**Furthering Persuasive Systems Design:
Persuasive Technology and Responsible Gambling**

by

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Abstract

Persuasive systems design (PSD) research focuses on applying principles of attitude and behaviour change from social psychology to computer interfaces with the goal of motivating a user to achieve a target behaviour or goal. An obvious area for implementation is activities that can become addictive: aiding individuals in gaining impulse control and reduce incidence of over-indulgence of a harmful activity or behaviour. Many domains have applied such principles including weight-loss, smoking cessation and alcohol addiction.

This thesis extends current research on PSD to recreational gambling. As online gambling carries a greater risk for the development of gambling addiction pathology than offline gambling, examination of how to create effective tools that can reduce this risk are warranted. One such area is usability and PSD, with the goal of aiding individuals to adhere to pre-set monetary limits without reducing the pleasure of gambling. A user-centered design process was employed to improve an existing monetary limit tool with the goal of facilitating responsible gambling. Focus groups served as the preliminary user research, personas and storyboards were developed, heuristic evaluation was employed to refine the monetary limit tool, and finally a controlled lab study was carried out to test the effectiveness of the newly developed tool vs. the current monetary limit tool. Results of the study show that applying usability and PSD principles increased monetary limit adherence and engagement compared with the current monetary limit tool. Importantly, the HCI-inspired monetary limit tool did not interfere with users' fun while gambling. Facilitating responsible gambling is a viable domain for the application of PSD principles. Future research directions are discussed.

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Introduction

As online gambling becomes ubiquitous, it is important to find methods of reducing personal and societal harm as a result of problem or pathological gambling habits. Monetary limit tools in the form of pop-up messages have proven useful in facilitating responsible gambling, however there remain several challenges such as engaging more users to use responsible gambling tools while gambling on their own and further facilitating responsible gambling. The current thesis sets out to research and apply principles of Persuasive Systems Design (PSD) within a monetary limit tool with the intent of facilitating responsible gambling and increasing engagement with responsible gambling tools in general. A user-centered design approach was employed to design an HCI-inspired monetary limit tool specifically with PSD consideration, and culminated in a comparison study. This study compared the effectiveness of a standard monetary limit tool that has been proven effective in facilitating responsible gambling with a newly designed monetary limit tool with consideration and employment of PSD and usability principles.

The Utility of Persuasive Systems Design in Human-Computer Interfaces

Technology is becoming ubiquitous. With 93% of 18-29 year olds online (Axon, 2010) and results from a new study showing that by 2015 mobile internet will dominate internet usage (Meeker et al. 2010), it is clear that we are becoming inseparable from our technology. With this ubiquity comes the pervasive nature of the benefits and consequences associated with being inseparable from our devices.

There are many historical examples where technology has been developed and implemented without adequate consideration of the potential negative consequences and ethical implications for society. The steam engine initiated the industrial revolution, enabling the wide spread

adoption of mass production. This afforded great advantages to our modern society, but also produced negative consequences such as the consumption of natural resources at an alarming rate and unsanitary living conditions due to increased urbanization. The development of the atomic bomb has been used to devastate the planet and its population, but also used in fundamental research that helped create the atomic clock and provide a necessary tool in the advancement of modern physics.

Other areas of use such as in the cessation of smoking or management of depression, the development and adoption of technology would seem to require no ethical analysis. In these cases, technology presents an opportunity to intervene and aid individuals in the attainment of beneficial personal and public (or societal) goals. The ubiquity of technology makes computing devices an ideal platform for this use of technology and the persuasive design that informs it.

As a social welfare state, society has a responsibility to aid individuals in achieving pro-health goals that they want to achieve or we, as a society, want to achieve. These goals can include improved road safety, reduction of healthcare costs, increased productivity or better interpersonal relationships. The social goal of research interest to this thesis is increasing responsible gambling.

One aspect of technology that is frequently overlooked is the fact that inherent in technology is persuasion. Persuasive Technology has been defined as, “interactive computing systems designed to change people’s attitudes and behaviours” (Fogg, 2003). All computing systems are designed to change attitudes and behaviours in one form or another, though not all changes are a consequence of intentional (or formal) persuasive design. When a designer creates a website, application, software or hardware, they have an intent and this intent can be considered benign or positive intent (such as creating an electric toothbrush for children which plays music for 2

minutes indicating how long to brush) or negative intent (such as attempting to engage the addiction centres in the brain to motivate an individual to continue gambling).

