zero [0]’ on their wheels, for example, have a house advantage of 2.7%.

The ‘loss/win’ variable often referred to as the Gross Gaming Revenue (GGR)—is the difference between ‘total bet’ and ‘total win.’ However, as a measure of a player’s gambling intensity, it is not suitable, as it is typically distorted by the occasional winning occurrences by gamblers, particularly in the short-term. In the very long run, GGR is a more reliable indicator of gambling intensity, as (statistically) it corresponds to the theoretical loss. This means that theoretical loss is the most reliable and robust indicator of gambling intensity. The theoretical loss of any given game is represented by the product of the bet size and the house advantage. Over very long periods of time, the theoretical loss corresponds to the GGR with increasing accuracy. The following formula shows the calculation of the theoretical loss for a bet on a single game [g]. The house advantage depends on the specific game in question.

$$\textit{Theoretical Loss}_g = \textit{Total Bet}_g \times \textit{House Advantage}_g$$

The more diverse the gambling behaviour, the more the bet size will typically deviate from the theoretical loss. For players playing only one game, a high bet size will always be accompanied by a high theoretical loss. However, if the gambling behaviour is more diverse, players with high bet sizes will not necessarily have a high theoretical loss. Given the reliance on variables such as bet size and/or number of games played as proxy measures for gambling intensity, this study examines the properties of theoretical loss using a mathematical simulation study of up to 300,000 gamblers, playing as many as 13 different games. The hypothesis is that the robustness of bet size and number of games played as measures of gambling intensity declines as gaming becomes more hybrid.

#### 4.1. Method

The analysis was performed with the statistical open source software 'R'. R is a powerful language for statistical computing and graphics. It runs on all important platforms and provides thousands of useful specialized modules and utilities. It is similar to the popular systems IBM SPSS and SAS, but requires more programming skills. R is particularly popular in the area of bioinformatics (Azam, 2015). A procedure was programmed in the statistical package 'R' that simulates different numbers of players, playing as many as 13 different forms of gambling games with varying house advantages. A simulation study is most appropriate to show that the bet size and the number of games does not completely explain the theoretical loss. Since an empirical study with a sample of gamblers always carries the problem of validity. For this reason, the mathematical approach of a simulation study was chosen.

*Game Types:* As argued above, casino operators offer a wide variety of games with different house advantages. The house advantage is a key structural factor that influences game attractiveness to players and helps determine the casinos' revenue stream. High house advantages tend to be less attractive to the gambler but yield high profits. Based on our experience in the field of gambling, as well as our knowledge of the different gaming platforms, we chose 13 games to be part in the simulation study. Table 4.1 displays these 13 games and their house advantages. These house advantages are mean average values, because different operators sometimes modify games slightly. For example, slot machines and video poker, in particular, can vary greatly across operators. Therefore, we provided two house advantages each for slot machines and video poker.

Table 4.1.: Game type and house advantage used in the simulation study

<b>Game Type</b>	<b>House Advantage</b>
Keno	25.0%
Big 6 Wheel	10.0%
Roulette (double zero)	5.6%
Video poker (high house advantage)	4.8%
Sports Betting	4.5%
Slot (high house advantage)	3.3%
Roulette (single zero)	2.7%
Slot (low house advantage)	1.8%
Baccarat (banker)	1.7%
Baccarat (player)	1.6%
Blackjack	0.8%
Craps (double odds)	0.6%
Video poker (low house advantage)	0.5%

Viewing the different house advantages also reflects the problem of using bet size or number of games as a measure of gambling intensity. Betting 10 Euros on keno actually corresponds to betting almost 100 Euros on roulette with a single zero. However, to date, all published studies using behavioural tracking data have only used bet size as the measure of gambling intensity. Using the number of games as a measure of gaming intensity would be an even-worse measure, as it also neglects the amount bet.

*Simulation Parameters:* As mentioned above, the first advantage of a simulation study is that gamblers could play up to 13 different games with varying house advantages. A second advantage is that the simulation can be conducted with different numbers of players. In this study up to 300,000 players, playing the 13 games, were simulated. For each of the players, the simulation calculates a specific game-preference pattern. On real

world platforms, it is known that gamblers also play a variety of different games (Wardle, Moody, Griffiths, Orford, & Volberg, 2011). Once the game preferences have been determined, up to 5,000 games per player were simulated. Each simulated player has an individual number of games simulated. The ‘drawing’ of games happens according to the game preference pattern. Finally, the bet size per game being played has to be determined. Each player’s range of bet size follows in a specific interval. The minimum bet size for each player is a natural number drawn from the interval [1:100]. To compute the maximum bet size, a natural number between 0 and 100 is drawn and added to the minimum bet size.

*Data analysis:* The data analysis was performed with the statistical package ‘R.’ R is a language and environment for statistical computing and graphics. It is a GNU project that is similar to the S language and environment that was developed at *Bell Laboratories* (formerly *AT&T*, now *Lucent Technologies*).

#### 4.2. Results

The explanatory quality of bet size and number of games with respect to the theoretical loss can most easily be determined by performing a correlation analysis. Table 4.2 shows the amount of variance of the theoretical loss explained by bet size and number of games played. Table 4.2 represents the results for different numbers of players, wagering on up to 5,000 single games and playing up to 13 different game types. The amount bet also varies from 1 to 200 monetary units. It may clearly be seen that the  $R^2$  converges to a specific value for both parameters. The simulation showed that bet size explains 56% of the variance of the theoretical loss, while the number of games played explains 32% of the variance of theoretical loss. This means that when using bet size alone, 44% of the gambling behaviour remains unexplained. When using the number of games played alone, 68% of the variance is left unexplained. The error when using bet size or the number of games played is considerable; it is clearly not justified to use only one of these two indicators as a measure of gaming intensity. All conclusions that have been drawn from previous studies should therefore be treated with considerable caution, as a large amount of the behaviour has not been accounted for.

Table 4.2: Explained proportion of Theoretical Loss by bet size and number of games played for different numbers of players

$R^2$		
n	Bet size	Number of games played
500	59%	38%
1,000	61%	32%
5,000	58%	34%
10,000	56%	32%
50,000	56%	34%
100,000	56%	32%
200,000	56%	32%
300,000	56%	32%

Table 4.2 clearly shows that the explained variance converges towards the two values 56% (bet size) and 32% (number of games played). Another flexible parameter is the number of single games being played per individual. In Table 4.2, this number was drawn from the uniform distribution [1:5,000]. In Table 4.3, the number of players simulated was fixed at 300,000, but the number of games played was varied. The first two values of  $R^2$  (52% and 29%) are the results from restricting the maximum number of single games played per individual to 50. The higher the number of single games, the more valid the result. For up to 1,000 single games, the two values of  $R^2$  remain stable (see Table 4.3).

Table 4.3: Explained proportion of Theoretical Loss by bet size and number of games played for different numbers of games played

$R^2$		
# games	Bet size	Number of games played
[1;50]	52%	29%
[1;100]	55%	31%
[1;1,000]	56%	32%
[1;2,500]	56%	32%
[1;5,000]	56%	32%

Another way of demonstrating the difference between Theoretical Loss, bet size, and number of games played is via a contingency table (*see* Table 4.4). The contingency table was produced from the simulation comprising 300,000 players playing a maximum of 5,000 single games each. Players were grouped into 10 groups according to Theoretical Loss and bet size. There was a correlation between the two measures, but was clearly far from perfect. Of the 30,000 most gaming intense players with respect to Theoretical Loss, 14,375 of them are also among the most gaming intense players with respect to bet size (therefore, 15,625 are not). The difference is even greater for moderate gamblers. For example, of the 30,000 gamblers in Group 6 of the Theoretical Loss group (see Table 4.4), only 5,430 are also in Group 6 of the bet size group. The error here amounts to 82%  $((30,000-5,430)/30,000)$ .

Table 4.4: Contingency table of Theoretical Loss and bet size

		Bet size										
		1	2	3	4	5	6	7	8	9	10	Total
theoretical loss	1	23,687	5,371	742	143	39	15	1	-	-	-	29,998
	2	5,583	13,384	7,295	2,403	838	303	132	46	16	-	30,000
	3	668	7,195	8,941	6,987	3,622	1,528	639	262	121	37	30,000
	4	53	3,085	6,178	6,999	6,267	4,026	1,981	903	364	144	30,000
	5	7	787	4,299	5,275	5,896	5,721	4,167	2,382	1,070	396	30,000
	6	-	144	1,885	4,419	4,777	5,430	5,440	4,445	2,555	905	30,000
	7	-	31	533	2,744	4,466	4,665	5,230	5,433	4,565	2,333	30,000
	8	-	3	105	843	3,022	4,778	5,152	5,594	6,017	4,486	30,000
	9	-	-	20	170	943	3,022	5,467	6,348	6,706	7,324	30,000
	10	-	-	2	17	130	512	1,791	4,587	8,586	14,375	30,000
Total		29,998	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	299,998

Table 4.5 shows that the concordance between Theoretical Loss and number of games is even less. Of the 30,000 most gaming intense players with respect to Theoretical Loss, only 8,649 are also among the most gaming intense players with respect to bet size (therefore, 21,351 are not). This amounts to an error of 71%  $((30,000-8,649)/30,000)$ .

Table 4.5: Contingency table of Theoretical Loss and the number of games played

		<b>Bet size</b>										
		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>Total</b>
<b>theoretical loss</b>	<b>1</b>	20,203	5,220	1,949	974	574	351	247	174	142	100	29,934
	<b>2</b>	6,783	9,199	5,169	2,954	1,980	1,287	913	735	523	457	30,000
	<b>3</b>	2,108	6,859	6,275	4,425	3,121	2,291	1,785	1,253	1,062	821	30,000
	<b>4</b>	646	4,333	5,509	4,986	3,998	3,085	2,452	2,086	1,590	1,315	30,000
	<b>5</b>	175	2,511	4,220	4,772	4,472	3,851	3,163	2,699	2,233	1,904	30,000
	<b>6</b>	34	1,218	2,988	4,143	4,285	4,314	3,976	3,421	3,003	2,618	30,000
	<b>7</b>	4	536	2,173	3,336	3,844	4,318	4,245	4,126	3,853	3,565	30,000
	<b>8</b>	-	142	1,226	2,503	3,421	4,193	4,574	4,684	4,711	4,546	30,000
	<b>9</b>	-	35	425	1,567	2,930	3,827	4,527	5,068	5,659	5,962	30,000
	<b>10</b>	-	2	68	385	1,268	2,552	4,115	5,678	7,283	8,649	30,000
<b>Total</b>		29,953	30,055	30,002	30,045	29,893	30,069	29,997	29,924	30,059	29,937	299,934

### 4.3. Discussion

No academic paper published in the gambling studies literature has used Theoretical Loss as a measure of gambling intensity, and when gambling intensity has been examined, proxy measures, such as bet size and/or number of games played have been incorporated. The hypothesis that the robustness of bet size and number of games played as measures of gambling intensity would decline as gaming becomes more hybrid was confirmed.

This study demonstrates that previous measures used are inadequate for explaining players' gambling intensity and that theoretical loss appears to be the most reliable and robust indicator of gaming intensity. The results presented using a concise simulation study clearly show that neither bet size nor (particularly) number of games played are

robust measures of gambling intensity. This suggests that future studies should not consider such variables as proxy measures for gambling intensity, and that Theoretical Loss is a much more robust measure.

In order to make statements about overall gambling behaviour, a complete view of gambling behaviour has to be generated (including, for example, sports betting, casino games and poker). Results from previous studies outlined in the introduction were only derived singularly for sports betting, casino, or poker playing behaviour. The analysis in the study presented here clearly demonstrates that researchers in the gambling studies field need to examine individual gambling behaviour across all game types and not just one type.

## **Chapter 5: Study 2 -An Empirical Investigation of Theoretical Loss and Gambling Intensity**

Study 1 of this PhD attempted to demonstrate that the most robust and stable measure for ‘gambling intensity’ is the ‘theoretical loss’. This next study examines the properties of theoretical loss using actual data from the behavioural tracking of gamblers at a real online gambling site. It is hypothesised that the bet size would not explain all of the theoretical loss. It is also hypothesised that the more diverse the individual’s gaming behaviour, the less important bet size becomes in explaining theoretical loss. This study provides an analysis of real online gambler data (as opposed to simulated data) to highlight the differences between bet size and theoretical loss in relation to actual gamblers who play different types of online games.

### **5.1. Method**

**Participants:** The anonymous sample comprised 100,000 online gamblers who played casino, lottery or poker games during one month (February 2012). All games played by these gamblers were recorded and subsequently analysed.

**Procedure:** Access was given to a large anonymised data set by a commercial gaming operator (*win2day Entwicklungs- und Betriebsgesellschaft m.b.H*), the online casino and lottery portal of *Österreichische Lotterien GmbH* and *Casinos Austria AG*. *win2day* has been online since 2003. *win2day* offers a wide range of lottery and casino games (as well as poker) to Austrian citizens. During the registration process, there is a mandatory requirement for all players to set time and cash-in limits. Furthermore, the weekly cash-in limit cannot exceed 800 Euros at any time during and after registration. *win2day* offers a wide range of lottery and casino games (as well as poker) to Austrian citizens.

The game types were categorised into eight distinct groups: (i) Lottery – Draw/Instant, (ii) Casino – Card, (iii) Casino – Slot, (iv) Casino – Videopoker, (v) Casino – Table, (vi) Casino Other, (vii) Bingo and (viii) Poker. For each of the game types and each player, the ‘bet size’ and the ‘theoretical loss’ were computed for the recorded time period (February 2012). In terms of house advantage these game types are very different. In general, lottery games have a relatively high house advantages (typically 50%) whereas slot machines have house advantages in the range of 1 to 5% depending on the gaming platform and the specific game. Poker on the other hand does not have a house advantage as such. In poker, the gaming involvement can be measured via the rake. The rake is a fixed percentage of the stake (bet size) that goes to the casino. The overall theoretical loss is thus comprised of the theoretical loss across all game types plus the poker rake.

Data analysis: The data analysis was performed with the statistical package ‘R’. R is a language and environment for statistical computing and graphics.

## 5.2. Results

The correlation between the ‘bet size’ and the overall ‘theoretical loss’ across the eight game types for the 100,000 players is 0.85 (d.f.=100,000,  $p<0.0001$ ). Though this correlation is significant, the bet size alone explains only 72% of the variance of the theoretical loss. In order to be able to make further inferences on the difference between the theoretical loss and the bet size, a measure of difference was computed. Theoretical loss and bet size cannot be compared directly as the theoretical loss is always a percentage of the bet size. For that reason it does not make sense to compute the difference between these two measures. If the bet size was a legitimate measure of the theoretical loss, players with high bet sizes should also have high theoretical losses. In order to compare the position of players with respect to theoretical loss and bet size, the ranks of both measures can be used. The ranks detach a player’s gambling intensity from the specific measure of theoretical loss or bet size and simply records where a player is positioned compared to all other players. If bet-size and theoretical loss assess

the same construct, the ranking of players should be the same for the theoretical loss and the bet size. The higher the difference in the ranking, the less the bet size accounts for the theoretical loss. Consequently the difference in ranks can be used as a proxy indicator of the difference between these two measures. Furthermore the sign of the ranking difference is not important. It does not matter whether the rank for the theoretical loss is higher than the one for the bet size or vice versa. Consequently the absolute value of the difference was computed.

Table 5.1 shows the distribution of the ranked theoretical loss and the ranked bet size. This shows that the two distributions are equal. The maximum is higher than the number of observations (N) because of ties. Ties occur if two players have the same value and two different ranks are assigned. Also the minimum is not '0' but 1,242 and 1,275, respectively. This corresponds to the number of gamblers who have either no gaming behaviour or very little but equally high gaming involvement. All of these gamblers get assigned the same ranks.

Table 5.1: Distribution of the ranks (Theoretical Loss and Bet Size) and the difference between these two measures.

Statistic	Rank Bet Size	Rank Theoretical Loss	Ranking Difference
Mean	60,026	60,008	13,519
Std Dev	34,617	34,624	13,244
Minimum	1,242	1,275	-
Maximum	119,971	119,971	94,422
N	100,000	100,000	100,000
1st Pctl	1,242	1,275	34
5th Pctl	6,366	6,029	516
10th Pctl	12,241	11,995	1,720
Lower Quartile	30,105	30,002	5,774
Median	60,032	59,951	10,492
Upper Quartile	89,992	90,045	15,410
90th Pctl	107,992	107,977	29,791
95th Pctl	113,997	113,989	46,168
99th Pctl	118,777	118,761	64,479

The third measure in Table 5.1 represents the difference between the two rank variables. If all players were ranked equally, the differences would be zero. But obviously this is not the case. A difference of '1' means that the players are either ranked one step higher according to the bet size or one step lower. The mean difference is 13,519. The 90th percentile shows that 10% of the players are more than 29,791 ranks apart. This is quite a high difference particularly as the maximum difference is 118,730 (the difference between the maximum rank 119,971 and the minimum rank is 1,242). A total of 5% of the players are more than 64,479 ranks apart.

The computed ranks were then used to check if the diversity of play correlated with the difference between the theoretical loss and the bet size. A high correlation would mean that players engaging in a variety of different games are not being correctly measured via the bet size. In order to analyse this, the game type specific involvement is being measured. The percentage of the theoretical loss per game type is computed for each

game type across the 100,000 gamblers in the sample. Table 5.2 displays the correlation between the difference in ranks and each game type specific involvement measure.

Table 5.2: Correlations between game type specific involvement and the ranking difference

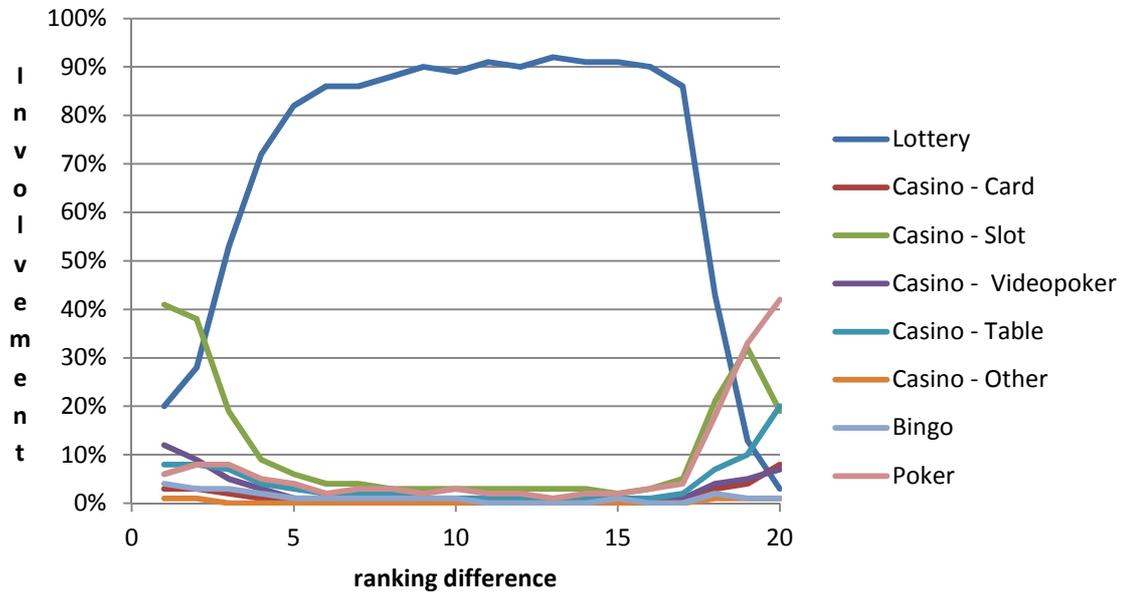
<b>Game Type</b>	<b>Correlation</b>
Lottery	-0.37672 (<.0001)
Casino – Card	0.14081 (<.0001)
Casino – Slot	0.0688 (<.0001)
Casino - Videopoker	0.03639 (<.0001)
Casino – Table	0.19381 (<.0001)
Casino – Other	0.029 (<.0001)
Bingo	-0.03574 (<.0001)
Poker	0.37666 (<.0001)

Table 5.2 shows that there is a correlation between the playing intensity of the different game types and the prediction error of the total bet. These underlying seven relative measures sum up to ‘1’ for each player as they measure the relative gaming involvement. This means that the higher the involvement in one measure the lower the involvement in the other measures. The biggest correlations between the relative gaming game type specific involvement and the difference in ranks occurred in lottery and poker games. The higher the involvement in lottery games the smaller the difference between the total bet ranking and the theoretical loss ranking. The opposite was found regarding poker involvement (i.e., the higher the involvement in poker games, the higher the difference between the total bet ranking and theoretical loss ranking).

Figure 5.1 shows the average relative game type involvement for different sizes of the ranking difference. This figure highlights the information that was used to compute the correlations in Table 5.2. The figure shows that the correlation between the two measures is non-linear for some game types. For players that were equally ranked according to total bet and theoretical loss, the lottery gaming involvement was low (20% lottery involvement on the left side of the graph in Figure 5.1). However, this is also the case for players who are completely differently ranked (less than 10% lottery involvement) on the right side of the graph in Figure 5.1. This highly non-linear pattern

produced an overall negative correlation of -0.37 (see Table 5.2). For this reason, the correlation that measures linear relationships has to be interpreted with caution, although Figure 5.1 clearly shows that there is a distinct pattern.

Figure 5.1: Average game type specific involvement for different degrees of the ranking difference between Bet Size and Theoretical Loss



Involvement in online slot games also shows a negative correlation with the ranking difference (see Table 5.2). Poker players have a peak at high ranking differences (right side of the graph in Figure 5.1). The group on the right hand side of the graph in Figure 5.1 shows the highest difference between the ranks of bet size and theoretical loss. This group of players shows the highest average involvement in poker, followed by Casino Slot games and Other Casino games. This group does not show any involvement in Lottery games.

Table 5.3 shows the actual numbers that were used to plot the graph in Figure 5.2. The higher the ranking difference the less valid the bet size as a measure of the theoretical loss. For instance, the data relating to poker clearly shows that high differences occurred with relatively high poker involvement. The last three groups showed 18%, 33% and 42% poker involvement.

Table 5.3: Average game type specific involvement for different degrees of the ranking difference between Bet Size and Theoretical Loss

Rank difference	Lottery	Casino - Card	Casino - Slot	Casino - Videopoker	Casino - Table	Casino - Other	Bingo	Poker
1	20%	3%	41%	12%	8%	1%	4%	6%
2	28%	3%	38%	9%	8%	1%	3%	8%
3	53%	2%	19%	5%	7%	0%	3%	8%
4	72%	1%	9%	3%	4%	0%	2%	5%
5	82%	1%	6%	1%	3%	0%	1%	4%
6	86%	1%	4%	1%	2%	0%	1%	2%
7	86%	1%	4%	1%	2%	0%	1%	3%
8	88%	0%	3%	1%	2%	0%	1%	3%
9	90%	0%	3%	1%	1%	0%	1%	2%
10	89%	0%	3%	1%	1%	0%	1%	3%
11	91%	0%	3%	1%	1%	0%	0%	2%
12	90%	0%	3%	1%	1%	0%	0%	2%
13	92%	0%	3%	0%	1%	0%	0%	1%
14	91%	0%	3%	1%	1%	0%	0%	2%
15	91%	0%	2%	1%	1%	0%	1%	2%
16	90%	0%	3%	0%	1%	0%	0%	3%
17	86%	1%	5%	1%	2%	0%	0%	4%
18	43%	3%	21%	4%	7%	1%	2%	18%
19	13%	4%	32%	5%	10%	1%	1%	33%
20	3%	8%	19%	7%	20%	1%	1%	42%

The first three groups (i.e., low difference between bet size and theoretical loss) show significant involvement in lottery games and casino slot games. Groups 4 to 17 almost exclusively play lottery games. High differences are associated with multiple game involvement and significant poker involvement.

### 5.3. Discussion

This chapter describes the first empirical study to ever examine theoretical loss using data from real gamblers. It generally confirms the theoretical findings of study 1. More specifically, this study shows that bet size alone explained only 72% of the variance of the theoretical loss (i.e., 28% of the variance was unaccounted for by bet size). The

simulation study (study 1) shows that 46% of the variance of the theoretical loss was unaccounted for by the bet size. The error found in the empirical analysis is lower, but this is because the house advantages are not as different as assumed in the simulation study.

The results of this study also show that there is a correlation between game type specific involvement, and the difference between the total bet ranking and the theoretical loss ranking. But this correlation cannot be explained by one number as it is highly non-linear. Conclusions (such as the higher the involvement in lottery games the bigger the difference between the total bet ranking and the theoretical loss ranking) cannot be drawn because of the nature of the relationship. The one exception is poker involvement (see Table 5.3). Poker involvement is only slightly increased in the first three ranking difference groups but very high in groups 18 to 20.

This means that players who among other games such as casino and lottery games engage up to 40% in poker games should never be analysed using the bet size. The mix between poker and other game types therefore appears to be especially poor in the predictive power of the bet size. The right hand side of Figure 5.1 shows the highest difference between the ranks of bet size and theoretical loss. This group of players shows the highest average involvement in poker, followed by the game types casino slot games and other casino games. This group did not show any involvement in lottery games. The occurrence of significant correlations shows that the difference between total bet ranking and theoretical loss ranking is highly associated with game type specific involvement. This again leads to the conclusion that the total bet is not an appropriate measure of the theoretical loss as it does not account for the different house advantages across different game types (or by the rake in poker games).

The data presented in Tables 5.2 and 5.3 (and Figure 5.1), clearly show that the diversity of play correlates with a deterioration of the bet size as a predictor of theoretical loss. This is especially interesting if we look at the inferences that have been made in earlier behavioural tracking studies. Earlier studies on behavioural tracking

identified highly involved players to play a variety of games (Nelson et al., 2008) and they made inferences based on the bet size. The data presented here show that these inferences might not hold true or at the very least should be re-analysed using the most stable and robust measure of gaming intensity (i.e., theoretical loss).

## **Chapter 6: Study 3 - Voluntary player choice and limit setting in most intense players**

This Chapter contains the first study to empirically investigate the effects of a specific Responsible Gaming measure that is commonly used to protect players from overspending at many online gambling sites. Voluntary time and money spending limits – which are the focus of this study – are described in more detail in section 2.1

Social responsibility in gambling has become a major issue for the gaming industry (Griffiths, Wood, Parke & Parke, 2007). One such social responsibility practice is the opportunity for players to pre-set limits for the amount of time and money they spend on gambling per day and/or per calendar month. This is a practice that is now widespread among online gaming operators (Wood & Griffiths, 2010). This study builds on the literature reviewed in Chapter 2 and investigates the effect of self-set limits on players gambling behaviour in an online-gambling environment

### **6.1. Method**

*Participants:* Data were collected from a representative random sample of 100,000 players who gambled on the *win2day* gambling website during a three-month test period. This sample comprised 5,000 registered gamblers who chose to set themselves limits while playing on *win2day*.

*Gambling website description and procedure:* Access was given to a large anonymised data set by a commercial gaming operator (*win2day Entwicklungs- und Betriebsgesellschaft m.b.H*), the online casino and lottery portal of *Österreichische Lotterien GmbH* and *Casinos Austria AG*. *win2day* has been online since 2003. *win2day* offers a wide range of lottery and casino games (as well as poker) to Austrian citizens. During the registration process, there is a mandatory requirement for all players to set time and cash-in limits. Furthermore, the weekly cash-in limit cannot exceed 800 Euros

at any time during and after registration. Following registration, players can change the value of the weekly limit at any time (up to the mandatory 800 Euro per week limit). Limit increases only become effective after a 72-hour cooling off period. For instance, the player can limit the daily, weekly and/or monthly cash-in amount and the playing duration. The latter can be limited per playing session and/or per day. *win2day* protects its players by limiting the maximum cash-in amount per week at €800. Furthermore *win2day* offers additional RG features such as self-exclusion options (where players can temporarily or permanently self-exclude from gambling at *win2day*), educational content (e.g., video films including information on the nature of gambling and signs of problematic gambling), and a problem gambling diagnostic self-test (comprising questions similar to DSM-IV criteria). In the three-month test period, all voluntary limit setting behaviour by online gamblers was tracked and recorded for subsequent data analysis.

*Monetary spending:* Monetary spending was measured via theoretical loss. As shown by studies 1 and 2 the theoretical loss is the most accurate and robust indicator of gambling intensity with regard to monetary involvement. The theoretical loss is computed as the product of bet size and house-advantage for each game being played. It was demonstrated, the theoretical loss should always be used when gamblers with different gambling habits are being compared in terms of their involvement. The higher the theoretical loss, the higher the gambling involvement in terms of monetary spending.

The computation of the theoretical loss as the product of bet size and house-advantage was applied to all games (e.g., lottery games, casino games) with the exception of poker. Monetary spending for poker was measured using the rake. The rake is a fixed percentage of the monetary bet that goes to the casino. In this study, poker refers to “social” poker in which gamblers compete with each other. This is clearly differentiated from ‘video poker’ that is a pure game of chance and thus a casino game. Previous studies have incorrectly tended to use bet size as a proxy measure of gambling involvement.

In this study, the effect of voluntary limit setting is calculated via the limit impact factor. To do this, the percentage change before and after the 30-day period after the limit was set was calculated. For the theoretical loss, the formula is as follows: impact factor = (theoretical loss 30 days after divided by the theoretical loss 30 days before). An impact factor greater than '1' corresponds to a behavioural increase, and an impact factor less than '0' corresponds to a behavioural decrease. The effect of limit setting is studied by means of the 10% most intense players. This group of most intense players is identified by means of the behaviour (as measured by theoretical loss) in the 30 days before the limit was set. This approach to calculating 'gaming intensity' is a crucial factor when it comes to the interpretation of limit setting effectiveness. Limits are deemed to have a significant effect if the mean theoretical loss or the mean playing duration after the limit setting event significantly decreases compared to before the limit setting event.

*Data analysis:* The data analysis was performed with the statistical package "R". The analysis focused on the voluntary limit setting events following the registration process. Given the large number of statistical tests performed, significance levels were set at the 1% level. Alternatively, a Bonferroni correction could have been applied. However, researchers such as Perneger (1998) argue that Bonferroni adjustments are, at best, unnecessary and, at worst, deleterious to sound statistical inference. Nakagawa (2004) also argues that the Bonferroni procedure substantially reduces the statistical power of rejecting an incorrect  $H_0$ . Mean changes in gambling behaviour before and after voluntary limit setting were performed via t-tests (by comparing the means of both theoretical loss and play duration before and after the limit setting events). Furthermore, changes in gambling behaviour were analysed overall and separately for casino, lottery and poker gambling. Only the 10% most intense gamblers among each game type were taken into account. This sub-segment of gamblers was chosen because they showed the highest losses based on their bet size and the types of games played (and therefore were arguably the ones who most need to set limits). A high theoretical loss can either occur through high bet sizes, through playing games with a high house advantage, or a

combination of both. Lottery games have higher house advantages than casino games and thus lead to a higher theoretical loss. This might seem counter-intuitive as casino games are more problematic due to their event frequency. However, most of the time, the high theoretical loss of lottery games is compensated by the low event frequency and low bet frequency that lottery gamblers usually show. Poker was taken into account via the rake, which as explained above is a fixed percentage of the stake that the player pays to the casino. A number of studies (Currie, Hodgins, Casey, et al., 2011) have shown that casino games correlate with increased harm. For that reason analysis was also performed separately for lottery, casino and poker games.

## 6.2. Results

### ***Findings relating to the total sample***

*Effect of voluntary limit setting among the total sample:* During the three-month test period, the sample of 5,000 gamblers produced a total of 22,002 limit setting acts (see Table 6.1). The mean number of limit setting acts per online gambler was 4.4 (SD=4.3). However, it should be noted that the changing of one limit can also result in the automatic changing of another. For instance, the monthly cash-in limit often determines a change in the weekly (as well as daily) cash-in limit. If the monthly cash-in limit is changed to €800, the weekly and daily cash-in limit cannot exceed that value. The same holds for the setting of play duration limits. Limiting the cash-in limit should consequently lead to a decreased playing behaviour either with respect to money spent or time spent.

Table 6.1: Types of limit and percentage of occurrence among online gamblers

<b>Limit type</b>	<b>Number</b>	<b>Percentage</b>
<b><i>All online players (n=5000)</i></b>		
Daily cash-in limit	5,566	25%
Weekly cash-in limit	6,299	29%
Monthly cash-in limit	6,947	32%
Session playing duration limit	1,537	7%
Daily playing duration limit	1,653	8%
Total	22,002	100%
<b><i>Online lottery players (n=3152)</i></b>		
Daily cash-in limit	3,063	25%
Weekly cash-in limit	3,525	29%
Monthly cash-in limit	3,918	32%
Session playing duration limit	815	7%
Daily playing duration limit	901	7%
Total	12,222	100%
<b><i>Online casino players (n=2,334)</i></b>		
Daily cash-in limit	2,439	23%
Weekly cash-in limit	2,981	28%
Monthly cash-in limit	3,718	35%
Session playing duration limit	773	7%
Daily playing duration limit	822	8%
Total	10,733	100%
<b><i>Online poker players (n=759)</i></b>		
Daily cash-in limit	720	25%
Weekly cash-in limit	863	30%
Monthly cash-in limit	933	32%
Session playing duration limit	188	6%
Daily playing duration limit	189	7%
Total	2,893	100%

In addition to theoretical loss, the following analysis also uses the playing duration as another measure of gambling intensity. In order to compute the playing duration for a certain time period, single playing sessions had to be identified. It was decided that the number of consecutive games belonged to one playing session if they were maximally 30 minutes apart. Therefore, a time gap of more than 30 minutes led to the recording of a new (and therefore separate) game session. A time gap of 30 minutes between page accesses is commonly used as a default session time-out (Losarwar et al., 2012). The daily play duration corresponded to the sum of all sessions on that particular day. The playing duration for a specific time period corresponded to the sum of all daily playing durations for that time period.

Table 6.2: Impact of limit setting on theoretical loss (€) after limit setting among most intense online gamblers (Limit Impact Factor) comparing play 30 days before and 30 days after limit setting event)

	Cash-in Limit			Duration Limit	
	Daily	Weekly	Monthly	Session	Daily
<b><i>All players (n=5000)</i></b>					
Mean	0.87	0.86	0.86	0.91	0.9
(SD)	(0.7)	(0.7)	(0.7)	(0.7)	(0.7)
t value	-4.15	-4.47	-4.47	-2.88	-3.19
(p)	(<0.001)	(<0.0001)	(<0.0001)	(<0.01)	(<0.01)
<b><i>Lottery players (n=3,152)</i></b>					
Mean	0.88	0.87	0.9	0.92	0.91
(SD)	(0.6)	(0.63)	(0.6)	(0.7)	(0.6)
t value	-3.55	-3.66	-2.96	-2.03	-2.66
(p)	(<0.001)	(<0.001)	(<0.01)	0.02	(<0.01)
<b><i>Casino players (n=2,344)</i></b>					
Mean	0.79	0.77	0.8	0.96	0.89
(SD)	(0.8)	(0.7)	(0.8)	(1)	(1)
t value	-4.01	-5.03	-3.82	-0.61	-1.68
(p)	(<0.0001)	(<0.0001)	(<0.0001)	(0.27)	(0.05)
<b><i>Poker players (n=759)</i></b>					
Mean	0.86	0.84	0.89	0.77	0.73
(SD)	(0.6)	(0.6)	(0.6)	(0.6)	(0.6)
t value	-2.02	-2.3	-1.59	-3.3	-3.9
(p)	(0.02)	(0.01)	(0.056)	(<0.001)	(<0.0001)

Table 6.2 shows the limit impact factor with regard to theoretical loss in the group of most intense players and the five types of limit. Using t-tests, the results showed that the 10% most gaming intense players produced significantly less theoretical loss in the 30 days following voluntary limit setting (see Table 6.2). The 10% most gaming intense players that chose a monthly cash-in limit produced 86% of the theoretical loss compared to 30 days before the limiting event. The setting of voluntary time limits also

had a significant impact on spending behaviour than monetary limits although not as much as the setting of monetary limits (see Table 6.2). The 10% most gaming intense players that chose a daily playing duration limit produced 90% of the theoretical loss compared to 30 days before voluntary limit setting.

Table 6.3: Impact of limit setting on Playing Duration after limit setting among most intense online gamblers (Limit Impact Factor) comparing play 30 days before and 30 days after limit setting event)

	Cash-in Limit			Duration Limit	
	Daily	Weekly	Monthly	Session	Daily
<b><i>All players (n=5000)</i></b>					
Mean	0.95	0.94	0.96	0.99	0.92
(SD)	(0.6)	(0.6)	(1)	(0.8)	(0.7)
t value	-1.86	-2.24	-0.89	-0.28	-2.55
(p)	(0.03)	(0.013)	(0.19)	(0.39)	(<0.01)
<b><i>Lottery players (n=3,152)</i></b>					
Mean	0.91	0.91	0.88	0.92	0.99
(SD)	(0.8)	(0.8)	(0.8)	(1)	(0.9)
<b><i>Casino players (n=2,344)</i></b>					
Mean	0.91	0.91	0.88	0.92	0.99
(SD)	(0.8)	(0.8)	-0.8	(1)	(1)
t value	-1.72	-1.72	-2.29	-1.22	-0.17
(p)	(0.04)	(0.04)	(0.01)	(0.11)	(0.43)
<b><i>Poker players (n=759)</i></b>					
Mean	0.93	0.94	0.97	0.73	0.7
(SD)	(0.4)	(0.6)	(0.6)	(0.4)	(0.4)
t value	-1.52	-0.87	-0.43	-5.85	-6.5
(p)	(0.07)	(0.19)	(0.33)	(<0.00001)	(<0.00000001)

Table 6.3 shows the impact of voluntary limit setting with regard to playing duration in the group of most intense players and the five types of limits. The results showed that the 10% most gaming intense players were playing significantly less often in the 30 days after setting voluntary time limits but only when choosing a daily duration limit. That is, in the 30 days after the limit setting event, the 10% most intense players that chose a daily playing duration limit spent 92% of the time playing compared to the 30 days before the limiting event. The setting of daily and weekly cash-in limits were

almost significant at the 1% level in reducing play duration. Therefore, overall effect of setting voluntary limits on playing duration was less pronounced (and less significant) than the effect of voluntary limit setting on theoretical loss.

### ***Findings relating to the subsamples of lottery, casino and poker players***

The following analysis examined whether there were groups of players who differed with regard to the effect of limit setting. The data provided by *win2day* also contained data about which specific games the gamblers were playing. Therefore, subsequent analysis examined gamblers who played lottery, casino, and poker games. However, it must be noted the analysis were not mutually exclusive. Players who engaged in one type of gambling often engaged in other forms too.

*Effect of voluntary limit setting among lottery players:* Of the 5,000 gamblers who set limits within the three-month test period, 3,152 gamblers played lottery games (such as Lotto 6/45 and scratchcards). This sub-sample of 3,152 lottery gamblers carried out 12,222 acts of voluntary limit setting. The number and percentage of the various limits chosen is shown in Table 6.1. This shows that the distribution was very similar to the overall number and percentage of limits set in (see also Table 6.1). The number of limits per player was 3.9 (SD=3.9). In order to show the impact of limit setting on time and money spent gambling, the 10% most intense gamblers were identified using the theoretical loss produced in lottery games in the 30 days before voluntary limit setting. Table 6.2 again shows that the theoretical loss significantly decreased among the top 10% most gaming intense lottery players in the 30 days following all types of voluntary limit setting. The impact of the cash-in limits was higher than playing duration limits (Table 6.3).

*Effect of voluntary limit setting among casino players:* Out of the sample 5,000 gamblers who chose to set themselves limits in the three-month test period, 2,344 gamblers played casino games (such as slot games, video poker and cards). These 2,344 gamblers carried out 10,733 acts of voluntary limit setting. The number and percentage of the various limits chosen is shown in Table 6.1. This shows that the distribution was

very similar to the overall number and percentage of limits (see also Table 6.1). The number of limits per player was 4.6 (SD=4.9). In order to show the impact of limit setting on time and money spent gambling, the 10% most intense players were identified using the theoretical loss produced in casino games in the 30 days before voluntary limit setting. Table 6.2 shows that the theoretical loss, this time in casino games, significantly decreased in the top 10% of gaming intense players with respect to the theoretical loss in casino games in the 30 days prior to voluntary monetary limit setting (for daily, weekly and monthly cash-in limits). However, the setting of voluntary duration limits among casino players had no significant effect on theoretical loss after the limit setting event. Casino players showed a more significant decrease than the general population of gamblers. Casino gamblers who set themselves weekly cash-in limits spent 77% of the theoretical loss 30 days after voluntary limit setting compared to the theoretical loss 30 days prior. This is by far the most significant impact that limit setting had on gambling behaviour.

Table 6.3 shows that in general there was no significant decrease in play duration among casino players following voluntary limit setting (except for those who set monthly cash-in limits). The top 10% of most gaming intense casino players showed decreases in playing duration after voluntary limit setting that approached statistical significance for those who set voluntary daily and weekly cash-in but were non-significant for those who set session and daily duration limits.

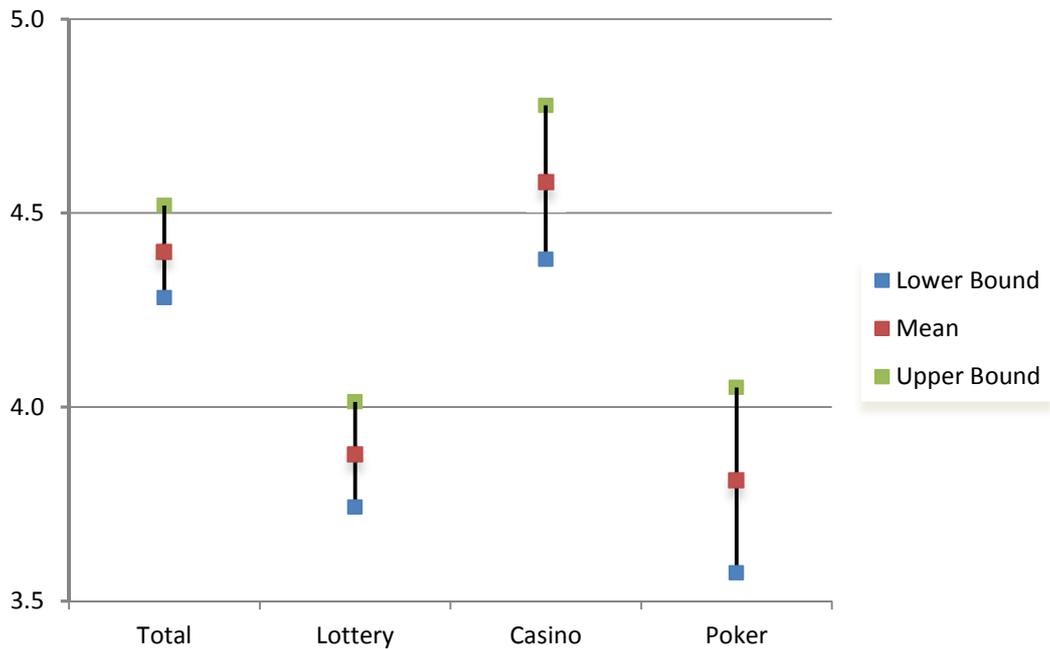
*Effect of voluntary limit setting among poker players:* Out of the sample 5,000 gamblers who chose to set themselves limits in the three-month test period, 759 gamblers played poker games (such as Texas Hold 'Em and Five Card Draw). These 759 gamblers carried out 2,893 acts of voluntary limit setting. The number and percentage of the various limits chosen is shown in Table 6.1. The number of limits per person was 3.8 (SD=3.6). In order to show the impact of limit setting on time and money spent gambling, the 10% most intense poker players were created using the theoretical loss produced in poker games in the 30 days before voluntary limit setting. Table 6.2 shows that poker rake decreased in the top 10% of gaming intense players in the 30 days

following voluntary limit setting. However, this was only significant for those who set weekly monetary limits, and session and daily play duration limits (although the setting of daily and monthly monetary limits approached significance). Therefore, the decrease in rake for the top 10% of players was larger for time limits than for money limits. For instance, poker players who set themselves a daily playing duration limit only spent 73% of the rake they previously spent.

Table 6.3 shows that the setting of voluntary session and daily duration limits had a highly significant effect on overall play duration following the limit setting event. The voluntary setting of daily cash-in limits lowered play duration and approached statistical significance. The setting of weekly and monthly cash-in limits had no significant on poker play duration. Poker players who set themselves a daily playing duration limit only spent 70% of the time they used to spend playing poker. The analysis showed that intense poker gamblers changed their behaviour in a positive way after they set time rather than money limits.

*Differences in limit setting between lottery, casino and poker players:* The frequency of limit setting was different between the three types of player. Figure 6.1 shows the 95% confidence intervals for the mean number of limit events per game type. Lottery (M=3.88; SD=3.89;  $t=-8.62$ ,  $p<0.001$ ) and poker players (M=3.81; SD=3.36;  $t=-9.71$ ,  $p<0.001$ ) had a significantly lower number of limit events than the total population (M=4.40; SD=4.29). Lottery ( $t=-6.93$ ;  $p<0.001$ ) and poker players ( $t=-7.58$ ,  $p<0.001$ ) were also significantly different from casino players (M=4.58; SD=4.90). Casino players tended to set more limits, but were not significantly different from the total population as the confidence intervals overlapped ( $t=1.76$ ,  $p=0.78$ ).

Figure 6.1: Mean number of limit events per game type



### 6.3. Discussion

The results of this study clearly show that overall, voluntary limit setting had a specific and statistically significant effect on high intensity gamblers. Therefore, the study shows that voluntary limit setting had an appropriate effect in the desired target group (i.e., the most gaming intense players). More specifically, the analysis showed that (in general) gaming intense players specifically changed their behaviour in a positive way after they limited themselves with respect to both time and money spent. In most of the analyses (with the exception of poker players), the setting of voluntary time duration limits were less important than voluntary monetary limits. The results would seem to confirm the speculation made by Wood and Griffiths (2010) that voluntary time limits would be less effective than voluntary spending limits in changing gambling behaviour for the better among problem gamblers (assuming that the most gaming intense players in this study included problem gamblers).