With the introduction of persuasive design (over the past decade) the intent behind technology has taken on new dimensions of effect where attitude and behaviour change in end users is concerned. Even though explicit persuasive systems design (PSD) has not long held a place in the field of Human-Computer Interaction (HCI) (approx. 10 years), other areas of human interaction such as sales, marketing, diplomacy, politics, and military training, have long used principles of persuasion to elicit specific attitude or behaviour changes (Ford, 1992). These uses of persuasion have presented a host of ethical implications.

An examination of the literature reveals two fundamental pillars upon which PSD is built: HCI usability research and social psychology research on attitude and behaviour change.

Literature Review

The Contribution of HCI Usability Principles to Persuasive Systems Design

A basic tenant in the field of HCI and interface development is usability: “The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use” (ISO 9241-11; 1998). The process for ensuring an interface is usable includes following usability principles, the gold standard of which are those created by Jakob Nielsen (1994b).

Nielsen’s 10 usability principles are as follows:

1. Visibility of system Status: Ensures users are aware of what the system is doing at all times

2. Match between system and the real world: Ensures the concepts used within an interface match those found in the real world, including language, metaphors, and organization of information
3. User control and freedom: Ensures users are able to navigate the interface however they desire, including functions such as undo, redo, exit and save
4. Consistency and standards: Ensures users are familiar with the interface elements and reduces learning time by the incorporation of best practices or industry standards
5. Error prevention: Reduces the number of errors users can make by designing an interface in a way that prevents users from making errors in the first place
6. Recognition rather than recall: Users can recognize information faster than recall it, meaning recognition speeds up the user's ability to achieve their goal
7. Flexibility and efficiency of use: Allow customizability so the end user can speed up interactions or implement short-cuts to frequently used items
8. Aesthetic and minimalist design: Ensuring the interface contains only necessary information increases speed and overall usability and satisfaction
9. Help users recognize, diagnose and recover from errors: Ensure users receive descriptive error messages when mistakes are made, and give users a clear solution as to how they can fix the error
10. Help and Documentation: Ensuring useful help documentation is available if a user needs to figure out how to use a part of an interface

Other similar sets of principles for interface design and evaluation have been developed, such as Quesenberry's 5E's (2002) and Shneiderman's eight golden rules of interface design (2005). The principles outlined by both Quesenberry and Shneiderman contain more similarities than

differences when compared to those presented by Nielsen, and therefore it usually is not necessary to combine them, as one set is sufficient for interface design and evaluation. However, the principles developed by each are worded differently, and therefore depending on the interface they are being applied to, combining principles can provide a richer understanding of a user's qualitative experience.

The aforementioned usability principles can be used not only to create satisfying and easy to use interfaces, but also to create interfaces that are persuasive. By contrast, if an interface is not satisfying or easy to use, there is little chance that it will be persuasive (Oinas-Kukkonen & Harjumaa, 2009).

Of note, however, is that there is one necessary attribute missing from usability design that prevents it alone from being PSD: intent. In order for an interface to be classified as incorporating PSD, the designer of that interface must have intended to persuade the end users to achieve a target attitude or behaviour change (Fogg, 2003). Therefore, usability principles implemented in isolation, although necessary to good interface design, are not sufficient for persuasive design.

Other human-computer interaction phenomena are also of utility in persuasive design, such as the halo effect, promoting or discouraging flow states, and computer "personalities". The halo effect shows that individuals make a judgment on whether they like or dislike an interface in half a second or less (Lindgaard et al., 2006). This means users form a first impression within a very short period of time, where the individual automatically processes very broad visual items such as colour scheme, layout or images. After this initial judgment has been made, users then proceed to follow what is known in social psychology as the confirmation bias: individuals search for and accept evidence that supports their initial impression and ignore evidence that

contradicts their initial impression (Snyder & Swann, 1978). Therefore, in terms of persuasive systems design, if the interface is to be a successful persuader, then the user needs to be immediately engaged by the visual and layout aspects of the interface.

Flow states occur when an individual is completely immersed in an activity, oblivious to outside stimuli and enjoying the process (Csikszentmihalyi, 1975). These flow states can have a strong impact on users. As an example, individuals who enter a flow state during a video game may not know how much time has past or what has gone on around them during play. Initiating flow states has become a goal of many designers in the creation of video games or television programming: the frequency and duration of user flow states has direct impact on the enjoyment users experience and the length of time they engage (Sherry, 2006).