Although the daily playing duration showed the highest impact on time spent gambling, there were no significant differences between voluntary cash-in and playing duration limits in overall time spent gambling following the limit setting event. The overall effect of limit setting on playing duration was much less than the overall effect on money spent. However, this might also be due to the fact that the distribution of monetary parameters was far more skewed and prone to outliers than the distribution of time parameters because the latter have natural lower and upper boundaries. For example the maximum daily time spend cannot exceed 24 hours.

It should also be noted that lottery games in general showed a very low frequency of play. Lotto is a very popular game but typically consists of players choosing the stake size and playing the game once or twice in a specified time period (e.g., once or twice a week). Therefore, there is a question as to whether setting limits (particularly time limits) would be of benefit as this study showed that limit setting by lottery players does not affect play duration. This would appear to be intuitively correct given that the structural characteristics (particularly event frequency) of bi-weekly lotteries would be unlikely to cause problems for players as compared to slot machines where event frequency can be very high (e.g., up to 30 times a minute), and that are known to have an association with problem gambling (e.g., Parke & Griffiths, 2006; 2007, Meyer, Hayer & Griffiths, 2009). That a limit on duration of session is irrelevant for playing the lottery has already been mentioned by Currie, Hodgins, Wang, el-Guebaly and Wynne, (2008). Given that the play duration for lottery games is typically much less than for casino or poker games, it could be argued that the setting of time limits is not needed for the playing of discontinuous lottery games.

As outlined above, casino games (especially slot machine games) tend to have a very high event frequency and can be problematic for certain vulnerable groups of players (Meyer, Hayer & Griffiths, 2009). Given this association, it was pleasing that the results showed that voluntary monetary limit setting among players of these types of game showed highly significant decreases in the money lost as a direct result of voluntary limit setting. Among poker players, voluntary time limits showed a larger effect on the

rake than monetary limits. Poker players were the only group where such an effect was observed. Given that playing poker is a more time intensive game than almost all other forms of gambling, it could be argued that voluntary limit setting impacting most on duration of play is a desirable outcome of limit setting in this particular type of player.

Overall – and excluding poker players – the analysis of the results shows that the setting of voluntary time limits are less important than the voluntary setting of monetary limits in significantly decreasing the theoretical losses among the most gaming intense players. The main concern of the analysis presented here is whether the playing behaviour of gamblers significantly changes after voluntary limits have been set. Here, the intensity of playing was measured in two ways (i.e., ‘theoretical loss’ and ‘play duration’). The results do seem to provide evidence that voluntary limit setting has the desired effect in helping the most gaming intense players spend less time and/or money on their gambling. Given that the most gaming intense group of players set their spending limits below their actual theoretical loss, the results of this study clearly demonstrate that the most gaming intense players subsequently set voluntary limits appropriately and decreased their time and/or money playing the month after the limits were set.

There are, of course, many limitations with behavioural tracking data. As Griffiths & Auer (2011) have noted, behavioural tracking data (i) collects data from only one gambling site and says nothing about the person’s online gambling in general (as online gamblers typically gamble on more than one site), (ii) always comes from unrepresentative samples (i.e., the players that use one particular internet gambling site), (iii) does not account for the fact that more than one person can use a particular account, and (iv) says nothing about *why* people gamble or why they engage in a particular online activity (such as limit setting). Another limitation is that once players reach their money or time limit, they may simply go and gamble on other online gambling websites.

Another more specific limitation in this study was whether the changes in observed behaviour were solely as a consequence of the voluntary limit setting.. Most players do not have limitless financial resources, therefore a high level of gambling cannot usually be sustained for very long. For this reason, high intensity gamblers' playing behaviour is likely to level off and/or decrease. Low intensity gamblers on the other hand are more likely to show an increase in their gambling rather than a decrease. In order to be able to make causal inferences, an experimental design would have to be constructed. Obviously this is not possible as limit setting is a voluntary event that cannot be enforced on players. However, if the results were purely a matter of chance, then differences between the types of limits and the types of gamblers would not likely have been observed. Many of the observed differences in this study were highly significant and showed that the setting of voluntary limits had a significant effect, and that different types of gamblers played differently as a result of voluntary limit setting.

Future analysis of data such as these could also include an examination of the players' behaviour when they get close to their time and money limits. It would be useful to know if they accelerate their behaviour (i.e., gamble more aggressively) or whether they reduce their level of gambling activity and become more passive. To be more specific, does the setting of limits create targets for gambling spend? Could the setting of limits be counterproductive (i.e., does the option to set limits actually encourage greater gambling)? This would help determine whether voluntary limits either encourage or inhibit gambling behaviour as the limit is reached. Such analysis might provide greater relevance to both public policy practitioners, and the gambling industry. Future studies should also investigate limit setting behaviour among less gambling intense players. It would be useful to know if this group of players knowingly set themselves limits that are higher than their actual gambling intensity. Among this group, the focus of limits would be to slow down the increase in gambling intensity rather than decrease the overall gambling intensity (as would be the aim among the most gaming intense players). The effect of limits can only be investigated by comparing gamblers who set themselves limits with similar gamblers who did not set themselves limits.

The focus of this study lies is on voluntary limit setting. The limited empirical evidence suggests that mandatory set limits are not liked by gamblers and that they prefer voluntary limits (e.g., International Gaming Research Unit, 2007). However, for voluntary limits to be effective in protecting players, a certain degree of readiness to change is required. The willingness and readiness to change is at the heart of the psychological ‘stages of change’ model (DiClemente & Prochaska, et al., 1991; Prochaska & Prochaska, 1991). The ‘stages of change’ model assumes that there are varying levels of readiness for people to change their behaviour across five levels (i.e., pre-contemplation, contemplation, preparation, action, and maintenance). Furthermore, there is an oscillation between the different stages. Most vulnerable players who are unable to change may only have effective protection via mandatory limits.

It would appear from reviewing the small empirical literature base that there is evidence to suggest that most gamblers (irrespective of pathology) try to regulate their spending. Furthermore, it would appear from the data presented here that voluntary spend limits have the capacity to helpfully assist in that process. The evidence base suggests that the most appropriate RG strategy to be implemented by gaming companies would be for voluntary (rather than mandatory) pre-determined spending limits by players. This is because individuals are likely to vary widely in the amount of disposable income that they have available for leisure activities such as gambling. Players should therefore be required to set their own self-determined spending limits before they commence gambling. This is actually the case for the online platform *win2day* that provided the data for the analysis in this study. Such an action emphasises individual responsibility for managing expenditure. It may also ensure that the player actively engages with at least one of the responsible gaming tools on offer. There would appear to be a consensus of expert opinion that encouraging player responsibility is a very effective long-term and preventive strategy for harm minimisation. One concern regarding low-risk limits is that gamblers adhering to these limits may feel they are safe and impervious to harm. A related concern noted by Currie, Hodgins, Wang, el-Guebaly, Wynne and Miller (2008) is that problem gamblers may justify continuing to gamble if they report staying within the limits.

Given that research in this important area is rather limited, it is recommended that the implementation and ongoing effectiveness of player set limits by gaming operators should be carefully monitored and evaluated. Follow-up research is needed to assess the impact of spending limits on player behaviour over time. Such research can provide a more accurate evaluation of the specific changes made, and can add valuable insight into the efficacy of such responsible gaming measures, contributing towards an exchange of best practice for both the national and international responsible gambling community. The term 'limit' appears to be unpopular, therefore the emphasis should instead be placed on offering game management tools that *assist* players in decisions about how much they want to spend gambling. Such management tools could also give players information about their actual gambling behaviour and advise them based on their personal gambling patterns. Monaghan and Blaszczynski (2010b) note that such systems should help players to reflect on the amount of time or money they have spent, compare expenditure to personally set limits, and consider whether they need appropriate self-regulatory action. Based on the findings of this study, it would appear that government policy makers, gaming regulators, and/or legislators should seriously consider making it mandatory for online gaming operators to introduce voluntary limit setting options for their players. This should include both time and money limit setting, particularly as time limit setting might be particularly good for some types of gamblers (i.e., poker players) whereas spending limits might be particularly helpful for other types (e.g., casino gamblers).

## **Chapter 7: Study 4 -Is “pop-up” messaging in online slot machine gambling effective as a responsible gambling strategy?**

Study 3 of this thesis investigated the effects of voluntary limits on subsequent time and money spent by gamblers. Voluntary limit setting first of all requires that players to take a conscious action. This study and study 5 in Chapter 8 focus on dynamic pop-up messages which automatically inform players based on pre-defined criteria such as time or spending limits. These interventions are one type of personalized feedback, as they depend on customers' behaviour and also inform players about such behaviour. Innovative interactive gambling technologies now provide socially responsible opportunities to support players and to help them control the amount and time and money they spend gambling (Study 3; Griffiths, 2012; Griffiths, Wood, & Parke, 2009). One such innovation is the use of pop-up messages that aim to give feedback to the players about the time and money that they have thus far spent gambling. Doing so allows players to reflect on their immediate gambling and decide if they need a break from their play (see Chapter 2 for a review of previous studies on pop-up messaging). However, the question remains as to whether pop-up messages do in fact bring about a substantial effect on gambling behaviour and whether they indeed help players control their gambling. This study investigates the effects of an interactive pop-up in an online gambling environment.

### **7.1. Method**

Access was given to a large anonymised dataset by a commercial gambling operator (i.e., *win2day*). For Austrian citizens, the online casino and lottery portal of *Österreichische Lotterien GmbH* and *Casinos Austria AG*. *win2day* offers a wide range of games, among them lottery, casino games, and poker. In 2011 *win2day* decided to enhance further their responsible gambling features and introduced pop-up messages (see Figure 7.1) that are triggered if customers play 1,000 consecutive games on slot machines during a single online gambling session. A gambling session at *win2day* is initiated when a player logs into their individual account and terminated if the player logs out or closes their web-browser. The pop-up informs players that they have just

played 1,000 slot games within a single gambling session. The exact words on the pop-up are “You have now played 1,000 slot games. Do you want to continue? (YES/NO)”. The chosen threshold was the operator’s decision. The operator’s reason for choosing a threshold of 1,000 slot games was based on the findings of previous studies (i.e., Ladouceur & Sévigny 2009; Schrans, Grace, & Schellink, 2004). Ladouceur and Sévigny (2009) reported that the most effective social responsibility feature was a 60-minute pop-up reminder, that resulted in a decrease in the length of time spent gambling among players. Schrans, Grace, and Schellink (2004) investigated the benefits of a 30-minute pop-up compared to a 60-minute pop-up on VLTs. Schrans et al. found that earlier exposure to pop-up messages during gambling did not influence either the likelihood of reading the message or the choice to stop playing instead of selecting “yes” to continue. A study by Schellink and Schrans (2002; cited in Monaghan, 2008), carried out for the *Atlantic Lottery Corporation* in Canada, demonstrated that the 60-minute pop-up message was associated among high risk players with a small reduction in session length and a decrease in expenditure.

Figure 7.1: View of the “Pop-up” message that appears after the playing of 1,000 consecutive games on slot machines



Technically, it was easier for *win2day* to track the number of games played rather than the playing time. Given that a typical slot game lasts 3 to 4 seconds, a 1,000 slot games roughly corresponds to a playing time between 50 and 66 minutes. For that reason, *win2day* chose to display a pop-up message after the playing of 1,000 slot games. Following the message, the player can then decide whether to stop or to continue the session. The pop-up that appears in the centre of the screen (see Figure 7.1) reminds the player that 1,000 games have been played, and gives the player the option to continue or to stop gambling. The pop-up remains on the screen until the player has pressed “yes” or “no” as to whether he or she wants to continue gambling. If the player presses “yes,” the pop-up message immediately disappears. If the player presses “no,” the game window immediately closes. The size of the pop-up is approximately one-eighth that of the full screen.

To analyse the effect of the recently introduced pop-up message, two representative random samples of 400,000 sessions were accessed, one sample each for before and after the pop-up message was introduced. The total dataset consisted of 800,000 game sessions comprising between them approximately 70,000 gamblers. To investigate the

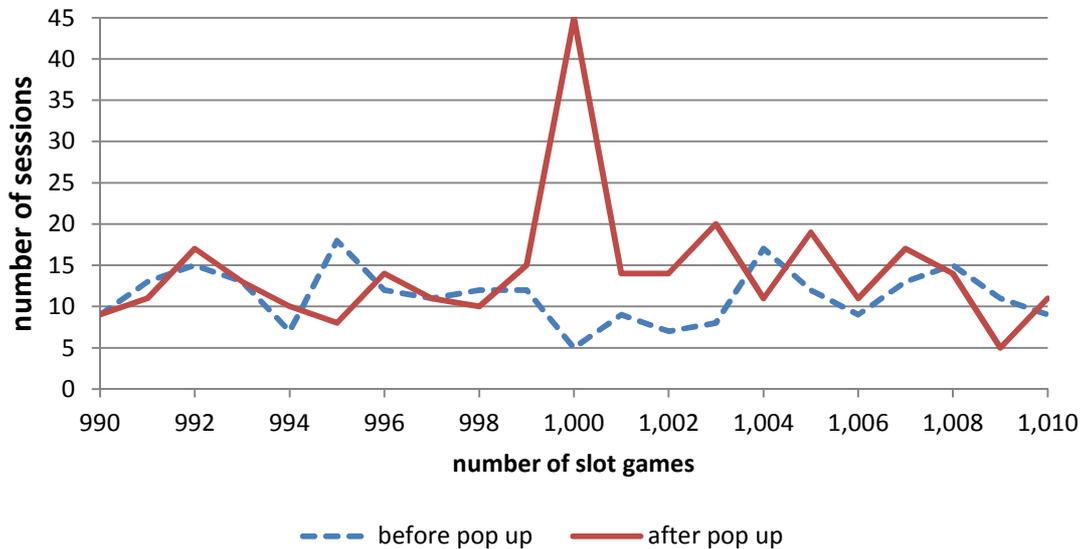
effect of the pop-up message on slot machine playing behaviour within single playing sessions, a random sample of 400,000 playing sessions that took place before the introduction of the mandatory pop-up message was compared to 400,000 random sessions after the introduction of the message. It was hypothesised that the introduction of the pop-up message would lead to an increase in gamblers terminating their gambling session after 1000 consecutive plays.

## 7.2. Results

Results showed that approximately 1% of playing sessions before and after the introduction of the slot pop-up message exceeded 1,000 consecutive slot games within a single gambling session. Results also indicated that players who exceeded 1,000 consecutive plays did so twice, on mean average, during the analysed time period. Therefore, such behaviour was relatively rare among the players of the win2day platform. Without information about the actual intensity of play among this group of gamblers, it can be reliably assumed that a threshold of 1,000 slot games identifies only the most highly involved gamblers.

Of the 400,000 sessions that were sampled before the slot pop-up message was introduced, it was found that 4,220 sessions contained at least 1,000 consecutive plays of the online slot machine. Only five sessions terminated at 1,000 slot games. Of the 400,000 sessions that were sampled following the introduction of the slot pop-up message, 4,205 sessions contained at least 1,000 consecutive plays of the online slot machine. Of these, 45 sessions terminated at 1,000 slot games. The sample was too large to conduct inferential statistics. Figure 7.2 shows the number of sessions ended by players between 990 and 1,010 consecutive slot machine games before and after the introduction of a pop-up warning message. This result clearly shows no differences except at the 1000th consecutive game when the pop-message was shown.

Figure 7.2: Number of sessions ended between 990 and 1,010 slot games before and after the introduction of a pop-up warning message



### 7.3. Discussion

To date, relatively few studies have collected empirical data relating to the effectiveness of social responsibility tools. This study adds to the sparse empirical base both generally and, in relation to pop-up messaging, more specifically. Previous research has often comprised laboratory studies to investigate the effects of pop-up messages on behavioural and cognitive processes such as belief patterns or dissociative states. Although such work is valid and important, laboratory study samples are typically much smaller than other methods (e.g., surveys and behavioural tracking studies), and behavioural results in laboratory situations can be distorted by the non-ecological validity of artificial settings. Gainsbury and Blaszczynski (2011) concluded that both laboratory and field studies provide valuable contributions to the field, but also observe that caution should be taken in interpreting results. Where possible, they asserted that both methods should be used to verify conclusions. This real-world study, that utilised a real-world sample of 800,000 game sessions, provided much more ecologically-reliable behavioural information on the effectiveness of pop-up messaging while gambling, and is not subject to the recall bias effects of self-report methods.

It cannot be definitively concluded from this study that it was the pop-up message only that had an impact on gamblers stopping after 1,000 consecutive plays of the slots game because we can only infer the number of gamblers who saw this message, and did not stop. However, the results obtained appear to show that the introduction of a mandatory pop-up message had an effect in stopping gambling behaviour among a small number of gamblers. More specifically, the results indicated that nine times more gamblers ceased their gambling session, following the viewing of a pop-up message after 1,000 consecutive gambles on an online slot machine game, compared to those gamblers who had not viewed a pop-up message. Although the difference was relatively small, it is argued that it was most likely caused by, and was the direct result of, the displaying of a pop-up message after 1,000 consecutive plays. The reason for this confidence was that the only peak of that magnitude occurred after the playing of 1,000 consecutive game following the introduction of the pop-up.

There are, of course, major limitations to the data collected. The study did not have access to any information about the samples (e.g., age, sex, income, ethnicity, levels of pathology) so it is not known if the two groups differed on any important variables. Another limitation to the study was that it was cross-sectional in design. As such, gamblers were not the same pre- and post- the intervention of the pop-up, and this fact may be a significant limitation for interpretation of the results. Notwithstanding these limitations, the data suggest that pop-up messages can influence a small number of gamblers to cease their playing session, and that pop-ups appear to be another potentially helpful social-responsibility tool in reducing excessive play within session.

## **Chapter 8: Study 5 -Testing normative and self-appraisal feedback in an online slot-machine pop-up in a real-world setting**

As normative feedback and information to aid self-efficacy appear to be essential aspects in influencing behavioural change, this study hypothesised that giving such information to gamblers might influence playing cessation if applied to pop-up messages while gambling. For that reason this study is a direct follow up to study 4. Self-appraisal feedback (i.e., information that helps an individual reflect on their own gambling behaviour), normative feedback (i.e., information that compares an individual's own gambling behaviour with others), cognitive belief feedback (i.e., factual information given to the individual about false gambling beliefs), and self-efficacy feedback (i.e., information that provides help on how they can change their behaviour) have never together been empirically examined in any real-world online gambling setting. Therefore, the present study investigated the effects of a normative and self-appraisal pop-up message among online slot machine players on a real online gambling site. Using the same methodology as in study 4 the goal of the present study was to investigate whether enhanced content on a pop-up message has any additional effect on player behaviour (i.e., will more players stop gambling after seeing an enhanced pop-up message compared to a simple message). It was hypothesised that the enhanced message with enhanced feedback content would lead to an increase in gamblers terminating their gambling session after playing 1,000 consecutive slot games compared to those gamblers who viewed a simple information-based message.

### 8.1. Method

#### ***Background information and data access***

Access was given to a large anonymised dataset from a commercial online gambling operator. In 2011, the online gambling operator decided to supplement their responsible gambling features and introduced a simple pop-up message that is triggered if their

customers play 1,000 consecutive games (i.e., approximately one hour's play) on slot machines during a single online gambling session. A gambling session is initiated when a player logs into their individual account and is terminated if the player logs out or closes their web-browser. The 1000-game threshold was the gaming operator's decision. The operator's reason for choosing a threshold of 1,000 slot games was partly based on the findings of previous studies outlined in the introduction that playing 1000 games takes approximately one hour (i.e., Ladouceur & Sevigny, 2009; Schellink & Schrans, 2002; Schrans et al., 2004). From a technical perspective, it was also easier for the operator to track the number of games played by the gamblers rather than their overall playing time.

#### ***Details about the pop-up message***

After the pop-up message has appeared on-screen, the player can then decide whether to stop or to continue the gambling session. The original ('simple') pop-up message appeared in the centre of the screen and simply informed the player that 1,000 games had been played and gave the player the option to continue or to stop gambling. The pop-up remained on the screen until the player pressed 'yes' or 'no' as to whether they wanted to continue gambling. If the player pressed 'yes', the pop-up message immediately disappeared. If the player pressed 'no', the game window immediately closed. The size of the pop-up was approximately one-eighth of the full screen.

In September 2013, the content of the pop-up message was further enhanced to include self-appraisal, normative feedback, text to address cognitive beliefs commonly found among gamblers, and a recommendation to enhance self-efficacy. The new pop-up message's content was an enhancement of the message content used in study 4. The present study compared the adherence to the enhanced pop-up with the adherence to the original pop-up. In order to analyse the effect of the more recently introduced pop-up message, two representative random samples of 800,000 sessions three months before and three months after the new enhanced pop-up message was introduced were accessed. The total dataset comprised 1,600,000 game sessions that contained at least one slot game with approximately 70,000 online slot machine gamblers. The

methodology is therefore quasi-experimental as it compares gambling behaviour across two different time periods. Data collected in the present study took place between June 2013 and November 2013.

#### ***Details of (and rationale for) the enhanced pop-up message***

The new pop-up message (translated from German, the native language used on the German-speaking site) read: “*We would like to inform you, that you have just played 1,000 slot games. Only a few people play more than 1,000 slot games. The chance of winning does not increase with the duration of the session. Taking a break often helps, and you can choose the duration of the break*”. The reasoning behind the messaging is as follows:

- “*We would like to inform you, that you have just played 1,000 slot games*”: This part of the message objectively informs players about the behaviour they engaged in.
- “*Only a few people play more than 1,000 slot games*”: This part of the message provides normative feedback that very few other gamblers play 1000 consecutive slots games.
- “*The chance of winning does not increase with the duration of the session*”: This part of the message addresses a common misbelief among gamblers (i.e., the gamblers’ fallacy).
- “*Taking a break often helps, and you can choose the duration of the break*”: This part of the message provides advice (to aid self-efficacy) and leaves the decision up to the player and is in line with the techniques of motivational interviewing (Millner & Rollnick, 1991)

Apart from the content of the message, nothing else in the pop-up was changed across the two conditions (e.g., size, location on the screen, etc.). A player has to press the less visible “*Spiel beenden*” (“*Close game*”) button to exit the playing session. If the player presses the “*OK*” button, the pop-up disappears and the playing session continues. The “*close game*” link and the “*OK*” button were exactly the same in both conditions. This is important with respect to the interpretation of the results. All changes in effectiveness

of the message in changing gamblers' behaviour can solely be traced back to changes in message content, as all other variables in the two playing conditions were identical.

### *Details of the dataset and analytic strategy*

The 800,000 sessions with the original pop-up message comprised 11,232 sessions where at least 1,000 consecutive slot games had been played (1.4% of the total sessions prior to the enhanced message being introduced). The 800,000 sessions with the new enhanced message comprised 11,878 sessions where at least 1,000 consecutive slot games had been played (1.48% of the total sessions after the enhanced message had been introduced). These figures demonstrate that the ratio of the most 'highly involved' players was similar in both study conditions and increases the validity of the study. Given the low percentages of sessions that reached 1,000 consecutive plays on the online slot machine, high gaming intensity (i.e., high gambling involvement as defined by the number of consecutive games played) is relatively rare among the player base examined. It can be assumed that the threshold of playing more than 1,000 consecutive slot games per session reliably identified only the most highly involved gamblers. The effectiveness of the pop-up message in both conditions was determined by the number of sessions that terminated after playing 1,000 consecutive slot games.

## 8.2. Results

Of the 11,232 sessions that lasted at least 1,000 consecutive slot games and received the original pop-up message, 75 sessions immediately terminated after the pop-up message was shown at the 1,000<sup>th</sup> consecutive game (0.67%). This behaviour cessation was almost certainly due to the appearance of the pop-up message. Of the 11,787 sessions that lasted at least 1,000 consecutive slot games and received the enhanced pop-up message, 169 sessions immediately terminated after the pop-up was shown at the 1,000<sup>th</sup> game (1.39%).

Table 8.1. Contingency table showing the number of players who stopped after playing 1,000 consecutive games on an online slot machine during the pre-condition (original pop-up message) and post-condition (enhanced pop-up message)

	Ceased to play	Continued to play	Total
Post-condition	169	11,709	11,878
Pre-condition	75	11,157	11,232
Total	244	22,886	23,110

This percentage of players stopping at 1,000 consecutive slot games was significantly higher than the percentage stopping as a consequence of the original pop-up message ( $X^2[1]=31.51, p<0.001$ ). However, large sample sizes often lead to significant results and are not necessarily meaningful. For this reason, the effect size was also calculated. With binary outcomes, the effect size can be derived from the Odds Ratio [OR] (Chinn, 2000). The OR is computed from the chance of ‘success’ in one group relative to the change of ‘success’ in another group. Table 8.1 shows the number of players who ceased or continued to play in the pre- and post-condition. The Odds Ratio is computed

as follows:  $OR = \frac{a}{\frac{a+b}{c}}$  if the cells of the contingency table are labelled in a clockwise

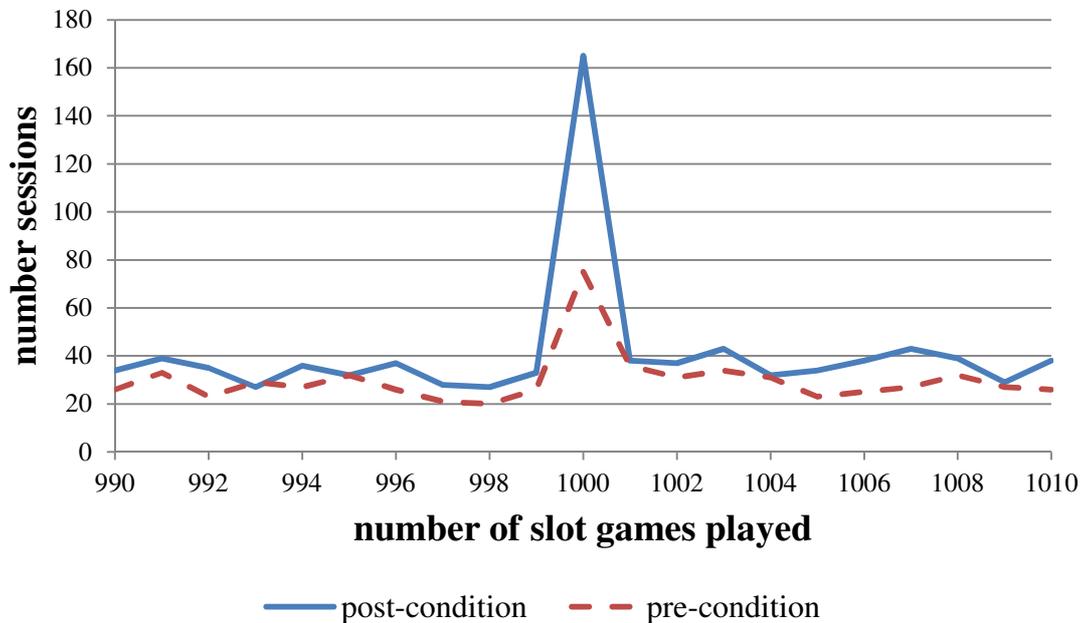
manner. In this case, the OR was  $2.13 = \frac{\frac{169}{11,878}}{\frac{75}{11,232}}$ . Chinn (2000) reports that the natural

logarithm of the Odds Ratio can be converted to Cohen’s  $d$  (Cohen, 1992), a measure of effect size, by dividing it by 1.81. A Cohen’s  $d$  value of 0.42 results when applying the formula  $\frac{\ln(OR)}{1.81}$ . Values between 0.2 to 0.5 are regarded as being small effect sizes (Cohen, 1992). The results therefore show there is an effect. However, the effect is modest.

The effect is further highlighted by Figure 8.1 that shows a clear visible spike that only appears when the pop-up message is shown (i.e., at the playing of 1,000 consecutive slot games). The x-axis range between sessions lasting 990 games to sessions lasting

1,010 games was chosen purely for visual presentation purposes. The selection of this range highlights the spike at exactly 1,000 games played, whereas the number of sessions ending at slightly less than 1,000 games or slightly more than 1,000 games is fairly similar. Figure 8.1 shows the effect of the pop-up is clearly visible, both before and after the message was changed. However the effect is greater after the original (simple) pop-up message was changed to the enhanced one.

Figure 8.1. Number of sessions that lasted exactly 990 to 1,010 consecutive games on an online slot machine during the pre-condition (original pop-up message) and post-condition (enhanced pop-up message)



In the original pop-up message condition, the 75 sessions that immediately ceased after 1,000 consecutive slot games were produced by 71 different players (95%). This demonstrates that very few players reacted to the pop-up message more than once. In the enhanced pop-up message condition, the 169 sessions that immediately ceased after 1,000 consecutive slot games were produced by 139 different players (84%). This also demonstrates that few players reacted to the pop-up more than once. However, the percentage of players who stopped gambling after viewing the pop-up message more than once was higher in the enhanced pop-up message condition. This suggests that the enhanced pop-up message encouraged more players to make use of it more often compared to the original pop-up message.

On the other hand, results showed that 59 of the 71 different players (83%) that terminated their sessions before the pop-up was changed ignored the pop-up message at least once in another session and played more than 1,000 slot games within one session.

After the pop-up was enhanced, the number of players that ignored the pop-up message at least once was 98 out of 139 (71%). The percentage of players that ignored the pop-up message was lower if informed by an enhanced pop-up compared to the purely informative pop-up message. This means that players that made use of the enhanced pop-up message were less likely to ignore it at other times compared to the purely informative pop-up message. This difference was significant ( $X^2[1]=3.95$ ,  $p<0.05$ ). However, the Odds Ratio was 1.18 (Cohen's  $d$  effect size = 0.09), and is therefore negligible according to Cohen (1996).

### 8.3.Discussion

The study outlined in this chapter utilised an empirical sample of 1.6 million game sessions (comprising approximately 70,000 online slot machine gamblers) and provided ecologically reliable behavioural information on the effectiveness of pop-up messaging while gambling. Consequently, the data are truly objective and not subject to the recall bias effects of self-report methods or the lack of ecological validity in laboratory experiments. The effectiveness of two different types of pop-up message was examined and showed that enhanced pop-up messages led to 1.39% of highly involved gamblers immediately ceasing their gambling session compared to 0.67% of highly involved gamblers that only saw the simple pop-up messaging. As the two spikes in Figure 8.1 demonstrate, the cessation of the playing sessions was almost certainly due to viewing the pop-up message. The percentage of players that immediately terminated their sessions due to the viewing of the pop-up message doubled from 0.67% to 1.39% as a consequence of enhancing the message with self-appraisal, normative, and cognitive belief content (compared to self-appraisal only). All other aspects of the pop-up message were identical in the two conditions. This difference was not only statistically significant but also meaningful as demonstrated by the modest effect size.

It should be acknowledged that this study is not a true experiment as the participants were not the same in the two conditions (however, it is likely there would be a large overlap as the data were collected from the same gaming company's customer base

within a short time period). The study would best be described as quasi-experimental in that a pre-condition was compared to a post-condition across different points in time. The percentage of sessions that lasted at least 1,000 consecutive slot games was roughly the same during the pre-condition and the post-condition period. In the original pop-up condition in study 4, only 1.4% of the 800,000 sessions (n=11,232) lasted longer than 1,000 consecutive slot games. In the enhanced pop-up condition, only 1.48% of the 800,000 sessions (n=11,878) lasted longer than 1,000 consecutive slot games. The similarity in percentages supports the claim of overall unchanged conditions, both before and after the pop-up was enhanced. If there was a significant difference in these percentages, one could question the validity of the study because important conditions (e.g., the nature of the games, promotional activity, playing behaviour, etc.) could have changed.

All assumptions made in study 4 also hold true for the present study because the follow-up study was conducted in the same real-world setting. In study 4, nine times more gamblers ceased their gambling session following the viewing of a pop-up message after 1,000 consecutive gambles on an online slot machine game compared to those who had not viewed a pop-up message at all. In the present study, twice as many gamblers ceased to gamble when presented with an enhanced pop-up message compared to the simple pop-up message. This enhanced pop-up contained normative, self-appraisal, and cognitive-belief content as well as behavioural advice to aid self-efficacy. All these aspects have been argued to influence gambling behaviour and enable behavioural change but have never been tested in an empirical setting..

To date, very few studies have been published that empirically investigate effectiveness of social responsibility tools in real world settings. This study adds to the sparse empirical base both generally and in relation to pop-up messaging more specifically. Previous research has often relied on self-report or experimental data, often in laboratory settings, to investigate the effects of pop-up messages on behavioural and/or cognitive processes such as belief patterns or dissociative states. Although such work is valid and important, laboratory study samples are typically much smaller than other

methodologies (e.g., surveys, behavioural tracking studies) and behavioural results in laboratory situations can be distorted by the non-ecological validity of these artificial settings.

There are, of course, limitations to the data collected. Gainsbury and Blaszczynski (2011) suggested using both methodologies (i.e., laboratory and field) to test hypotheses. Therefore, caution should be taken in interpreting results when only one approach or methodology was used. There was no access to any other information about the samples (e.g., age, sex, income, ethnicity, levels of pathology) so it is not known if the groups in the two conditions differed on any key variables. Another important limitation to the present study was that it was cross-sectional and quasi-experimental in design. As such, the gamblers were not necessarily the same pre- and post- the pop-up message intervention and this may be a significant limitation for interpretation of the results. However, (as mentioned previously), there is no evidence to suggest that the most heavily involved gamblers before and after the change in pop-up messaging did not comprise many of the same people as these were all presumably regular gamblers on this particular website and the study's data were collected over a relatively short time period (i.e., six months).

Although the message in the present study was enhanced with text based on psychological theory relating to behaviour change, it cannot be determined which specific aspect(s) (i.e., normative, self-appraisal, cognitive-belief and/or information to aid self-efficacy) had the greatest effect in enabling the small behavioural change. The additional benefit may also be due to the fact that the enhanced message was simply much longer than the previous message text. It is also worth noting that the normative part of the pop-up message was a general statement (“*Only a few people play more than a 1000 games*”). A much more specific statement may have had a more pronounced effect on the results. For these reason, an experimental study in which every different permutation is applied with more specific messages would need to be carried out. Such an approach would also shed light on possible synergies and interactions between the different intervention strategies, much like the research of Wohl, Gainsbury, Stewart

and Sztainert (2013). However, the underlying study was conducted in a real-world gambling environment and ecological validity was therefore much higher than a laboratory study.

Overall, the data suggest that pop-up messages influence only a small number of gamblers to cease long playing sessions and that enhanced messages are slightly more effective in helping gamblers to stop playing in-session. The most likely explanation for the doubling of sessions stopping in the enhanced feedback condition was due to the changed content of the pop-up message. Looking at the results, some may argue that the findings show that pop-up messages are ineffective in changing the behaviour of a high-intensity gambler (as only 0.67% to 1.39% across the two conditions ceased gambling). However, seen from a more optimistic point of view, it can be argued that pop-up messages are only one of a range of responsible gambling tools that are available, and that the additive effect of such a feature when combined with other responsible gambling features available (e.g., time and money spending limits, self-exclusion options, etc.) is of use.

Taking the more optimistic line about the results presented here, future studies should try to determine the specific impacts of different theoretical concepts such as normative beliefs, self-appraisal, and information that aids self-efficacy. Ultimately it will be gaming operators that implement responsible gaming initiatives. Real world studies such as the present one are an important way of determining the practical effectiveness of pop-up interventions. At present, several responsible gambling accreditation organisations (e.g., *GamCare*) mandatorily require pop-ups, and this is another reason to investigate their impact in real world environments. However, it has to be emphasised that real world studies are accompanied with specific strengths as well as specific weaknesses. The main strength is the high external validity, because the intervention occurred in a real world setting and the study participants were real players. On the other hand, external factors cannot be controlled in the same manner as in laboratory-based studies. Overall, the findings presented here provides a potentially important insight into the effectiveness (or non-effectiveness depending upon viewpoint) of pop-

up messaging as a responsible gambling intervention for gaming operators around the world that provide screen-based games.

## **Chapter 9: Study 6 -The use of personalised behavioural feedback for online gamblers: An empirical study**

The study in this final empirical chapter examines personalized feedback and information given to players during real world gambling sessions. More specifically, its aim is to investigate the effects of personalized information about past gambling behaviour on future gambling. (See Chapter 2 for a review of the literature relating to personalised feedback in gambling). It was hypothesized that gamblers receiving tailored feedback about their online gambling behaviour would be more likely to change (i.e., reduce) their behaviour (as measured by playing duration and theoretical loss) compared to players who did not receive feedback.

### **9.1. Method**

#### **Participants**

A large online-gambling operator granted access to behavioural tracking data of 1,358 gamblers who had voluntarily signed up to a behavioural feedback system (mentor) that is offered to all customers on the website. The behavioural feedback system is an additional service provided by the gambling operator. The players were notified about the system via email and they also had information available online while they are playing. The participants were not selected randomly as they could decide for themselves whether to opt into using the service that was advertised on the gambling website as a responsible gambling tool that helps players gamble more responsibly.

#### *Overview of the Behavioural Feedback System*

This section provides a brief description of the behavioural feedback system implemented by the gambling operator. The system is an opt-in system (i.e., gamblers can voluntarily choose to use it and the system is not mandatory). Once gamblers have enrolled to use the system, they can retrieve detailed visual and numerical feedback about their gambling behaviour via a button on the website. Player feedback is displayed in a number of ways (numerical, graphical, and textual) and provides

information about wins and losses, playing duration (PD), number of playing days, and games played. The system can also display personal gambling behaviour over time. For instance, Figure 9.1 shows the playing time information for a hypothetical player in the form of a graph over time. At the top of the screen, players receive information about playing time over the previous 4-week and 24-week period. The white line in Figure 9.1 indicates that the player shows an upward trend and is steadily increasing the amount of time spent gambling. During the previous 4-week period, the player spent 25.75 h gambling online. The upper line in Figure 9.1 is the average playing time for all other comparable (either lottery-type or casino-type) online players and provides the gambler both normative and comparative feedback. Such feedback has been emphasized as an important aspect in facilitating behavioural change (Miller and Rollnick, 1991). Players are either assigned to 'lottery' type players or 'casino' type players based on their playing patterns. The categorization is derived from the theoretical loss (TL) that is produced in casino and lottery games respectively.

Figure 9.1: Illustration of ‘time played’ information in the feedback system as seen by a hypothetical player

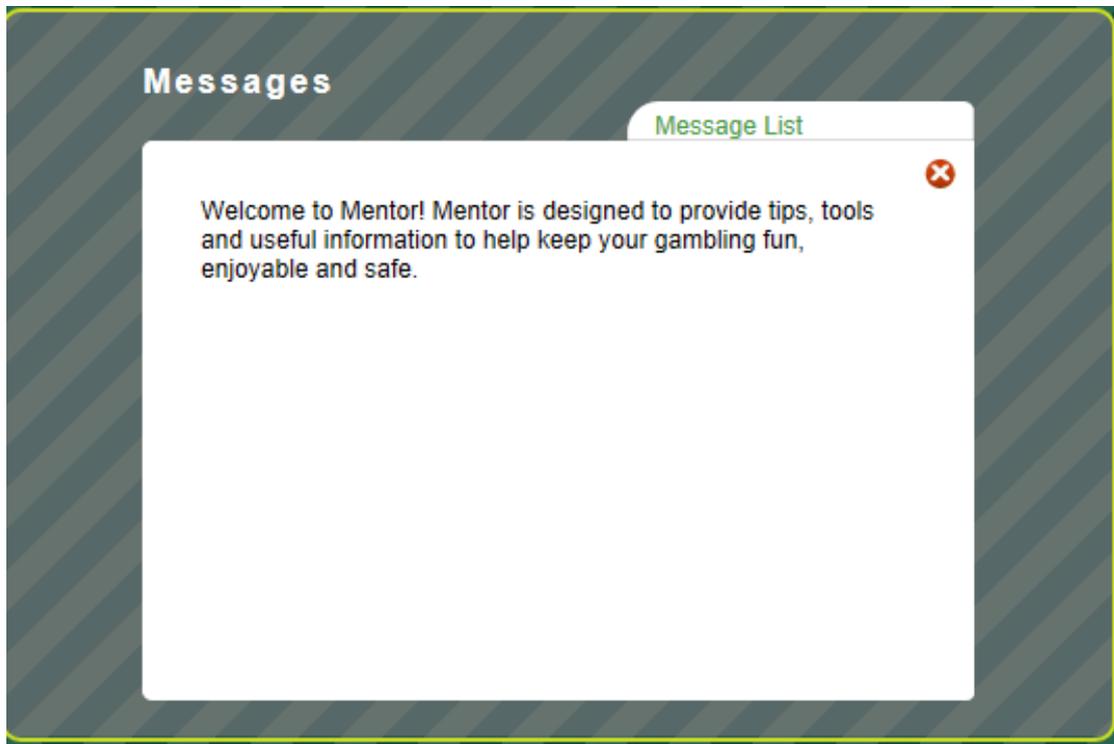


Of the daily active players, 10% (n = 1,358) opted into the system. Players could opt-in via a clearly visible button on the post-login website page which appeared immediately after they logged into their account. The personalized information appeared in a new pop-up window. This typically led to a break in play, as gamblers who viewed the information are unlikely to play and view information simultaneously. Due to reasons of data protection, the players’ interaction with the system is anonymous and not tracked. For this reason it is not known how often players retrieve the information or how much time they spent viewing the information. The system tracks those players who sign up and therefore the opt-in date is known and can also be used for analytical purposes.

Game categories were developed similar to other research in the gambling studies field (Gainsbury et al., 2012) and studies 1 and 2. The eight game types available on the

gambling operator's website are Lottery Draw, Lottery Instant, Poker, Bingo, Casino Slots, Casino Videopoker, Casino Table, and Sports Wagering. Additionally, players receive a message that welcomes players to the system (see Figure 9.2). All the visual, numerical, and textual information can be accessed by the gambler via a user-friendly on-screen dashboard. Responsiveness means that interactive content automatically adapts to technical environments. The player front end thus looks similar on different devices such as desktops, laptops, mobile phones, or tablets and also across different browsers and operating systems such as Windows, Android, or iOS. In line with Human-Computer-Interaction (HCI) principles, professionals both from a content and visual point of view designed the system. Persuasive Design (PSD) was taken into account by the salient self-monitoring features of the system, the personalized content, and normative information

Figure 9.2: Information message sent to players about the feedback system



The hypothesis investigated whether players' gambling behaviour (i.e., time and money spent gambling) changes after they have registered for the system and see the personalized feedback for the first time compared to the gambling behaviour of a matched pairs control group. Both Playing Duration (PD) and Theoretical Loss (TL) 14 days before and 14 days after registration were measured. TL refers to the amount of money wagered multiplied by the payout percentage of a specific game played. In order to be able to investigate the effect of the personalized feedback an appropriate time period of playing had to be observed. If there was an influence on gambling behaviour it would most certainly materialize quickly after the information had been viewed. If a short-term change in gambling behaviour is visible, long-term changes can be hypothesized and investigated in future studies. A long-term change was unlikely and would only have been observable in a true experimental setting.

The next issue was determining the length of time needed to detect behaviour change. The distribution of gambling behaviour on the gambling website ranges from daily play to weekly play to less than weekly play. Additionally, players were not randomly assigned to the study and therefore several other factors could not be controlled for. The online gambling site imposes a weekly deposit limit upon all players that cannot be exceeded. There are also numerous marketing campaigns that target players at any given time. For that reason, a longer observable time period would probably not have yielded any significant changes as the gambling behaviour may have been influenced by many other factors. However, if the time period is chosen too short, changes might only be purely random and players who play rarely might not even have had a chance to play. For that reason it was chosen to compare 14 days of playing behaviour prior to opt-in to 14 days after opt-in. Two metrics – ‘TL’ and ‘PD’ were measured.

#### *Rationale for matched pairs design*

The aim of the present study was to determine whether the presentation of personalized feedback to gamblers has an effect on their subsequent playing behaviour compared to those gamblers that do not receive personalized feedback. Due to the fact that the players voluntarily chose to sign up for the service it is not appropriate to simply compare the behaviour before and after the registration, as the sample is not a random representation of the population.

After the data were provided, careful thought was given to all of the ways in which the data could be analysed. Following an initial inspection of the data, it became clear that comparing the overall amount of time and money spent by gamblers before and after using the personalized feedback system (i.e., within-group analysis) would not be meaningful because there was very large variation in what individual gamblers spent financially and how long they played in terms of time. For instance, some gamblers spent 100s of Euros on every gambling session while others spent just a few Euros per session. The resulting mean average differences in terms of time and money spent as a whole group before and after using the personalized feedback tool were therefore likely to be spurious because of the large individual differences in gambling behaviour.

Furthermore, there was no way of assessing whether the difference in the amount of time and money spent within group was significant as there was no reliable comparison point. Therefore, a control group was needed.

One way to determine a valid control group is via a matched pairs design in which similar players out of the population are assigned to each of the 1,358 target group members. The control group population only comprised online gamblers that had not used the system but who played during the period in which those in the target group signed up for the system. Matched pairs for the target group members were chosen using the following criteria:

- **Age:** Control group members had to be in the same age group as the target group member. Age groups were derived from Wardle et al. (2011) and can be seen in Table 2.
- **Gender:** Control group members had to be the same gender as the target group member
- **Playing duration 14 days before registration:** Control group members had to have gambled for the same amount of time as the target group. Players were matched if their PD in the 14 days before the registration date was within 10% of the target individual. For instance, if a target group member played for 10 h during the 14 days, the control group member's PD needed to be within 9–11 h in order to be considered for matching.
- **Theoretical loss 14 days before registration:** Control group members had to have the same TL as the target group. Players were matched if their TL in the 14 days before the registration date was within 10% of the target individual. Control group members were matched if their TL in the 14 days prior to registration was within 10% of the target individual. For instance, if a target group member's TL was €100, the control group member's TL needed to be within €90–€110 in order to be considered for matching.

Demographic variables have reported to correlate with gambling behaviour. Potenza et al. (2001) reported gender-related differences in underlying motivations to gamble and in problems generated by excessive gambling. They concluded that different strategies may be necessary to maximize treatment efficacy for men and for women with gambling problems. Frequency of play as measured via 'PD' and 'TL' are important moderators of gambling behaviour. Afifi et al. (2014) re-analysed the data from the nationally representative Canadian Community Health Survey (CCHS) and showed that after adjusting for gambling involvement, gender and age no longer moderated the correlation between frequency of play and game type. They suggested a shift toward a more complex model that also included the level of gambling involvement. The type of game played was not used to match players. However, similar values in PD as well as TL will necessarily lead to similar game-type preferences. It is unlikely that a player who spends a lot of time on slot machines would be matched with a player who preferred lottery games, because lottery players do not require much interaction with the website to gamble.