For some interfaces though, flow is to be avoided. For example, individuals who engage in online gambling are at much greater risk of developing gambling pathology than their counterparts who gamble offline at casinos (40% vs. 1-3% respectively; Wood & Williams, 2007). One of the factors affecting this increase in pathology could be flow states: the user has a much lower chance of being distracted from gambling at home than they do in a casino, where flashing lights, the sounds of other games and gamblers, servers offering libations, and friends pose additional distraction. If an individual is gambling at home they may have a greater chance of entering a flow state that can cause them to lose track of the time or money they have spent. Therefore, attempting to either encourage or discourage flow states can have a grand impact on the persuasive power of an interface, particularly in areas such as online gambling.

It has also been shown that users tend to enjoy engaging with interfaces that they perceive to be similar to themselves. For example, Naas and colleagues (1995) showed that computer interfaces can easily take on human personality characteristics, and users are attracted to computers that

express characteristics they perceive as similar to themselves. This attraction produces a willingness to engage with an interface on the part of the user, as well as increases their overall satisfaction with the system.

Although not sufficient for persuasion alone, HCI research and usability principles form the building blocks from which technology can become an effective persuader.

The Contribution of Psychology Research to Persuasive Systems Design

Fundamentally, PSD employs principles from an area of social psychology known as attitude and behaviour change: defining how, when and why individuals are persuaded to change beliefs, values, intentions or behaviours. In Cialdini's 2008 book, *Influence: Science and Practice*, he details a history of the social science literature on persuasion, and divides the research into six categories of influence:

1. Reciprocation: individuals generally feel obliged to return favours, even if they are not particularly interested in the favour done for them (e.g. given a gift they do not particularly want) (Becker, 1986). Many variations on this principle exist, such as asking for a particularly big favour, and when rejected, the smaller, actually desired, favour is more likely to be conceded (Cialdini & Trost, 1998; Patch, Hoang, & Stahelski, 1997; Reeves et al., 1991; Wang, Brownstein & Katzev, 1989).
2. Commitment and Consistency: Individuals generally like to be perceived as consistent in their own behaviour, and prefer others to be consistent in their behaviour as well (Cialdini, 2008). Additionally, individuals are motivated to honour commitments they have made and provide justifications for keeping those commitments (Plous, 1993).

3. **Social Proof:** Individuals frequently look to others in their environment for cues as to how to behave, what to believe, and which values to adopt (Asch, 1951; 1956). Looking for social cues becomes particularly salient when the situation is ambiguous (e.g. when an individual is entering a new situation such as starting a new job, they may not know how to appropriately act in meetings and therefore will look for social cues from their colleagues before interacting themselves) (Baron et al., 1996; Tesser et al., 1983; Walther et al., 2002).
4. **Liking:** It has been shown that individuals are more prone to believe and listen to opinions that come from people they like (Hardin, 2002). There are many factors that influence how much one person likes another, including but not limited to: similarity (Berscheid, 1966; Bettinghaus, 1968; Brock, 1965), physical attractiveness (Walster et al., 1966), and working towards a common goal (Sherif, 1961).
5. **Authority:** When an individual perceives information or direction to be coming from someone in a position of authority, they are more likely to oblige and either perform a behaviour or adopt a belief (Blass, 2004). This is most famously shown in the Milgram experiments, where participants were told by a man in a lab coat to deliver an electric shock to another participant (who was in fact an actor and confederate who was not actually being shocked) whenever an incorrect answer was provided (Milgram, 1974). The level of compliance was extraordinary, especially given how convincing the confederate was at pretending he was in pain.
6. **Scarcity:** Individuals tend to have a greater desire for something when they perceive it as less available. It has been shown that censorship (i.e. restriction of information) has been

shown to lead to an outcry of individuals wanting to consume restricted information, much more so than when the restriction did not exist (Fromkin, 1970).

Each of these principles contains two necessary attributes: 1) An external stimulus, and 2) An individual's emotional and cognitive processes in reaction to the external stimulus. Therefore, for persuasion to be effective, the external stimuli must elicit a reaction where an individual is motivated to behave in an intended way.