All of the four main criteria (age, gender, PD, TL) were weighted equally. For that reason, each target group member was matched with at least one control group member (as described above). On the majority of paired matches, target population individuals were paired with more than one control player from the total population that amounted to ~53,000 players. In order to determine the effect for each target group member, PD and TL in the 14 days after the registration were divided by the PD and TL 14 days before the registration. This indicator will subsequently be called the 'ratio.'

For each gambler that used mentor and for each gambler who did not, the ratio of playing intensity was computed as well as PD before and after they signed up to the system. The smaller the ratio, the lower the subsequent gambling intensity (in terms of PD and TL), and therefore higher the effect of the personalized feedback. Each target group member's computed ratio was compared to the mean average ratio of the matched pairs for that target group member, both for PD and TL. If a target group member's ratio was smaller than the respective control group's average ratio it was concluded that the

target group member's behaviour decreased more as a consequence of the personalized feedback compared to the control group members who did not receive this information. So for each target/control pair, a binary variable was computed. The actual difference was not analysed as the different target/control pairs showed large individual variation. The way the study was designed was to make sure the gambling behaviour between the two groups were comparable (that is why the matched pairs design was chosen). Ethical approval for the study was given by the research team's University Ethics Committee.

## 9.2. Results

### *Gamblers using the personalised feedback system*

Of the 1,358 gamblers that had registered to use the mentor system, the vast majority ( $n = 1,119$ ) had played on the website in the 14 days prior to their registration on the system. The 239 gamblers that did not gamble 2 weeks before registering were excluded from the analysis. This was because it would be impossible to determine if the behavioural feedback had an effect on subsequent behaviour because the starting point would have been no gambling activity (meaning they would have automatically showed an increase in gambling intensity).

### *Gender distribution of samples*

The gender distribution in the target group was compared with the expected gender distribution that was computed from all active players during the research period. Via this comparison, the representativeness of the target group to the whole population on the gambling website with respect to gender can be determined. The distribution of 80% males and 20% females in the target group did not deviate significantly from the expected distribution of 78% males and 22% females. The chi-square test was not significant ( $\chi^2[1] = 1.22, p = 0.27$ ). Therefore, in terms of gender, the target group was representative of the population of players on that gambling website.

### *Age distribution of samples*

The age distribution in the target group was compared with the expected age distribution that was computed from all active players during the research period. The

chi-square test was significant ( $\chi^2[6] = 46.24, p < 0.0001$ ) which means that in terms of age, the target group was not representative of the population of players. The biggest difference occurred in the group aged 30–44 years. In the target group, 18% were between 30 and 44 years, and in the population group, 25% were between 30 and 44 years. No other differences were observed.

#### *Gambling intensity of samples*

In order to determine the target groups' representativeness regarding gambling intensity, the TL percentile values at 10, 25, 50, 75, and 90% in the population of active players were determined. The number of target group members between those percentiles was then computed. Table 1 contains the distribution of target group members with respect to TL. The column 'expected %' describes the expected percentages according to the population distribution. It can clearly be seen that the sample is underrepresented in the lower range and overrepresented in the higher range. For instance, 17% of the target group members are in the top 10% whereas only 10% would have been expected if the target group was equally distributed across the population. On the other hand, only 18% of the target group members are between the first quartile (Q1) and the median, whereas 25% would be expected if the target group was equally distributed across the population. Consequently, the chi-square analysis was significant ( $\chi^2[5] = 134.22, p < 0.0001$ ).

Table 9.1: Theoretical loss distribution of the online gambler target group population (n=1,119)

	N	Actual %	Expected %
10 <sup>th</sup> percentile	87	8%	10%
25 <sup>th</sup> percentile	106	9%	15%
Median	200	18%	25%
75 <sup>th</sup> percentile	307	27%	25%
90 <sup>th</sup> percentile	224	20%	15%
100 <sup>th</sup> percentile	195	17%	10%
	1,119		

### *Group differences*

The differences in age and TL between the target group and the population of all active players are important indicators for the necessity of a matched pairs design described above. Therefore, each target group member was matched with several control group members that did not opt to use the behavioural feedback system. As all the indicators for matching were weighted equally, all control group members that met the required criteria were selected for a given target group member. At least one valid control group member was found for 1,015 of the players that had registered for the system. Therefore, 104 target group members were discarded from the analysis because of a lack of comparability. Table 2 displays the distribution of the number of matched control group members across the remaining 1,015 individuals in the target population. On average, each target group member was matched with 18 control group members. The same control group members were sometimes matched with several different target group members and the total number of unique online gamblers in the control group was 15,216. This number is reported in Table 2 as “N unique control.” The maximum number of control group members matched with one target group member was 260.



Table 2: Distribution of the number of matched controls across the target group

N (target)	1,015
Min	1
Max	260
Average	17.99
SD	25.52
N unique	
control	15,216
10 <sup>th</sup> percentile	2
25 <sup>th</sup> percentile	4
Median	9
75 <sup>th</sup> percentile	20
90 <sup>th</sup> percentile	48

---

#### *Effect of personalised feedback*

The effect that the personalized behavioural feedback had on subsequent TL and PD of those that signed up to the system was then statistically analysed and compared with that of the control group. It was assumed that any difference between the gambling behaviours in the two groups could be due to chance and would be similar to the tossing of a coin. For that reason, it was assumed under the null hypothesis that in 50% of the cases the target group's gambling behaviour (as measured by time and money spent) would be higher than the control group's gambling behaviour and in 50% of the cases the control group's gambling behaviour (as measured by time and money spent) would be higher than the target group's gambling behaviour. Therefore, any deviation from that distribution is due to the effect of the tailored feedback. In the present study, the difference between the actual observed percentage to the expected percentage (50%) of gambling behaviour was statistically tested.

Of the 1,015 target group members, 625 (62%) showed a smaller TL ratio and 610 (60%) showed a smaller PD ratio (compared to the average TL ratio of the matched control group members). Among these target group members, overall gambling

behaviour (as measured by TL and PD) decreased more after registration than among the matched control group members. A standard normal distribution test was used to compare the actual percentage of target group members who showed a smaller TL than the respective control group members with the expected percentage of target group members who showed a smaller TL than the respective control group members. The results showed significant differences for both TL ( $Z = 7.38$ ;  $p < 0.0001$ ) and PD ( $Z = 6.43$ ,  $p < 0.0001$ ). Therefore, behavioural feedback had the desired impact on subsequent playing behaviour with respect to monetary spending and play duration.

#### *Personalised feedback and gambling intensity*

Analysis was also carried out to see if gambling intensity was associated with the effect of personalized feedback. To do this, the 1,015 target group members were divided into ten equally sized groups according to the TL in the 14 days prior to registration. Table 9.3 shows the percentage of target group members in each group for which the TL or PD ratio was smaller than the average of the matched control group members. The 10% least gambling intense players (as measured by TL) had the lowest effect on the time and money they spent gambling, whereas those in the fourth group had the highest effect (see Table 9.3). However, no clear pattern emerged.

Table 9.3: Effect of the behavioural feedback on theoretical loss (TL) and playing duration (PD) across monetary gambling intensity groups

TL group	Effect TL	Effect PD
1	55%	51%
2	56%	59%
3	56%	53%
4	74%	74%
5	62%	61%
6	60%	53%
7	65%	70%
8	66%	59%
9	62%	58%
10	59%	62%

One would naturally expect that an intervention such as the responsible gambling tool in this study would influence the time and money spent in a similar way. More specifically, players that decreased the amount of money they spent would also be more likely to decrease the amount of time they spent gambling (and vice versa) as a consequence of using the system. If there was no association between the changes in time and money spent then it would likely indicate potentially spurious results that might have occurred purely by chance. Consequently, to further evaluate the internal validity of the results, the association between the effects on time and money spent across the target group members was statistically examined. This was done via cross-tabulating the effect on TL and PD (see Table 4). In order to determine if there is a positive association between TL and PD, the frequencies expected under the null hypothesis were computed. The expected frequencies under the null hypothesis are highlighted in Table 9.4.

Table 9.4: Observed and expected cross-table between effect on theoretical loss (TL) and playing duration (PD)

Observed Effect PD			
Effect TL	No	Yes	
No	289	101	390
Yes	116	509	625
	405	610	1015

Expected Effect PD			
Effect TL	No	Yes	
No	156	234	390
Yes	249	376	625
	405	610	1015

Comparing the observed and expected frequencies in Table 9.4 it can be seen that the values in the lower half of the table are bigger in in the main diagonal and smaller in the secondary diagonal. This means that the number of players who showed an effect in relation to time and money spent was bigger than expected (i.e., 289 vs. 156) and the number of players that did not show an effect in relation to time and money spent was also bigger than expected (509 vs. 376). The number of players that only showed an effect in one of the behaviours was smaller than expected. This means that the registration influenced time and money spent in a similar way and underlines the internal validity of the study. Given the fact that the main diagonal's numbers are higher than expected under the null hypothesis and the secondary diagonal's numbers are lower than expected, it is not surprising that the distribution in the lower half Table 4 is significantly different from a purely random distribution ( $\chi^2[1] = 309, p < 0.0001$ ).

### 9.3. Discussion

The study in this chapter aimed to evaluate the effectiveness of a personalized behavioural tool (i.e., mentor) on subsequent gambling behaviour in a real world

population of online gamblers by comparing it with a group of matched controls that did not receive personalized feedback. Results indicated that the personalized feedback system achieved the anticipated effect and that the time and money spent gambling was significantly reduced compared to that of the control group. The results suggest that responsible gambling tools such as mentor may help the clientele of gambling companies gamble more responsibly, and may be of help those who gamble excessively.

Although the present study did not study disordered (i.e., problem) gambling, responsible gambling tools may also be of help to this group of gamblers. Disordered gambling may be influenced by the failure to set and adhere to pre-set monetary limits (Lesieur, 1979). Tools such as the system evaluated here, may help facilitate the setting of and adhering to such limits as some of the personalized information provided links to pre-commitment limit setting tools on the gambling operator's website. Pre-commitment measures have been shown to effectively limit players' time and money spent gambling (see study 3; Stewart and Wohl, 2013; Wohl et al., 2013). The results in the present study appear to concur with the literature on dynamic pop-up messages that show they effectively change players' gambling-related beliefs and subsequent behaviour (e.g., Schellink and Schrans, 2002; Ladouceur and Sevigny, 2003; Cloutier et al., 2006; Monaghan and Blaszczynski, 2007, 2010a; Monaghan et al., 2009). The findings also support the assertions of Monaghan and Blaszczynski (2010b) who claimed that warning signs should promote the application of self-appraisal and self-regulation skills.

This study takes into account many of the findings from previous research, such as presenting information in a non-confrontational way (e.g., Miller and Rollnick, 1991) and displaying them in an appealing and HCI-inspired interactive environment (Wohl et al., 2010, 2014). In the present study, players received personalized information along with normative comparisons that reflected their actual personal gambling behaviour.

The way that the information was presented was in line with previous laboratory research and followed concepts of HCI and PSD principles (Fogg, 2003; Wohl et al., 2010, 2014). One of the goals of the study was to investigate whether personalized numerical and visual (as well as normative) feedback could change behaviour (i.e., reduce the amount of time and money spent gambling) in a real world gambling environment. Results showed that compared to the control group, players significantly decreased the amount of time and money spent after they were exposed to the personalized information about their individual behaviour for the first time. These results appear to show that personalized, behavioural feedback has significant and relatively immediate effects on subsequent gambling behaviour compared to controls. This is not surprising given the evidence in the gambling studies field (e.g., Kim et al., 2014) as well as other areas of non-gambling research (Farmer et al., 2005; Buttussi et al., 2006; Cho et al., 2009; Colkesen et al., 2013). The main results were also validated by additional analysis showing that the individual players reacted similarly with respect to time and money spent when provided with personalized feedback.

Despite the many strengths of this study, there are a number of key limitations. All of the participants in the target population had voluntarily registered to use the system and were therefore not selected randomly from the population of players. In an attempt to overcome this, a matched pairs design was chosen in which each and every target group member was matched with a number of most similar control group members who were not given personalized feedback. This matched pairs design is the next best approach in overcoming the problems associated with investigating non-randomly selected target group members. However, it is worth noting that in reality, most responsible gambling tools and systems used currently are very often based on voluntary commitments from the player. Therefore, the context in which the gamblers were investigated in the present study had high external (and ecological) validity. However, the reliability is limited due to the fact that data were only collected from one online gambling environment. Replicating the results with other operators and other gambling channels (such as EGMs) would help further corroborate the findings reported here.

It could also be the case that players who voluntarily signed up to receive messages about their play were fundamentally different from controls and had a desire and intention to reduce their gambling. Therefore, the control group may not have actually acted as a true control and the impact of messages may have been indirectly inferred rather than measured. Put more simply, gamblers who voluntarily signed up to receive messages may have already been interested in reducing their gambling and would be likely to gamble less. Future studies should also incorporate qualitative information in order to be able to analyse players' attitudes and opinions toward such systems.

Given this limitation, it is not absolutely certain that it was the intervention that caused the difference in behaviour compared to controls, rather than differences in the gamblers who signed up and their motivation to gamble more or less. Simply looking at reductions in time and money spent gambling does not allow the causal mechanism to be determined in the present study. This could only have been done if the players were randomly allocated to receive the informative messages (which was impossible to do given the data were collected on a real gambling site). There is no way of determining if the gamblers read the messages they received and how they were influenced if they were read, or whether it was the personalized feedback and/or the comparative feedback that had most influence in reducing the time and money spent gambling.

The effects of the mentor system are fairly modest – 12% above expected for TL and 10% for play duration. Taking this into account, along with the relatively small effect sizes from using the system, some may argue how effective the tool is for reducing the amount of time and money spent gambling. While erring on the side of caution, one could also take the more optimistic view that the results do at least suggest that those gamblers using the tool lowered their gambling involvement compared to those not using it. However, other important limitations remain. The results here may not be generalizable to other jurisdictions. Furthermore, the study provides no definitive indication that any of the gamblers who voluntarily opted to use the system were at-risk or problem gamblers. Therefore it is not known whether the system captures gamblers

most in need of this intervention. Based on the findings, one explanation may be that the tool may simply be curtailing gambling in those who already gamble responsibly.

A further limitation is that there is no way of knowing whether the target group used other online gambling sites, or land-based gambling, during the evaluation period. These gamblers may have transferred their gambling activity elsewhere to avoid negative personalized feedback via the system. Studies such as the British Gambling Prevalence Surveys (Wardle et al., 2007, 2011b) have shown that at-risk and problem gamblers in particular engage with numerous gambling websites and gambling forms. In an ideal study, what is really needed is a pre- and post-assessment of all of these individuals' gambling, not just the single site. However, this was not possible given the nature of the study.

The fact that this study was performed in a real world setting with objective behavioural data provides many advantages but is limited because motivations and cognitive mechanisms of the participants are unknown and can only be inferred. Furthermore, the study focused on only 2 weeks of gambling behaviour following first exposure to the information. Future studies should also examine longer-term behavioural changes and corroborate findings with other psychological and dispositional mechanisms via the collection of self-report data.

Online gambling operators have the technical capabilities to introduce behavioural feedback systems such as the one described in the present study, and the results presented here suggest that the desired effect of helping players limit the amount of time and money spent gambling can be achieved. Future research should investigate behavioural feedback in more detail in order to better determine which player attributes (e.g., personality traits, beliefs about the nature of games, motivations to gamble, etc.) are associated with positive behavioural changes and whether there are interactions with other variables such as types of games played or intensity of gambling. Furthermore research should focus on investigating personalized messages and at which point in time players should receive messages to optimize behavioural change.



## Chapter 10: Conclusion

### 10.1. Introduction

For most people gambling is a leisure activity. However, as argued throughout this thesis, for some people gambling can become addictive and harmful to their lives. With the advent of the internet and the increasing abundance of interactive devices such as smart phones and tablets the popularity of internet gambling has increased. From a player protection point of view, it has been shown via the studies in this thesis that gambling on the internet can also be turned into an advantage. Players have to register in order to be able to play and each and every bet made can be tracked. Over the last few years, researchers have studied innovative Responsible Gaming (RG) tools that leverage the availability of this information. The empirical studies in this PhD build upon these insights and look at ways of analysing player data and the effectiveness of RG tools that are based on player data in online gambling environments. In contrast to the studies in this thesis, most previous research in the area has been based upon self-recollected information which has some specific disadvantages compared to objective information (Griffiths & Auer, 2011).

It has also been shown that players' estimated losses are biased (Braverman et al., 2014) which means that self-recollected information has to be considered carefully when used as a proxy measure for gambling involvement. Other studies that have made use of player information have been conducted in laboratory settings (e.g. Wohl et al., 2010, 2013, 2014; Kim et al., 2014) The gambling behaviour demonstrated in real world settings might deviate from that shown in laboratory settings. For this reason, the present PhD contributes to the understanding of the effectiveness of RG Tools.

### 10.2. Key Findings

To date, there have been a number of different approaches to collecting information about online gamblers. More specifically, most published studies concerning online gambling have used one of two approaches – behavioural tracking studies (e.g., studies that collect data based on real online gamblers' data typically supplied by online gaming

operators to academic researchers) and self-report studies (e.g., studies that collect data via surveys, focus groups and/or interviews) (Griffiths & Auer, 2011). As noted in more detail in Chapter 3, both of these approaches have advantages and disadvantages. Most importantly behavioural tracking data provides a totally objective record of an individual's gambling behaviour on a particular online gambling website (whereas individuals in self-report studies may be prone to social desirability factors, unreliable memory, etc.). Furthermore, behavioural tracking data are arguably the most appropriate measure of assessing players' true gambling involvement.

However behavioural tracking data tell us nothing about the relationships between gambling and other behaviours (e.g., the relationship between gambling and alcohol or the relationship between gambling and tobacco use). Behavioural tracking data also cannot examine problem gambling using current diagnostic criteria (whereas self-report studies can). In fact, behavioural tracking data studies cannot tell us anything about problem gambling as this is not a variable that has been examined in any of the published studies to date. Data for behavioural tracking studies also mostly come from one or several operators whereas self-recollected information can be collected from representative samples. Self-recollected losses as a proxy measure of real losses have been studied by Braverman et al. (2014). They found the subjective information to be biased. Gamblers were more accurate when asked about short-term (i.e., three-month) losses than long-term (i.e., six-month) losses.

To date, few studies have combined behavioural tracking data and self-recollected information to gather a holistic picture of gambling behaviour. However, each type of information has shortcomings that can only be overcome by utilizing a combined approach. Many recent studies of internet gambling – particularly those that have analysed behavioural tracking data have used variables such 'bet size' and 'number of games played' as proxy measures for 'gambling intensity' (e.g., Broda, LaPlante, Nelson, LaBrie, Bosworth & Shaffer, 2008; LaBrie, Kaplan, LaPlante, Nelson & Shaffer, 2008; LaPlante, Kleschinsky, LaBrie, Nelson & Shaffer, 2009; LaPlante, Schumann, LaBrie & Shaffer, 2008; Nelson, LaPlante, Peller, Schumann, LaBrie &

Shaffer, 2008; Dragicevic, Tsogas & Kudic, 2011). However, neither bet size nor the number of games played takes into account the house advantage of a game. Players are risking less when they play games with low house advantages. A low house advantage, therefore, corresponds to a high payout.

Study 1 of this thesis argued that the best and most stable measure for ‘monetary gambling intensity’ is the ‘theoretical loss’. The theoretical loss takes into account the house advantage and can be used to determine the monetary gambling intensity, even during short periods of play. In the long run the theoretical loss is the same as the real loss. However in the short-term, the real loss is biased due to the random nature of events over short periods of times or few games. This is why the theoretical loss should be chosen as it best reflects the riskiness of the monetary involvement over short periods of times and if only a few games are played. For instance, lottery games typically have relatively high house advantages (e.g., 50%), whereas casino games typically have relatively low house advantages. For example, roulette games with a single ‘zero [0]’ on their wheels, have a house advantage of 2.7%.

Study 1 demonstrated that the bet size only accounted for 56% of the variance of the theoretical loss and that the number of games played (another measure popular in previous studies) only accounted for 32% of the variance of the theoretical loss. The results supported the hypothesis that bet size and the number of games played were not valid proxy measures of gambling intensity.

Study 2 was an empirical follow-up to study 1 which was of theoretical nature. It empirically examined the relationship between bet size, number of games played and theoretical loss among a real sample of 100,000 online gamblers from a specific online gambling website. The correlation between ‘bet size’ and the overall ‘theoretical loss’ across the eight game types for the 100,000 players was 0.85. Although this correlation was significant, the bet size alone explained only 72% of the variance of the theoretical loss. The error found in the empirical analysis was lower than in the simulation study, but this was because the house advantages were not as different as assumed in the

simulation study. The study also demonstrated that the correlation deteriorated as a function of the diversity of play. The more game-types a player was involved in, the less reliable bet size and number of games played were as proxy measures of gaming intensity.

Studies 1 and 2 clearly showed that behavioural tracking studies should use theoretical loss as a proxy measure of monetary gambling intensity rather than bet size and number of games played. Theoretical loss delivers information about the amount of money players are willing to lose on the long run as a function of their playing pattern. Of course, theoretical loss also has its' shortcomings. Lottery games have a much higher house advantage than slot games which means that players risk less money playing the latter. However, slot games are considered more 'dangerous' and 'harmful' based on their features such as the event frequency (e.g., Linnet et al., 2010). The theoretical loss does not take this into account. In fact, one single measure cannot deliver all the information as gambling is multidimensional and not only concerns monetary involvement. For example, time spent gambling and attitude towards gambling are other important aspects of gambling that need to be considered when examining the findings from behavioural tracking studies.

As noted earlier in this thesis, one social responsibility practice used by online gambling operators is the opportunity for players to pre-set limits for the amount of time and money they spend on gambling per day and/or per calendar month. This is a practice that is now widespread among online gaming operators (Wood & Griffiths, 2010). The use of voluntary (and mandatory) limit-setting options are viewed by some gambling companies and some researchers as a method of putting informed player choice into place at gaming sites (Griffiths & Wood, 2008). Spending limit practices operated by current gaming operators come in a variety of forms. For instance, Wood and Griffiths (2010) reported that players' spending can be restricted in terms of deposit limits, play limits, loss limits, and bet limits.

In study 3, a sample of 100,000 players from an Austrian online gambling website was used to study the impact of voluntary deposit and time limits on subsequent gambling behaviour. The results of this study clearly demonstrated that overall, voluntary limit setting had a specific and statistically significant effect on high intensity gamblers. More specifically, the analysis showed that (in general) gaming intense players specifically changed their behaviour in a positive way after they limited themselves with respect to both time and money spent. Poker players played less after choosing time limits whereas casino players played less after choosing money limits. The overall effect of limit setting on playing duration was much less than the overall effect on money spent.

However, the data in this study was collected from only one online gambling operator and players voluntarily changed their limits. Operators offer these services in different ways – both from a visual and a technical point of view – that could influence the impact on players. The fact that the behaviour is voluntary makes it impossible to draw causal conclusions. An experimental setting is not possible as players cannot be assigned to different conditions as the behaviour to be studied is voluntary. However, this is only one of two studies (the other being Broda et al., 2008) that have investigated the effect of voluntary limit setting in a real world online gambling environment. This is particularly noteworthy given the popularity of these features on online gambling sites. Consequently, the limit-setting study in the present thesis delivered specific insights into the type of limits that are most appropriate based on the type of gambling.

Whereas voluntary limits require players to engage in responsible gambling behaviour, interactive technology also enables operators to actively interact with players. As demonstrated in this thesis, one such innovative approach is the use of pop-up messages that aim to give feedback to the players about the time and money that they have spent gambling. Doing so allows players to reflect on their immediate gambling and decide if they need a break from their play. Pop-up messages have been subject to previous studies in both online gambling as well as land-based Video Lottery Terminal gambling (e.g., Wohl et al., 2010, 2013, 2014; Kim et al., 2014; Monaghan et al., 2007, 2008,

2009, 2010a, 2010b) However, none of the previous studies were conducted in real world settings, or had either relied on self-recollected data and/or data from laboratory settings.

Study 4 described a real world empirical online gambling study during which players were alerted after they had played 1,000 consecutive slot games on an online gambling website. A random sample of 400,000 playing sessions that took place before the introduction of the mandatory pop-up message was compared to 400,000 random sessions after the introduction of the message on a real online gambling site. It was hypothesised that the introduction of the pop-up message would lead to an increase in gamblers terminating their gambling session after 1,000 consecutive plays. The results obtained appear to show that the introduction of a mandatory pop-up message had an effect in stopping gambling behaviour among a small number of gamblers. More specifically, the results indicated that nine times more gamblers ceased their gambling session, following the viewing of a pop-up message after 1,000 consecutive gambles on an online slot machine game, compared to those gamblers who had not viewed a pop-up message.

Although the difference was relatively small, it is argued that it was most likely caused by, and was the direct result of, the displaying of a pop-up message after 1,000 consecutive plays. Online operators have the ability to display any type of information at any time to players. For the first time, this particular study demonstrated that interactive pop-ups appear to influence real world gambling behaviour. More specific studies are needed in order to help online operators to decide how to inform players at specific points in time with the most appropriate messages to help players gamble more responsibly.

Normative feedback and information to aid self-efficacy appear to be essential aspects in influencing behavioural change. Consequently, study 5 was a direct follow-up to study 4 and hypothesised that normative and self-appraisal feedback as well as the addressing of cognitive beliefs would enhance the effectiveness of the 'simple' pop-up

message. Self-appraisal feedback (i.e., information that helps an individual reflect on their own gambling behaviour), normative feedback (i.e., information that compares an individual's own gambling behaviour with others), cognitive belief feedback (i.e., factual information given to the individual about false gambling beliefs), and self-efficacy feedback (i.e., information that provides help on how they can change their behaviour) had never together been empirically examined in any real-world online gambling setting before.

In study 5, the enhanced pop-up message led to 1.39% of highly involved gamblers immediately ceasing their gambling session compared to 0.67% of highly involved gamblers that only saw the simple pop-up messaging. The percentage of players that immediately terminated their sessions due to the viewing of the pop-up message doubled from 0.67% to 1.39% as a consequence of enhancing the message with self-appraisal, normative, and cognitive belief content (compared to self-appraisal only). All other aspects of the pop-up message were identical in the two conditions. This difference was not only statistically significant but also meaningful as demonstrated by a modest effect size. The importance of self-appraisal (Monaghan, Blaszczynski & Nower, 2009; Monaghan & Blaszczynski, 2010a) and normative feedback (Van den Putte, Yzer, Willemsen & de Bruijn, 2009; Celio & Lisman), as well as the addressing of cognitive beliefs (Griffiths, 1994; Strickland et al., 2006) in responsible gambling have been addressed previously. The study in this thesis is the first ever study to have investigated the effect of these concepts in a real world study. The results clearly showed that the incorporation of these aspects leverages the effectiveness of a pop-up message. However, the study had several limitations. The study was cross-sectional and quasi-experimental in design. As such, the gamblers were not necessarily the same pre- and post- the pop-up message intervention. Future studies should shed light on the visual appearance of pop-up messages and the time as to when the pop-up message appears. These aspects could have major impacts on the effectiveness of a pop-up message.

Study 6 examined personalized feedback and information given to players during real world gambling sessions. More specifically, its aim was to investigate the effects of personalized information concerning past gambling behaviour on future gambling. It was hypothesized that gamblers receiving tailored feedback about their online gambling behaviour would be more likely to change (i.e., reduce) their behaviour (as measured by playing duration and theoretical loss) compared to players who did not receive feedback. To date no studies have shed light on the effects of personalized feedback which incorporates information about longer time periods of play than just the current gambling session.

To carry out the final study, a large online-gambling operator granted access to behavioural tracking data of 1,358 gamblers who had voluntarily signed up to a behavioural feedback system (i.e., *mentor*) that is offered to all customers on the website. The player front-end which displays various types of information (losses, types of games played, playing duration) is in line with Human-Computer-Interaction (HCI) principles and professionals both from a content and visual point of view designed the system. Persuasive Design (PSD) was taken into account by the salient self-monitoring features of the system, the personalized content, and normative information. The hypothesis investigated whether players' gambling behaviour (i.e., time and money spent gambling) changed after they had registered for the system and saw the personalized feedback for the first time compared to the gambling behaviour of a matched-pairs control group. Both Playing Duration (PD) and Theoretical Loss (TL) 14 days before and 14 days after registration were measured.

Results indicated that the personalized feedback system achieved the anticipated effect and that the time and money spent gambling was significantly reduced compared to that of the control group. This is not surprising given the evidence in the gambling studies field (e.g., Kim et al., 2014) as well as other areas of non-gambling research (Farmer et al., 2005; Buttussi et al., 2006; Cho et al., 2009; Colkesen et al., 2013). The main results were also validated by additional analysis showing that the individual players reacted

similarly with respect to time and money spent when provided with personalized feedback.

Despite the many strengths of this particular study, there are a number of key limitations. All of the participants in the target population had voluntarily registered to use the system and were therefore not selected randomly from the population of players. In an attempt to overcome this, a matched-pairs design was chosen in which each and every target group member was matched with a number of most similar control group members who were not given personalized feedback. As the data were only collected from one online gambling environment replicating the results with other operators and other gambling channels (such as EGMs) would help further corroborate the findings reported.

Take as a whole the findings in this PhD shed light on behavioural tracking as an important aspect of innovative RG tools. In the course of a simulation as well as an empirical study, a structured and novel behavioural tracking approach was introduced and underlined the importance of a robust and stable measure of monetary gambling intensity. Voluntary limits, which are common among online operators, were studied and proved to lead to decreased time and money spent by gamblers in real world gambling environments. It was also shown that different players benefited from different types of limits. Among others, this playing pattern specific analysis was a novel approach in the study of voluntary limit setting.

Within session feedback in the form of interactive pop-up messages was investigated in two consecutive studies. Compared to previous research, these studies were conducted in a real world setting with objective information about time and money spent. The second study supported the hypothesis that normative and self-appraisal feedback increases the effectiveness of pop-up messages. This finding is in line with previous research that demonstrated that messages should be formulated in specific ways. Finally personalized feedback that provides players with visual and numerical information about their gambling behaviour over the last six months was shown to change monetary

as well as time-related expenditure. This final study also took into account aspects of Human Computer Interaction as well Persuasive System Design and clearly showed that personalized feedback is a valid way for online gambling operators to inform players about their personal involvement. Personalized feedback that provides players with historic behaviour beyond the current playing session has never been subject to gambling research before. However, other areas are successfully utilizing these tools to trigger behavioural change (Cho, 2011). The studies carried out in this PhD built upon previous research which was mostly theoretical, relied on self-recollected information, and was conducted in laboratory settings. It was clearly shown that voluntary limit setting, interactive pop-ups, and personalize feedback can have a demonstrable impact on players in a real-world gambling environment.

### 10.3. Implications, Limitations and Future Research

The real-world studies in this thesis attempt to demonstrate meaningful insights that gambling operators can immediately build upon. The studies built upon the innovation of previous research that was conducted in laboratory settings and that was often based on self-recollected information. The results demonstrated for the first time that voluntary limit setting, interactive pop-up messages, and personalized feedback can affect player behaviour in a real-world environment. The studies also reveal differences among subpopulations of players. It is almost impossible to uncover such insights in laboratory settings or with self-recollected information as a longer history of playing behaviour is necessary in order to extract player profiles.

This is particularly interesting given the way online operators treat their players. Player communication is often personalized and depends upon players' behaviour and it is also logical that responsible gambling should also be more effective when targeting players. This means that the results in this PhD can be used alongside the usual process that operators have established. It has been shown that pop-up messages are more effective when designed in specific ways and slot players benefit more from monetary limits than lottery players. Studies 4 and 5 could easily be refined by future studies in order to

better understand the impact of dynamic in-session feedback. This is particularly important as in-session feedback and voluntary limits are common RG features offered by most online operators.

Although it is difficult to perform, future research should try to conduct studies in a real world environment and as close to an experimental setting as possible. Most studies in this area are based on self-report data, experiments, or (as in this thesis) data from real world settings that do not control for other variables. In the latter case it is difficult to derive causal relations because the correlation could always be the result of unknown factors. An ideal study design would consist of several steps. First a hypothesis would have to be tested in a laboratory setting. This allows for the random assignment of test-participants to several conditions. These conditions would represent different RG “interventions” such as personalized feedback and normative feedback, possibly using different visual and verbal variations. The different groups could be tested under the same conditions as well as other variables that could potentially influence the outcome would be controlled for. The single effects and possible interactions between the interventions could then be analysed in detail. The results of the laboratory study could then be used to develop a real-world study.

In such a follow-up study (preferably conducted with several online-gambling operators) players could be randomly assigned to different conditions (e.g., personalized feedback, normative feedback, pure recommendation of RG tools) and the impact of the different types of personalized could be compared to a control group that does not receive any treatment. Such a study design would allow for the derivation of causal relations and also possible interactions between different types of feedback in a real-world setting. Normative feedback could (for example) be potentially helpful to some players but not to others.

In order to conduct such an experiment, gambling operators would have to work closely with researchers. Such research study designs also have to overcome a lot of organizational as well as technical challenges that naturally accrue financial costs. This

experience was also prominent throughout the studies in this thesis. The latter might be one reason for the low number of industry-involved studies. Nonetheless, meaningful results and insights can only be achieved in collaboration with the industry.

Most of the studies in this PhD were conducted in real world settings. However, this comes along with several limitations. The data always stemmed from one gambling operator and the customers were from one specific country (Austria). This means that the results might not be applicable to other environments because this single operator might serve a specific clientele and/or offer unique games that do not occur in the same way elsewhere. Furthermore, players were not assigned randomly in a pure experimental fashion that impacts the casual interpretation of the results. However, this might even not be possible in certain situations, namely when the RG tool in question has to be chosen voluntarily. In any case, when operators offer players assistance that requires a proactive response by the player, an experimental study design is difficult to achieve.

As noted earlier, this PhD research delivers significant insights into the impacts of RG tools, but it also has implications for future research. Firstly, the research introduced a new metric to assess gambling intensity (i.e., theoretical loss). The metric is commonly used in marketing-oriented analysis and is regularly utilized by this researcher. It was argued that the theoretical loss is a valid measure of monetary gambling intensity and that other previously used measures such as bet size and number of games played do not fully explain gambling intensity. It is also fair to assume that other studies did not have access to enough information because data were only available on an aggregated level. Behavioural tracking studies should preferably have access to data at the lowest level of granularity.

Apart from monetary measures, behavioural tracking research should also always take into account playing time. Poker players' playing time was shown to decrease the most as a consequence of time limits amongst the most gaming-intense players. Playing time should be measured directly and not as a derivative of other measures as it was done in

other studies. Again this requires more detailed data than has been available in previous studies. Otherwise results could be misleading.

Real-world studies should also build upon previously conducted laboratory studies such as was done in this research. The interactive pop-up studies in this PhD incorporated insights from similar laboratory studies. In this way, results can be evaluated in real world and which is mandatory for the use by online-operators. This PhD also utilised theoretical concepts such as the Theory of Planned Behaviour (Ajzen, 1985), the Health Belief Model (Maiman & Becker, 1974; Janz & Becker, 1984), the Extended Parallel Process Model (Witte, 1992), and Protection Motivation Theory (Rogers, 1983) and were not utilised by previous similar research. These theoretical concepts shed light on important aspects for the understanding of player behaviour and should be incorporated by researchers in future studies.

Research should also test the visual appearance as well as the wording and the timing of RG interventions. Future research should investigate the impact of these components separately in order to determine the single as well as the mutual effects, as well as possible interactions. Future research should also focus on the long-term changes as a consequence of RG interventions that have not been the subject of the studies in this PhD. The repeated display of relevant information to players could shed important insights into the impact on long-term behavioural change.

Operators can immediately benefit from the findings of this PhD. For instance, different types of voluntary limits could be advertised to different types of players in different ways as it was shown that casino players benefit more from monetary limits whereas poker players benefit more from time limits. This PhD also clearly describes how interactive pop-ups can be designed and also shows that additional features can enhance the effectiveness. Pop-up messages should enhance self-efficacy, and address normative as well as erroneous gambling-related beliefs. However it is only the gambling operators that possess the possibility to analyse the effects of RG tools thoroughly and they should also continuously evaluate the effectiveness of the RG tools that use.

It is not uncommon among online operators to test features of their products in an experimental manner where different players receive see different features. The best performing feature is then selected. These are mostly automatic processes and RG features and tools could also be evaluated this way. The online gambling community as well as the research community would benefit enormously. The benefit of collaboration between the gambling industry and researchers was recently discussed by Griffiths and Auer (2015). They argued that unlike other consumptive and potentially addictive behaviours (smoking cigarettes, drinking alcohol, etc.), researchers can study real-time gambling (and other potentially addictive behaviours like video gaming and social networking) (Griffiths, Kuss & Demetrovics, 2014) in a way that just cannot be done with other chemical and behavioural addictions (e.g., sex, exercise, work, etc.) because gambling operators have online data and/or player card-based technologies. It was also argued that researchers often carry out consultancy for gambling companies and that this might lead to a conflict of interest. This might very well be the case but it depends on the integrity of the researchers. However, meaningful research can only be generated if researchers are involved and they have a clear understanding of the data, and is only possible if online operators and researchers continue to collaborate.

## References

Afifi, T. O., LaPlante, D. A., Taillieu, T. L., Dowd, D., Shaffer, H. J. (2014). Gambling involvement: Considering frequency of play and the moderating effects of gender and age. *International Journal of Mental Health and Addiction*, 12, 283-294.

Ajzen, I. (1985). From intentions to action: a theory of planned behavior. In: Kuhl, J., & Beckman, J. (Eds). In *Action Control: from Cognitions to Behaviors* (pp. 11-39). New York: Springer.

American Gaming Association (2008). 2008 Annual Report. Retrieved January 1, 2013, from [http://www.americangaming.org/sites/default/files/uploads/docs/annual\\_reports/aga\\_annual\\_2008.pdf](http://www.americangaming.org/sites/default/files/uploads/docs/annual_reports/aga_annual_2008.pdf).

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders (4th ed., text rev.)*. Washington, DC: American Psychiatric Publishing.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (5th ed.)*. Washington, DC: American Psychiatric Publishing.

Anderson, G. & Brown, R. I. F. (1984) Real and laboratory gambling, sensation seeking and arousal: toward a Pavlovian component in general theories of gambling and gambling addictions. *British Journal of Psychology*, 75, 401–411.

Azam, M. N. (2015). R statistical software for data analysts: Past present and future. *Global Journal of Quantitative Science*, 2, 34-39.

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology*, 52, 1-26.

Becker J., Haug S., Sullivan R., Schaub M. P (2014). Effectiveness of different web-based interventions to prepare co-smokers of cigarettes and cannabis for double cessation: A three-arm randomized controlled trial. *Journal of Medical Internet Research*, 16. doi: 10.2196/JMIR.3246.

Bernhard, B. J., Lucas, A. F. & Jang, D. (2006). *Responsible gaming device research report*. University of Nevada, Las Vegas International Gaming Institute.

Bergler, E. (1958) *The psychology of gambling*. New York: Hill and Wang.

Blume, S. (1987) Compulsive gambling and the medical model. *Journal of Gambling Behavior*, 3, 237–247.

Blaszczynski, A., Winter, S. W. & McConaghy, N. (1986) Plasma endorphin levels in pathological gamblers. *Journal of Gambling Behavior*, 2, 3–14.

Blaszczynski, A. & McConaghy, N. (1989). The medical model of pathological gambling: Current shortcomings. *Journal of Gambling Behavior*, 5, 42-52.

Blaszczynski, A., Nower, E. (2002). A pathways model of problem and pathological gambling. *Addiction*, 97, 487-499.

Blaszczynski, A., Ladouceur, R., & Shaffer, H. J. (2004). A Science-Based Framework for Responsible Gaming: The Reno Model. *Journal of Gambling Studies*, 20, 301-317.

Braverman J., LaPlante, D. A., Nelson, S. E., Shaffer, H. J. (2013). Using cross-game behavioral markers for early identification of high-risk internet gamblers. *Psychology of Addictive Behaviors*, 27, 868-877.

Braverman, J., Tom, M. A., Schaffer, H. J. (2014). Accuracy of self-reported versus actual online gambling wins and losses. *Psychological Assessment*, 26, 865-877.

Broda, A., LaPlante, D. A., Nelson, S. E., LaBrie, R. A., Bosworth, L. B. & Shaffer, H. J. (2008). Virtual harm reduction efforts for Internet gambling: effects of deposit limits on actual Internet sports gambling behaviour. *Harm Reduction Journal*, 5, 27.

Brown, R. I. F. (1987a). Classical and operant paradigms in the management of gambling addictions. *Behavioural Psychotherapy*, 15, 111-122.

Brown, R. I. F. (1987b). Gambling addictions, arousal, and an affective/decision-making explanation of behavioural reversions or relapses. *International Journal of the Addictions*, 22, 1053-1067.

Brunelle, N., Cousineau, M-M., Dufour, M., Gendron, A., Leclerc, D. (2009, March). A look at the contextual elements surrounding internet gambling among adolescents. Paper presented at the 8<sup>th</sup> Annual Conference of Alberta Gaming Research Institute. Banff Center, Alberta.

Buttussi, F., Chittaro, L., & Nadalutti, D. (2006). Bringing mobile guides and fitness activities together: a solution based on an embodied virtual trainer. *Proceedings of MOBILE HCI 2006: 8th International Conference on Human-Computer Interaction with Mobile Devices and Services* (pp. 29-36). New York: ACM Press.

Canale, N., Santinello, M., & Griffiths, M. D. (2015). Validation of the reasons for gambling questionnaire (RGQ) in a British population survey. *Addictive Behaviors*, 45, 276-280.

Cantinotti M., Ladouceur R., Jaques C. (2004). Sports Betting: Can gamblers beat randomness? *Psychology of Addictive Behaviors*, 18, 143-147,

Carlton, P. L. & Goldstein, L. (1987) Physiological determinants of pathological gambling. In: Galski, T., (Ed.), *A Handbook of Pathological Gambling* (pp. 111–122). Springfield, IL: Charles C. Thomas.

Cassidy, R. (2014). Fair game? Producing and publishing gambling research. *International Gambling Studies*, *15*, 10-11

Castellani, B. & Rugle, L. (1995) A comparison of pathological gamblers to alcoholics and cocaine misusers on impulsivity, sensation seeking, and craving. *International Journal of the Addictions*, *30*, 275-289.

Celio, M. A., Lisman, S. A. (2014) Examining the efficacy of a personalized normative feedback intervention to reduce college student gambling, *Journal of American College Health*, *62*, 154-164

Chinn, S. (2000). A simple method for converting odds ratio into effect size for use in meta-analysis. *Statistics in Medicine*, *19*, 3127-3131.

Cho, H. (2011). *Health Communication Message Design: Theory and Practice*. Los Angeles: Sage.

Cho, J. H., Lee, H. C., Lim, D. J., Kwon, H. S., & Yoon, K. H. (2009). Mobile communication using a mobile phone with glucometer for glucose control in Type 2 patients with diabetes: as effective as an internet based glucose monitoring system. *Journal of Telemedicine and Telecare*, *15*, 77-82.

Clark, L., Crooks, B., Clarke, R., Aitken, M. R. F., & Dunn, B., D. (2012). Physiological responses to near-miss outcomes and personal control during simulated gambling. *Journal of Gambling Studies*, *28*, 123-137.

Clockfelter C. T. & Cook P. J. (1993). The gambler's fallacy in lottery play. *Management Science*, *39*, 1521-1525.

Cloutier, M., Ladouceur, R., & Sevigny R. (2006). Responsible gambling tools: pop-up messages and pauses on video lottery terminal. *Journal of Psychology: Interdisciplinary and Applied*, 140, 434-438.

Cohen, J. (1992). *Statistical power analysis for the behavioral sciences (2nd ed.)*. Hillsdale, NJ: Erlbaum

Cohen, J. (1996). A power primer. *Psychological Bulletin*, 112, 155-159.

Cohn, A. M., Hunter-Reel, D., Hagman, B. T., & Mitchell, J. (2011). Promoting behavior change from alcohol use through mobile technology: The future of ecological momentary assessment. *Alcoholism: Clinical & Experimental Research*, 35, 2209-2215.

Colbert, G., Murray, D., & Nieschwietz, R. (2009). The use of expected value in pricing judgements. *Journal of Risk Research*, 12, 199-208.

Cole, T., Barrett, D. J. K., & Griffiths, M. D. (2011). Social facilitation in online and offline gambling: A pilot study. *International Journal of Mental Health and Addiction*, 9, 240–247.

Colkesen, E.B., Laan, E.K., Tijssen, J.G., Kraaijenhagen, R.A., Van Kalken, C.K., Peters, R.J. (2013). Effect of a web-based health risk assessment with tailored feedback on lifestyle among voluntary participating employees: A long-term follow-up study. *Journal of Community Medicine and Health Education*, 3: 204. doi: 10.4172/2161-0711.1000204

Comings, D. E., Rosenthal, R. J., Lesieur, H. R. & Rugle, L. (1996) A study of the dopamine D2 receptor gene in pathological gambling. *Pharmacogenetics*, 6, 223–234.

Comings, D. E., Gade-Andavolu, R., Gonzalez, N., Wu, S., Muhleman, D., Chen, C., Koh, P., Farwell, K., Blake, H., Dietz, G., MacMurray, J. P., Lesieur, H.R., Rugle, L. J., Rosenthal, R. J. (2001). *Clinical Genetics*, 60, 107-116.

Corney, R., & Davis, J. (2010). The attractions and risks of Internet gambling for women: A qualitative study. *Journal of Gambling Issues*, 24, 121–139.

Coventry, K. R., & Norman, A. C. (1998). Arousal, erroneous verbalisations and the illusion of control during a computer-generated gambling task. *British Journal of Psychology*, 89, 629-645.

Cunningham, J. A., Hodgins, D. C., Toneatto, T., Rai, A., Cordingley, J. (2009). Pilot study of a personalized feedback intervention for problem gamblers. *Behavior Therapy*, 40, 219-224.

Currie, S. R., Hodgins, D. C., Wang, J., el-Guebaly, N., & Wynne, H. (2008). In pursuit of empirically based responsible gambling limits. *International Gambling Studies* 8, 207-227.

Currie, S. R., Hodgins, D. C., Wang, J., el-Guebaly, N., Wynne, H. & Miller, N. V. (2008). Replication of low-risk gambling limits using Canadian provincial gambling prevalence data. *Journal of Gambling Studies* 24, 321-335.

Currie, S. R., Hodgins, D. C., Casey, D. M., el-Guebaly, N., Smith, G. J., Williams, R. J., Schopflocher, D. P., & Wood, R. T. (2011). Examining the predictive validity of low-risk gambling limits with longitudinal data. *Addiction*, 107, 400-406.

Custer, R. (1984). Profile of the pathological gambler. *Journal of Clinical Psychiatry*, 45, 35-38.

DiClemente, C. C., Prochaska, J. O., Fairhurst, S. K., Velicer, W. F., Velasquez, M. M.,

& Rossi, J. S. (1991). The process of smoking cessation: an analysis of precontemplation, contemplation, and preparation stages of change. *Journal of Consulting and Clinical Psychology, 59*, 295-304.

Dickerson, M.G. (1979). FI schedules and persistence at gambling in the U.K. betting office. *Journal of Applied Behavior Analysis, 12*, 315-323.

Dixon, M. (2000). Manipulating the illusion of control: variations in gambling as a function of perceived control over chance outcomes. *Psychological Record, 50*, 705-720.

Donati, M. A., Chiesi, F., & Primi, C. (2013). A model to explain at-risk/problem gambling among male and female adolescents: Gender similarities and differences. *Journal of Adolescence 36*, 129-37.

Donovan, R., & Henley, N. (2010). *Principles and practice of social marketing: an international perspective*. Cambridge: Cambridge University Press.

Dowling, N., Smith, D., & Thomas, T. (2005). Electronic gaming machines: Are they the 'crack-cocaine' of gambling? *Addiction, 100*, 33-45.

Dowling, N. A., Youssef, G. J., Jackson, A.C., Pennay, D. W., Fancis, K. L., Lubman, D. I. (2015). National estimates of Australian gambling prevalence: findings from a dual-frame omnibus survey, *Addiction*, doi: 10.1111/add.13176.

Dragicevic, S., Tsogas, G. & Kudic, A. (2011). Analysis of casino online gambling data in relation to behavioural risk markers for high-risk gambling and player protection. *International Gambling Studies, 11*, 377-391.

Dragicevic, S., Percy, C., Kudic, A., Parke, J. (2013). A Descriptive Analysis of Demographic and Behavioral Data from Internet Gamblers and Those Who Self-exclude from Online Gambling Platforms. *Journal of Gambling Studies*, 31, 105-132.

Farmer, A., Gibson, O., Hayton, P., Bryden, K., Dudley, C., Neil, A., & Tarassenko L. (2005). A real-time, mobile phone-based telemedicine system to support young adults with type 1 diabetes. *Informatics in Primary Care*, 13, 171-178.

Farrelly, S., French, S., Ogeil, R. P., & Philips, J. G. (2007). Coping strategies and problem gambling. *Behaviour Change*, 24, 14-24

Ferris, J., Wynne, H. & Single, E. (1999). Measuring problem gambling in Canada: Final report - Phase 1. For the Inter-Provincial Task Force on Problem Gambling, Retrieved December 4, 2013, from: <http://www.ccsa.ca/>.

Focal Research (2004). *2003 NS VL responsible gaming features evaluation: Final report*. Nova Scotia, Focal Research Consultants Ltd.

Focal Research Consultants (2007). *Assessment of the behavioural Impact of the responsible Gaming Device (RGD) Features: Analysis of Nova Scotia Player-Card Data. The Windsor Trial*. Report prepared for the Nova Scotia Gaming Corporation.

Fogg, B. J. (2003) *PSD: Using Computers to Change What We Think and Do*. San Francisco, CA: Morgan Kaufmann Publishers.

Gaboury, A., & Ladouceur, R. (1989). Erroneous perceptions and gambling. *Journal of Social Behavior and Personality*, 4, 411-420.

Gainsbury, S. M. (2015a). Online gambling addiction: The relationship between internet gambling and disordered gambling. *Current Addiction Reports*, 2, 185-193.

Gainsbury, S. M. (2015b). The interaction between gambling activities and modes of access: A comparison of Internet-only, land-based only, and mixed-mode gamblers. *Addictive Behaviors, 41*, 34-40.

Gainsbury, S. M., & Blaszczynski, A. (2011). The appropriateness of using laboratories and student participants in gambling research. *Journal of Gambling Studies, 27*, 83-97.

Gainsbury, S. M., Hing, N., Delfabbro, P. H., & King, D. L. (2014). A taxonomy of gambling and casino games via social media and online technologies. *International Gambling Studies, 14*, 196-213.

Gainsbury, S. M., Wood, R., Russell, A., Hing, N., & Blaszczynski, A. (2012). A digital revolution: Comparison of demographic profiles, attitudes and gambling behavior of Internet and non-Internet gamblers. *Computers in Human Behavior, 28*, 1388-1398

Gainsbury, S. M., Russell, A., Hing, N., Wood, R. T., Lubman, D., & Blaszczynski, A. (2014). Assessing the impact of interactive gambling and new technologies. *Psychology of Addictive Behaviors, 28*, 769-779.

Gainsbury, S. M., Russell, A., Hing, N., Wood, R. T., & Blaszczynski, A. (2013). The impact of internet gambling on gambling problems: A comparison of moderate-risk and problem internet and non-internet gamblers. *Psychology of Addictive Behaviors, 27*, 1092-1101.

Gallagher, T., Nicki, R., Otteson, A., & Elliot, H. (2011). Effects of a video lottery terminal (VLT) banner on gambling: A field study. *International Journal of Mental Health and Addiction, 9*, 126-133.

Gambling Commission. (2009). Survey data on remote gambling participation. Retrieved December 10 2013, from

<http://www.gamblingcommission.gov.uk/pdf/icm%20data%20-%20year%20to%20june%202009.pdf>

Gaming Intelligence Group. (2007). Results of Swedish online gambling study released. Retrieved December 2 2013, from [http://www.responsible-gambling.org/articles/Results\\_of\\_Swedish\\_Online\\_Gambling\\_Study\\_released.pdf](http://www.responsible-gambling.org/articles/Results_of_Swedish_Online_Gambling_Study_released.pdf).

Gilberts, G., Agran, M., Hughes, C., & Wehmeyer, M. (2001). The effects of peer-reviewed self-monitoring strategies on the participation of students with severe disabilities in general education classrooms. *Journal of the Association of Persons With Severe Handicaps*, 26, 25-36.

González Ibáñez, A., Jimenez, S., Aymami, M. N., Domenech, J. M., Granero, R., & Lourido-Ferreira, M. R. (2009). Assessment of pathological gamblers who use slot machines. *Psychological Reports*, 707-716.

Goudriaan, A. E., Oosterlaan, J., deBeurs, E., & Van den Brink, W. (2004). Pathological gambling: A comprehensive review of biobehavioral findings. *Neuroscience and Biobehavioral Reviews*, 28, 123-141.

Graham, J. R. & Lowenfeld, B. L. (1986) Personality dimensions of the pathological gambler. *Journal of Gambling Behavior*, 2, 58–66.

Greenfield, D. N. (1999). *Virtual addiction*. Oakland C.A. New Harbinger Publications.

Griffiths, M. D. (1991). The observational study of adolescent gambling in UK amusement arcades. *Journal of Community and Applied Social Psychology*, 1, 309-320.

Griffiths, M. D. (1994). The role of cognitive bias and skill in fruit machine gambling. *British Journal of Psychology*, 85, 351-369.

Griffiths, M. D. (1995). Towards a risk factor model of fruit machine addiction: A brief note. *Journal of Gambling Studies*, 11, 343-346.

Griffiths, M. D. (1999). Gambling technologies: Prospects for problem gambling. *Journal of Gambling Studies*, 15, 265-283.

Griffiths, M. D. (2001). Internet gambling: Preliminary results of the first UK prevalence study. *Journal of Gambling Issues*, 5. Retrieved January 2014, from <http://www.austgamingcouncil.org.au/images/pdf/eLibrary/319.pdf>

Griffiths, M. D. (2002). Internet gambling in the workplace. In M. Anandarajan & C. Simmers (Eds.), *Managing web usage in the workplace: A social, ethical and legal perspective* (pp. 148-167). Hershey, PA: Idea Publishing.

Griffiths, M. D. (2003). Internet gambling: Issues, concerns, and recommendations. *CyberPsychology and Behavior*, 6, 557-568.

Griffiths, M.D. (2004). Betting your life on it: Problem gambling has clear health related consequences. *British Medical Journal*, 329, 1055-1056.

Griffiths, M. D., (2006). A case study of binge problem gambling. *International Journal of Mental Health and Addiction*, 4, 369-376.

Griffiths, M. D. (2010). Gambling addiction on the Internet. In: Young, K., & Nabuco de Abreu, C. (Eds.) *Internet addiction: a handbook for evaluation and treatment* (pp. 91-111). New York: Wiley.

Griffiths, M. D. (2012). Internet gambling, player protection and social responsibility. In R. Williams, R. Wood & J. Parke (Ed.), *Routledge Handbook of Internet Gambling* (pp.227-249). London: Routledge.

Griffiths, M. D. (2012b). Mind games: A brief psychosocial overview of in-play betting. *i-Gaming Business Affiliate*, June/July, 44.

Griffiths, M.D., & Auer, M. (2011). Online versus offline gambling: Methodological considerations in empirical gambling research. *Casino and Gaming International*, 7, 45-48.

Griffiths, M. D. & Auer, M. (2013). The irrelevancy of game-type in the acquisition, development and maintenance of problem gambling. *Frontiers in Psychology*, 3, 621. doi: 10.3389/fpsyg.2012.00621.

Griffiths, M.D. & Auer, M. (2015). Research funding in gambling studies: Some further observations. *International Gambling Studies*, 15, 15-19.

Griffiths, M. D., & Barnes, A. (2008). Internet gambling: An online empirical study among student gamblers. *International Journal of Mental Health and Addiction*, 6, 194–204.

Griffiths, M. D., Derevensky, J. & Parke, J. (2012). Online gambling in youth. In R. Williams, R. Wood & J. Parke (Ed.), *Routledge Handbook of Internet Gambling* (pp.183-199). London: Routledge.

Griffiths, M D., King, D. L. & DelFabbro, D. L. (2014). The technological convergence of gambling and gaming practices. In: Richard, D.C.S., Blaszczynski, A., & Nower, L. (Ed.), *The Wiley-Blackwell handbook of disordered gambling* (pp. 327-346). Chichester: Wiley.

Griffiths, M. D., & Parke, J. (2002). The social impact of Internet gambling. *Social Science Computer Review*, 20, 312–320.

Griffiths, M. D., Parke, A., Wood, R. T. A. (2006). Internet gambling: an overview of psychosocial impacts. *UNLV Gaming Research and Review Journal*, 27, 27-39.

Griffiths, M. D., Parke, J., Wood, R. T. A. & Rigbye, J. (2010). Online poker gambling in university students: Further findings from an online survey. *International Journal of Mental Health and Addiction*, 8, 82-89.

Griffiths, M. D., Parke, J., & Derevensky, J. L. (2011). Online gambling among youth: cause for concern? In: J. L. Derevensky, D. T. L. Shek & J. Merrick, (Eds.). *Youth gambling: The hidden addiction* (pp. 125-143). Berlin: De Gruyter.

Griffiths, M. D., Wardle, H., Orford, J., Sproston, K., & Erens, B. (2009). Sociodemographic correlates of Internet gambling: Findings from the 2007 British Gambling Prevalence Survey. *CyberPsychology and Behavior*, 12, 199–202.

Griffiths, M. D., Wardle, H., Orford, J., Sproston, K., & Erens, B. (2011). Internet gambling, health, smoking and alcohol use: Findings from the 2007 British Gambling Prevalence Survey. *International Journal of Mental Health and Addiction*, 9, 1–11.

Griffiths, M. D., & Whitty, M. W. (2010). Online behavioural tracking in Internet gambling research: ethical and methodological issues. *International Journal of Internet Research Ethics*, 3, 104–117.

Griffiths, M. D., & Wood, R. T. A. (2000). Risk factors in adolescence. The case of gambling, video-game playing and the internet *Journal of Gambling Studies*, 16, 199-225.

Griffiths, M. D., Wood, R. T. A. (2007). A qualitative investigation of problem gambling as an escape-based coping strategy. *Psychology and Psychotherapy: Theory, Research and Practice*, 80, 107-125.

Griffiths, M.D. & Wood, R.T.A. (2008). Responsible gaming and best practice: How can academics help? *Casino and Gaming International*, 4, 107-112.

Griffiths, M. D., Wood, R. T. A., & Parke, J. (2009). Social responsibility tools in online gambling: A survey of attitudes and behaviour among Internet gamblers. *CyberPsychology and Behavior*, 12, 413-421.

Griffiths, M. D., Wood, R. T. A., Parke, J., & Parke, A. (2006). Dissociative states in problem gambling. In C. Allcock (Ed.), *Current Issues Related To Dissociation* (pp. 27-37). Melbourne: Australian Gaming Council.

Griffiths, M. D., Wood, R. T. A., Parke, J. & Parke, A. (2007). Gaming research and best practice: Gaming industry, social responsibility and academia. *Casino and Gaming International*, 3, 97-103.

Gupta, R., & Derevensky, J. L. (1998). Adolescent gambling behavior: A prevalence study and examination of the correlates associated with problem gambling. *Journal of Gambling Studies*, 14, 319-345.

Gupta, R. (2011, 3-4 October) *Toward a definition and assessment of binge gambling*. Presentation presented at the Nova Scotia Gaming Corporation's Responsible Gaming Conference, Halifax, Canada. Retrieved September 28, 2015, from <https://www.google.at/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCQQFjAAahUKEwiTmrPhyZnIAhXBORQKHZH8BvA&url=http%3A%2F%2Fyouthgambling.mcgill.ca%2FGambling2%2Fen%2Fpublications%2FGupta.pps&usg=AFQjCNG5JRVYMVlprhZkt2Fxq16Bg6kYEw&sig2=Rut-i0SrsUeM1Cy6gwTIQw>.

Gupta, R., Nower, L. J. D., Derevensky, J. L., Blaszczynski, A. (2013). Problem gambling in adolescents: An examination of the pathways model. *Journal of Gambling Studies*, 29, 575-588.

Haefeli, J. Lischer, S., & Schwarx, J. (2011). Early detection items and responsible gambling features for online gambling. *International Gambling Studies*, *11*, 273-288.

Hardeman, W., Johnston, M., Johnston, D., Bonetti, D., Wareham, N., & Kinmoth, A. (2002). Applications of theory of planned behaviour in behaviour change interventions: A systematic review. *Psychology and Health*, *17*, 123-158.

Hayer, T., & Meyer, G. (2011). Self-exclusion as a harm-minimization strategy: Evidence for the casino sector from selected European countries. *Journal of Gambling Studies*, *27*, 685-700

Hedman, E., Ljotsson, B., Lindefors, N. (2012). Cognitive behavior therapy via the Internet: a systematic review of applications, clinical efficacy and cost-effectiveness. *Expert Review of Pharmacoeconomics and Outcomes Research*. *12*, 745-64.

Hewett, T., Baecker, R., Card, S., Carey, T., Gasen, J., Mantei, M., & Verplanck, W. (1992). *ACM SIGCHI Curricula for Human-Computer Interaction*. New York: ACM.

Hing, N. (2003). *An assessment of member awareness, perceived adequacy and perceived effectiveness of responsible gambling strategies in Sydney clubs*. Lismore, Australia: Centre for Gambling Education and Research.

Ialomiteanu, A., & Adlaf, E. M. (2001). Internet gambling among Ontario adults. *Journal of Gambling Issues*, *5*, doi: 10.4309/jgi.2001.5.9.

International Gaming Research Unit (2007). *The global online gambling report: An exploratory investigation into the attitudes and behaviours of internet casino and poker players*. eCOGRA (e-Commerce and Online Gaming Regulation and Assurance).

Jacobs, D. F. (1986) A general theory of addictions: a new theoretical model. *Journal of Gambling Behavior*, *2*, 15–31.

Jacobs, D. F. (1988). Evidence for a common dissociative-like reaction among addicts. *Journal of Gambling Behavior*, 4, 27-37.

Janz, N. K., & Becker, M. H. (1984). The health belief model: A decade later. *Health Education Quarterly*, 11, 1-47.

Kim, H.S., Wohl, M. J., Stewart, M. K., Sztainert, T., Gainsbury, S.M. (2014). Limit your time, gamble responsibly: setting a time limit (via pop-up message) on an electronic gaming machine reduces time on device. *International Gambling Studies*, 14, 266-278.

Knapp, T. & Lech, B. (1987). Pathological gambling: A review with recommendations. *Advances in Behaviour Research and Therapy*, 9, 21-49.

Kuss, D. J. & Griffiths, M. D. (2012a). Internet gambling behavior. In Z. Yan (Ed.), *Encyclopedia of Cyber Behavior* (pp.735-753). Pennsylvania: IGI Global.

Kuss, D. J. & Griffiths, M. D. (2012b). Online social networking and addiction - A review of the psychological literature. In S. Sussman (Ed.), *Substance and behavioral addictions: Co-occurrence and specificity* (pp.117-141). Basel, Switzerland: MPDI.

Kuss, D. J., Griffiths, M. D., Karila, L. & Billieux, J. (2014). Internet addiction: a systematic review of epidemiological research for the last decade. *Current Pharmaceutical Design*, 20, 4026-4052.

LaBrie, R. A., LaPlante, D. A., Nelson, S. E., Schumann, A. & Shaffer, H. J. (2007). Assessing the playing field: A prospective longitudinal study of internet sports gambling behavior. *Journal of Gambling Studies*, 23, 347-363.

LaBrie, R. A., Kaplan, S., LaPlante, D. A., Nelson, S. E., & Shaffer, H. J. (2008). Inside

the virtual casino: A prospective longitudinal study of Internet casino gambling. *European Journal of Public Health*, 18, 410-416

Ladd G. T., & Petry, N. M. (2002). Disordered gambling among university-based medical and dental patients: A focus on Internet gambling. *Psychology of Addictive Behaviors*, 16, 76–79.

Ladouceur, R. & Walker, M. (1996) A cognitive perspective on gambling. In: Salkovskies, P. M., (Ed). *Trends in Cognitive and Behavioural Therapies* (pp. 89–120). Chichester: John Wiley and Sons.

Ladouceur, R. & Walker, M. (1996). A cognitive perspective on gambling. In P. Salkovskis (Ed.) *Trends in Cognitive and Behavioural Therapies* (pp. 89-120) Chichester: John Wiley and Sons.

Ladouceur, R. & Sevigny, S. (2003). Interactive messages on video lottery terminals and persistence in gambling. *Gambling Research*, 15, 45-50.

Ladouceur, R., & Sévigny, S. (2009). Electronic gambling machines: Influence of a clock, a cash display, and a precommitment on gambling time. *Journal of Gambling Issues*, 23, 31-41.

Langer, E. J. (1975). The illusion of control. *Journal of Personality and Social Psychology*, 32, 311-328.

Langer, E. J., & Roth, J. (1975). Heads I win, tails it's chance: The illusion of control as a function of the sequence of outcomes in a purely chance task. *Journal of Personality and Social Psychology*, 32, 951-955.

Lapham, G.T., Hawkins, E.J., Chavez, L.J., Achtmeyer, C.E., Williams, E.C., Thomas, R.M., Ludman, E.J., Kypri, K., Hunt, S.C., & Bradley, K.A. (2012). Feedback from

recently returned veterans on an anonymous web-based brief alcohol intervention. *Addiction Science Clinical Practice*, 7, 7-12.

LaPlante, D. A., Kleschinsky, J. H., LaBrie, R. A., Nelson, S. E. & Shaffer, H. J. (2009). Sitting at the virtual poker table: A prospective epidemiological study of actual Internet poker gambling behavior. *Computers in Human Behavior*, 25, 711-717.

LaPlante, D. A., Schumann, A., LaBrie, R. A., & Shaffer, H. J. (2008). Population trends in Internet sports gambling. *Computers in Human Behavior*, 24, 2399–2414.

Lapuz, J., Griffiths, M. D. (2010). The role of chips in poker gambling: An empirical pilot study. *Gambling Research*, 22, 34-39.

Lee, C. K., Chung, N., & Bernhard, B. J. (2014). Examining the structural relationships among gambling motivation, passion, and consequences of internet sports betting. *Journal of Gambling Studies*, 30, 845-858.

Lehto, T. & Oinas-Kukkonen, H. (2009). Persuasive features in web-based alcohol and smoking interventions: A systematic review of the literature. *Journal of Medical Internet Research*, 13, e46.

Lejoyeux M. (2012) Psychological and social impact of online gambling. *Bulletin de l'Academie nationale de medicine*, 196, 27-34.

Lesieur, H. R. (1979). The compulsive gambler's spiral of options and involvement. *Psychiatry: Journal for the Study of Interpersonal Processes*, 42, 79-87.

Lesieur, H. R., Blume, S. B. (1987). The South Oaks Gambling Screen (SOGS): A new instrument for the identification of pathological gamblers. *American Journal of Psychiatry*, 144, 1184-1188.

Lesieur, H. R. & Rosenthal, R. (1991) Pathological gambling: a review of the literature (prepared for the American psychiatric Association task Force on DSM-IV committee on disorders of impulse control not elsewhere classified). *Journal of Gambling Studies*, 7, 5–40.

Li, S. (2003). The role of expected value illustrated in decision-making under risk: Single-play vs multiple-play. *Journal of Risk Research*, 6, 113-124.

Linnet J., Thomsen, K.R., Møller, A., & Buhl-Callesen, M. (2010). Event frequency, excitement and desire to gamble, among pathological gamblers. *International Gambling Studies*, 10, 177-188

Losarwar, V., Joshi, M. (2012, July). Data preprocessing and web usage mining. Paper presented at the International Conference on Artificial Intelligence and Embedded Systems (ICAIES'2012), Singapore.

Lucar, C., Wiebe, J., & Philander, K. (2013). Monetary limits tools for internet gamblers: A review of their availability, implementation and effectiveness online. *Responsible Gambling Council*, Retrieved December 5 2013, from <http://www.responsiblegambling.org/docs/research-reports/monetary-limits-tools-for-internet-gamblers.pdf?sfvrsn=8>.

Lucas, A. F., & Singh, A. K. (2012). Estimating the ability of gamblers to detect differences in the payback percentages of reel slot machines: A closer look at the slot player experience. *UNLV Gaming Research and Review Journal*, 15, 17-36

Maiman, L. A. & Becker, M. H. (1974). The Health Belief Model: Origins and correlates in psychological theory. *Health Education Monographs*, 2, 336-353.

Martens, M. P., Arterberry, B. J., Takamatsu, S. K., Masters, J., Dude, K. (2015). The efficacy of a personalized feedback-only intervention for at-risk college gamblers. *Journal of Consulting and Clinical Psychology, 83*, 494-499.

Matthews, N., Farnsworth, B., & Griffiths, M. D. (2009). A pilot study of problem gambling among student online gamblers: Mood states as predictors of problematic behavior. *CyberPsychology and Behavior, 12*, 741–745.

Mayer, R. N., & Scammon, D. L. (1992). Caution: Weak product warnings may be hazardous to corporate health. *Journal of Business Research, 24*, 347–359.

McBride, J., & Derevensky, J. L. (2009). Internet gambling behavior in a sample of online gamblers. *International Journal of Mental Health and Addiction, 7*, 149–167.

McConaghy, N., Armstrong, M. S., Blaszczynski, A. & Allcock, C. (1983) Controlled comparison of aversive therapy and imaginal desensitisation in compulsive gambling. *British Journal of Psychiatry, 142*, 366–372.

McCormack, A., & Griffiths, M. D. (2013). A scoping study of the structural and situational characteristics of internet gambling. *International Journal of Cyber Behavior, Psychology and Learning, 3*, 29-49.

McCormack, A., Shorter, G. W., & Griffiths, M. D. (2014). An examination of participation in online gambling activities and the relationship with problem gambling. *Journal of Behavioral Addictions, 2*, 31-41.

McCormack, A., Shorter, G. W., & Griffiths, M. D. (2014). An empirical study of gender differences in online gambling. *Journal of Gambling Studies, 30*, 71-88.

McCormick, R. A. (1994) The importance of coping skill enhancement in the treatment of the pathological gambler. *Journal of Gambling Studies, 10*, 77-86.

McCormick, R. A. & Taber, J. I. (1987) The pathological gambler: salient personality variables. In: Galski, T., (Ed). *The Handbook of Pathological Gambling* (pp. 9-39). Springfield, IL: Charles C. Thomas.

McCusker, C., & Gettings, B. (1997). Automaticity of cognitive biases in addictive behaviors: Further evidence with gamblers. *British Journal of Clinical Psychology*, *36*, 543-554.

Meyer, G., Heise, D. J., Hauffa, B. P., Schedlowski, M., Pawlak, C., Stadler, M. A., Exton, M. S. (2000). Casino gambling increases heart rate and salivary cortisol in regular gamblers. *Biological Psychiatry* *48*, 948–953.

Meyer, G., Schwertfeger, J., Exton, M. S., Janssen, O. E., Knapp, W., Stadler, M. A., Schedlowski, M., Krüger, T. H. C. (2004). Neuroendocrine response to casino gambling in problem gamblers. *Psychoneuroendocrinology*, *29*, 1272–1280.

Meyer, G., Hayer, T. & Griffiths, M. D. (2009). *Problem Gaming in Europe: Challenges, Prevention, and Interventions*. New York: Springer.

Miller, W. R., & Rollnick, S. (1991). *Motivational interviewing: Preparing people to change addictive behavior*. New York: Guilford Press.

Ministry of Community Development Youth and Sports. (2008). Report of survey on participation in gambling activities among Singapore residents 2008. Retrieved September 28 2015, from <https://www.ncpg.org.sg/en/pdf/publications-survey-gambling08.pdf>.

Monaghan, S. M. & Blaszczynski, A. (2007). Recall of electronic gambling machine signs: A static versus a dynamic mode of presentation. *Journal of Gambling Issues*, *20*, 253-268.

Monaghan, S. M. (2008). Review of pop-up messages on electronic gaming machines as a proposed responsible gambling strategy. *International Journal of Mental Health and Addiction*, 6, 214-222.

Monaghan, S. M. (2009). Responsible gambling strategies for Internet gambling: the theoretical and empirical base of using pop-up messages to encourage self-awareness. *Computers in Human Behavior*, 25, 202-207.

Monaghan, S. M., Blaszczynski, A., & Nower, L. (2009). Do warning signs on electronic gaming machines influence irrational cognitions? *Psychological Reports*, 105, 173-187.

Monaghan, S. M. & Blaszczynski, A. (2010a). Impact of mode of display and message content of responsible gaming signs for electronic gaming machines on regular gamblers. *Journal of Gambling Studies*, 26, 67-88.

Monaghan, S.M. & Blaszczynski, A. (2010b) Electronic gaming machine warning messages: information versus self-evaluation. *Journal of Psychology: Interdisciplinary and Applied*, 144, 83-96.

Munoz, Y., Chebat, J. C., & Borges, A. (2013). Graphic gambling warning: How they affect emotions, cognitive responses and attitude change. *Journal of Gambling Studies*, 29, 507-524.

Nakagawa, S. (2004). A farewell to Bonferroni: The problems of low statistical power and publication bias. *Behavioural Ecology*, 15, 1044-1045.

Nelson, S. E., LaPlante, D. A., Peller, A. J., Schumann, A., LaBrie, R. A. & Shaffer, H. J. (2008). Real limits in the virtual world: Self-limiting behavior of internet gamblers, *Journal of Gambling Studies*, 24, 463-477.

National Council on Problem Gambling (2015). *Report of Survey on Participation in Gambling Activities among Singapore Residents, 2014*. Retrieved September 28, 2015, from [http://www.ncpg.org.sg/en/pdf/2014%20NCPG%20Gambling%20Participation%20Survey\\_FINAL.pdf](http://www.ncpg.org.sg/en/pdf/2014%20NCPG%20Gambling%20Participation%20Survey_FINAL.pdf).

Noseworthy, T. J., & Finlay, K. (2009). Numerous studies point out that there is a group of gamblers who seek to distance themselves and partially. *Journal of Gambling Studies*, 25, 331-342.

Nower, L. & Blaszczynski, A. (2003). Binge gambling: a neglected concept. *International Journal of Gambling Studies*, 3, 23-36.

Nussbaum, D., Honarmand, K., Govoni, R., Kalahani-Bargis, M., Bass, S., Ni X., LaForge, K., Burden, A., Romero, K., Basarke, S., Courbasson, C., Deamond W. (2010). An eight component decision-making model for problem gambling: A systems approach to stimulate integrative research. *Journal of Gambling Studies*, 27, 523-563.

Obermayer J. L., Riley W. T., Asif, O., & Jean-Mary J. (2004). College smoking-cessation using cell phone text messaging. *Journal of American College Health*, 53, 71-79.

Ocean, G. & Smith, G. J. (1993) Social reward, conflict and commitment: a theoretical model of gambling behaviour. *Journal of Gambling Studies*, 9, 321–339.

Orford, J., Sproston, K., Erens, B., & Mitchell, L. (2003). *Gambling and Problem Gambling in Britain*. Hove: Brunner-Routledge.

Parke, A. & Griffiths, M.D. (2012). Beyond illusion of control: An interpretative phenomenological analysis of gambling in the context of information technology. *Addiction Research and Theory*, 20, 250-260.

Parke, J. & Griffiths, M. D. (2006). The psychology of the fruit machine: The role of structural characteristics (revisited). *International Journal of Mental Health and Addiction*, 4, 151-179.

Parke, J., & Griffiths, M. D. (2007). The role of structural characteristics in gambling. In: Smith, G., Hodgins, D., & Williams, R. (Eds.), *Research and measurement issues in gambling studies* (pp. 211–243). New York: Elsevier.

Parke, J., Griffiths, M. D. & Parke, A. (2007). Positive thinking among slot machine gamblers: A case of maladaptive coping? *International Journal of Mental Health and Addiction*, 5, 39-52.

Peck, C. P. (1986) Risk-taking behaviour and compulsive gambling. *American Psychologist*, 41, 461-465.

Perloff, R. M. (2008). *The dynamics of persuasion: Communication and attitudes in the 21st century (3rd ed.)*. New York: Lawrence Erlbaum Associates.

Perneger, T. V. (1998). What's wrong with Bonferroni adjustments. *BMJ*, 316, 1236-1238.

Petry, N. M. (2005). *Pathological gambling: Etiology, comorbidity and treatment*. Washington D.C.: American Psychological Association.

Petry, N. M. (2006). Internet gambling: An emerging concern in family practice medicine? *Family Practice*, 23, 421–426.

Petry, N. M., & Weinstock, J. (2007). Internet gambling is common in college students and associated with poor mental health. *American Journal on Addictions, 16*, 325-330.

Petry, N. M., & Gonzalez-Ibanez, G. (2015). Internet gambling in problem gambling college students, *Journal of Gambling Studies, 31*, 397-408.

Philander, K. S., & MacKay, T. L. (2014). Online gambling participation and problem gambling severity: is there a causal relationship? *International Gambling Studies, 14*, 214-227.

Potenza, M.N., 2001. The neurobiology of pathological gambling. *Seminars in Clinical Neuropsychiatry 6*, 217–226.

Potenza, M. N., Steinberg, M. A., McLaughlin, S. D., Wu, R., Rounsaville, B. J., O'Malley, S. S. (2001). Gender-related differences in the characteristics of problem gamblers using a gambling helpline. *American Journal of Psychiatry, 158*, 1500-1505.

Powell, J., Hardoon, K., Derevensky, J., & Gupta, R. (1996, September). Gambling and risk taking behaviour amongst university students. Paper presented at the 10th National Conference on Gambling Behavior, Chicago.

Preece, J., Sharp, H., & Rogers, Y. (2011). *Interaction design: Beyond human computer interaction* (3<sup>rd</sup> ed.). Chichester: John Wiley & Sons Ltd.

Prochaska, J. O., & DiClemente, C. C. (1983). Stages and processes of self-change of smoking: toward an integrative model of change. *Journal of Consulting and Clinical Psychology, 51*, 390-395.

Prochaska, J. O. P., & Prochaska, J. M. (1991). Why don't people change? Why don't continents move? *Journal of Psychotherapy Integration, 9*, 83-102.

Ranade, S., Bailey, S., & Harvey, A. (2006). A literature review and survey of statistical sources on remote gambling (RSe Consulting, Ed.). London, UK.

Reith, G. (2003). *Gambling: Who Wins? Who Loses?* New York: Prometheus Books.

Rizvi, S. L., Dimeff, L. A., Skutch, J., Carroll, D., Linehan, M. M. (2011). A pilot study of the DBT coach: An interactive mobile phone application for individuals with borderline personality disorder and substance use disorder. *Behavior Therapy*, 42, 589-600.

Rogers, R. W. (1983). Cognitive and physiological processes in fear appeals and attitude change: a revised theory of protection motivation. In: Cacioppo, J. T., Petty, R. E. (Eds.) In *Social Psychophysiology: A sourcebook* (pp. 153-176). Guildford Press: New York.

Rosecrance, J. (1985a) Compulsive gambling and the medicalization of deviance. *Social Problems*, 32, 275–284.

Rosecrance, J. (1985b). “The next best thing”: A study of problem gambling. *International Journal of the Addictions*, 20, 1727-1739.

Rosenthal, R. (1986). The pathological gambler’s system for self-deception. *Journal of Gambling Behaviour*, 2, 108-120.

Rosenthal, R. (1992). Pathological gambling. *Psychiatric Annals*, 22, 72–78.

Rugle, L. (1993). Initial thought on viewing pathological gambling from a physiological and intrapsychic structural perspective. *Journal of Gambling Studies*, 9, 3–16.

Sand B. (2012, January). Monopoly No More: The Liberalization of the Danish Gambling Market. *Casino Enterprise Management*. Retrieved September 28 2015,

from: <http://www.casinoenterprisemanagement.com/articles/january-2012/monopoly-no-more-liberalization-danish-gambling-market>.

Schellink, T., & Schrans, T. (2002). *Atlantic Lottery Corporation Video Lottery Responsible Gaming Feature Research: Final Report*. Halifax, Nova Scotia: Focal Research Consultants.

Shneiderman, B., Plaisant, C., Cohen, M., & Jacobs, S. (2009). *Designing the user interface: Strategies for effective human-computer interaction (5<sup>th</sup> ed.)*. Reading, MA: Pearson Addison-Wesley.

Schrans, T., Grace, J., & Schellink, T. (2004). *2003 Nova Scotia Video Lottery Responsible Gaming Features Evaluation: Final Report*. Halifax, NS. Focal Research Consultants.

Schultz, W. (2006). Behavioral theories and the neurophysiology of reward. *Annual Review of Psychology*, *57*, 87–115.

Schwedes, U., Siebolds, M., & Mertes, G. (2002). Meal-related structured self-monitoring of blood glucose. *Diabetes Care*, *25*, 1928-1932.

Selzer, J. (1992). Borderline omnipotence in pathological gambling. *Archives of Psychiatric Nursing*, *6*, 215-218.

Sharpe, L. (2004). Patterns of autonomic arousal in imaginal situations of winning and losing in problem gambling. *Journal of Gambling Studies*, *20*, 95–104.

Sharpe, L. (2002). A reformulated cognitive-behavioral model of problem gambling: a biopsychosocial perspective. *Clinical Psychology Review*. *22*, 1–25.

Sharpe, L., & TARRIER, N. (1993) Towards a cognitive-behavioural theory of problem gambling. *British Journal of Psychiatry*, *162*, 407–412.

Skinner, B. F. (1953). *Science and human behaviour*. New York: Macmillan.

Skitch, S. A., & Hodgins, D. C. (2004). Impulsivity, compulsivity and pathological gambling: An exploratory study of pathological gambling as an impulsivity-compulsivity spectrum disorder. *International Gambling Studies*, *4*, 175–188.

Slutske W. S. (2006). Natural recovery and treatment-seeking in pathological gambling: results of two US national surveys. *American Journal of Psychiatry*. *163*, 297-302.

Slutske, W.S., Piasecki, T.M., Blaszczynski, A., & Martin, N. G. (2010). Pathological gambling recovery in the absence of abstinence. *Addiction*, *105*, 2169-2175.

Smeaton, M., & Griffiths, M. D. (2004). Internet gambling and social responsibility: An exploratory study. *CyberPsychology and Behavior*, *7*, 49–57.

Stein, S. (1989). A developmental approach to understanding compulsive gambling behaviour. In H. Shaffer (Ed.). *Compulsive Gambling: Theory, Research, and Practice*. Lexington, MA: Lexington Books/D. C. Heath and Company.

Steel, Z., & Blaszczynski, A. (1998). Impulsivity, personality disorders and pathological gambling severity. *Addiction*, *93*, 895-905.

Stewart, M. J. & Wohl, M. J. A. (2013). Pop-up messages, dissociation, and craving: How monetary limit reminders facilitate adherence in a session of slot machine gambling. *Psychology of Addictive Behaviors*, *27*, 268-273

Tony, S. (2012) *Playing it safe: The court of justice, the freedom to provide services and internet gambling*. In: British and Irish Law Education and Technology Association (BILETA) Conference. Newcastle upon Tyne: Centre for Life,

Stotts, A. L., Groff, J. Y., Velasquez, M. M., Benjamin-Garner, R., Green, C., Carbonari, J. P., & DiClemene, C.C. (2009). Ultrasound feedback and motivational interviewing targeting smoking cessation in the second and third trimesters of pregnancy. *Nicotine and Tobacco Research, 11*, 961-968.

Strickland, C. R., Taylor, A., Hendon, K. J., Provost, S., & Bizo, L. A. (2006). Erroneous beliefs among frequent fruit-machine gamblers. *Gambling Research: Journal of the National Association for Gambling Studies, 18*, 42-54.

Suurvali, H., Hodgins, D., Toneatto, T., Cunningham, J. (2008). Treatment seeking among Ontario problem gamblers: results of a population survey. *Psychiatric Services, 59*, 1343-1346.

Suurvali, H., Hodgins, D. C., Cunningham, J. A. (2010). Motivators for resolving or seeking help for gambling problems: A review of the empirical literature. *Journal of Gambling Studies, 26*, 1-33

Taber, J. I., McCormick, R. A., Russo, A. M., Adkins, B. J., Ramirez, L. F. (1987). Follow-up of pathological gamblers after treatment. *American Journal of Psychiatry, 144*, 757-761.

Toscos, T., Faber, A., An, S., & Gandhi, M. P. (2006). Chick Clique: PSD to motivate teenage girls to exercise. *[CHI] 06'Extended Abstracts on Human Factors in Computing*, (pp. 1873-1878), *New York: ACM*.

Tsai, C. C., Lee, G., Raab, F., Norman, G. J., Sohn, T., Griswold, W. G., & Patrick, K. (2007) Usability and feasibility of PmEB: A mobile phone application for monitoring real time caloric balance. *Mobile Networks and Applications*, 12, 173-184.

Valentine, G., & Hughes, K. (2008). *New forms of gambling participation: Problem Internet gambling and the role of the family*. London, UK: Responsibility in Gambling Trust.

Van den Putte, B., Yzer, M., Willemsen, M., de Bruijn G.J. (2009). The effects of smoking self-identity and quitting self-identity on attempts to quit smoking. *Health Psychology*, 28, 535-544.

Wardle, H., Moody, A., Spence, S., Orford, J., Volberg, R., Jotangia, D., Griffiths, M. D., Hussey, D., Dobbie, F. (2010). *British Gambling Prevalence Survey*. National Centre for Social Research: London.

Wardle, H., Moody, A., Griffiths, M. D., Orford, J., Volberg, R. (2011) Defining the online gambler and patterns of behaviour integration: Evidence from the British Gambling Prevalence Survey 2010. *International Gambling Studies*, 11, 339-356.

Wardle, H., Griffiths, M. D., Orford, J., Moody, A., Volberg, R. (2012). Gambling in Britain: A time of change? Health implications from the British Gambling Prevalence Survey 2010. *International Journal of Mental Health and Addiction*, 10, 273-277.

Wardle, H., Sproston, K., Orford, J., Erens, B., Griffiths, M. D., Constantine, R. & Pigott, S. (2007). *The British Gambling Prevalence Survey 2007*. London: The Stationery Office

Westphal, J. R. (2008). Pathological gambling: Psychiatric models. *International Journal of Mental Health Addiction*, 6, 602–618.

Westphal, J. R., Jackson, A.C., Thomas, S. A., Blaszczynski, A. (2008). A review of pharmacological approaches to intervention in pathological gambling. *Journal of Social Work Practice in the Addictions*, 8, 192-207

Wildman, R. (1997). *Gambling: An attempt at an integration*. Edmonton: Wynne Resources Inc.

Williams, R. J., & Connolly, D. (2006). Does learning about the mathematics of gambling change gambling behavior? *Psychology of Addictive Behaviors*, 20, 62-68.

Williams, R. J., Wood, R. T., & Parke, J. (2012). *Routledge International Handbook of Internet Gambling*. London: Routledge

Willingham, R., & Dowling, J. (2015). Precommitment coming to Victorian pokies in bid to curb spending by problem gamblers. *The Age Victoria*. Retrieved September 28, 2015, from <http://www.theage.com.au/victoria/precommitment-coming-to-victorian-pokies-in-bid-to-curb-spending-by-problem-gamblers-20150208-139058.html>

Winefield, A. H. (1966). Negative recency and event-dependence. *Quarterly Journal of Experimental Psychology*, 18, 47-54.

Witte, K. (1992). Putting the fear back into fear appeal: The extended parallel process model (EPPM). *Communication Monographs*, 61, 113-132.

Witte, K., Meyer, G., & Martell, D. (2001). *Effective health risk messages: A step-by-step guide*. Thousand Oaks, CA: Sage Publications.

Wohl M. J., Christie, K. L., Matheson, C. & Anisman, H. (2010). Animation-based education as a gambling prevention tool: Correcting erroneous cognitions and reducing

the frequency of exceeding limits among slots players. *Journal of Gambling Studies*, 26, 469-486

Wohl, M. J., Gainsbury, S., Stewart, M. J. & Sztainert, T. (2013). Facilitating responsible gambling: The relative effectiveness of education-based animation and monetary limit setting pop-up messages among electronic gaming machine players. *Journal of Gambling Studies*, 29, 703-717.

Wohl, M. J., Parush, A. Kim, H.S., & Warren, K. (2014). Building it better: Applying human-computer interaction and persuasive system design principles to a monetary limit tool improves responsible gambling. *Computers in Human Behavior*, 37, 124-132

Wong, I. L. K. (2010). Internet gambling: A school-based survey among Macau students. *Social Behavior and Personality*, 38, 365–371.

Wood, G. (1992). Predicting outcomes: in Sports and Stocks. *Journal of Gambling Studies*, 8, 201-222

Wood, R. T. A., & Griffiths, M. D. (2007). On-line guidance, advice, and support for problem gamblers and concerned relatives and friends: An evaluation of the GamAid pilot service. *British Journal of Guidance & Counselling*, 35, 373–389.

Wood, R. T. A., & Griffiths, M. D. (2008). Why Swedish people play online poker and factors that can increase or decrease trust in poker Web sites: A qualitative investigation. *Journal of Gambling Issues*, 21, 80-97.

Wood, R. T. A. & Griffiths, M.D. (2010). Social responsibility in online gambling: Voluntary limit setting. *World Online Gambling Law Report*, 9, 10-11.

Wood, R. T. A., Griffiths, M. D., & Parke, J. (2007). Acquisition, development, and maintenance of online poker playing in a student sample *CyberPsychology and Behavior, 10*, 354–361.

Wood, R. T., & Williams, R. J. (2007). Problem gambling on the Internet: Implications for internet gambling policy in North America. *New Media and Society, 9*, 520–542.

Wood, R. T., & Williams, R. J. (2008). *Internet gambling: Prevalence, patterns, problems, and policy options*. Guelph, Ontario: Ontario Problem Gambling Research Center.

Wood, R. T., Williams, R. J. (2011). A comparative profile of the Internet Gambler: Demographic characteristics, game-play patterns, and problem gambling status. *New Media and Society, 13*, 1123-1141.

Wood, R. T., Williams, R. J., & Lawton, P. K. (2007). Why do Internet gamblers prefer online versus land-based venues? Some preliminary findings and implications. *Journal of Gambling Issues, 20*, 235–252.

Wulfert, E., Blanchard E. B., Freidenberg, B. M., Martell, R. S. (2006). Retaining pathological gamblers in cognitive behavior therapy through motivational enhancement: A pilot study. *Behavior Modification, 30*, 315-340.

Xuan, Z. M. & Shaffer, H .J. (2009). How do gamblers end gambling: Longitudinal analysis of internet gambling behaviors prior to account closure due to gambling related problems. *Journal of Gambling Studies, 25*, 239-252.

Young, K. S. (1998). Internet Addiction. The emergence of a new clinical disorder. *CyberPsychology and Behavior, 1*, 273-244.

Young, K. S. (2007). Cognitive behavior therapy with internet addicts: Treatment outcomes and implications. *CyberPsychology and Behavior* 10, 671-679

Yousafzai, S., Hussain, Z., Griffiths, M. D. (2014). Social responsibility in online videogaming: What should the videogame industry do? *Addiction Research & Theory*, 22, 181-185.

Yzer, M. C., Siero, F. W., & Buunk, B. P. (2000). Can public campaigns effectively change psychological determinants of safer sex? An evaluation of three Dutch safer sex campaigns. *Health Education Research*, 15, 339-352.

Yzer, M. C., Fishbein, M., Cappella, J. N. (2007). Using behavioral theory to investigate routes to persuasion for segmented groups: A case study of adolescent drug use. In Hinner, M. B. (Ed.). *Freiberger Beitrage zur Interkulturellen und Wirtschaftskommunikation: A Forum for General and Intercultural Business Communication (Vol. 3)* (pp. 297-320). Frankfurt, Germany: Lang.