All of these principles can be incorporated into human-computer interfaces in order to persuade users, and many of the core principles of PSD (see below) are directly related to one or more of the aforementioned social psychology principles.

The Core Principles of Persuasive Systems Design

To begin, it is necessary to overview how interfaces deliver persuasive messages. Fogg's functional triad (2003) details three methods by which computer interfaces become the necessary external stimuli which can promote attitude or behaviour change: Interfaces as tools, interfaces as media, and interfaces as social actors.

Interfaces can act as tools to aid users in achieving a goal by making it easier to do or faster to complete. As tools, interfaces can persuade by guiding users down a certain path that would not be attainable (or much more difficult to attain) without the computer interface, such as computing complex calculations for nutrition intake trends, monitoring heart rate, or delivering of insulin on a fixed schedule (i.e. an insulin pump). Enabling users to quickly input data and

view corresponding output allows computer interfaces to be persuasive in a way that human-human interactions cannot¹.

Interfaces can act as media, using narrative to associate and empathize with the user. This role can be particularly useful in creating motivational and persuasive interactions. This method of persuasion incorporates aspects from usability such as match between system and the real world (both media and narrative are particularly effective at transferring real-world metaphors and concepts), and consistency and standards (narrative provides the opportunity to communicate with the user in a way that is familiar to them). Also, interfaces as media can promote many principles from psychology attitude and behaviour change, such as liking (users will like an interface that empathizes with them and therefore the interface will be persuasive), and authority (if the system is presenting itself as a trustworthy authority on a subject).

Finally, interfaces can also be social actors, which facilitates social influence. People tend to anthropomorphize computers and interfaces (e.g. we say a computer has “died” when it stops working, we put it to “sleep” when we are not using it for a while, and we often attribute human characteristics such as intent when we are confused or angry, e.g. why won’t you let me print?), and therefore as social actors, computers can participate in many aspects of attitude and behaviour change common between humans. A few examples include reciprocity and social support (if a computer interface provides a reward for performing a certain behaviour, the user may respond in kind by continuing to use the application), authority (if an interface presents itself as an authority on a body of knowledge, the user will be more likely to believe and conform to its suggestions), and social proof (if a user is not sure how to use an interface, the interface itself becomes the guide to aid the user in using the system in a specified way).

¹ It is of note, however, that upon further analysis of Fogg’s first functional triad item – computers as tools – it could be argued that author is conflating the general usability principle of ease of use or efficiency with persuasion.

Persuasive Systems Design (PSD) (Oinas-Kukkonen and Harjumaa, 2008) has become the leading model for implementation of PSD within computer interfaces. The core principles of PSD (also known as persuasive technology) are based on social psychology literature and applied to the domain of human-computer interaction. Oinas-Kukkonen and Harjumaa (2009) outline seven principles, which are currently considered the most comprehensive framework for evaluating PSD (Wiafe, Nakata & Moran, 2011), and designing applications with the goal of altering attitude and/or behaviour. They are:

- **Information technology is never neutral.** Because PSD is “always on” in the sense that users can access a specific website or application at any given time, users are constantly being persuaded. Persuasion is often a multi-phased and complex task, influenced by different factors such as a user’s end goal that may change during use and the system should be able to adapt.
- **People like their views about the world to be organized and consistent.** Based on cognitive consistency (Cialdini, Petty and Cacioppo, 1981), if users are presented with information that is inconsistent with their thinking, they may behave in a manner opposite to their attitudes. This will cause cognitive dissonance, and dissonance reduction strategies may be effective in motivating change of attitude to match behaviour.
- **Direct and indirect routes are key persuasion strategies.** Direct routes refer to users actively evaluating the persuasive message, while indirect routes occur when users are less thoughtful and instead utilize simple cues or heuristics to interpret persuasive information. Although direct has proven to be the more effective of the two, both are recommended given that many users may not have the time or motivation to carefully consider persuasive content.

- **Persuasion is often incremental.** It is easier to motivate a user to follow a series of simple steps rather than a one-time consolidated suggestion. Therefore, presenting small steps over a period of time will have a greater probability of persuading users towards the target attitude or behaviour.
- **Persuasion through persuasive systems should always be open.** Revealing the intent of the persuasion or the designer bias is important in gaining user trust and subsequently changing attitudes or behaviour. If the intent or bias is not made explicit, user engagement will decrease due to lack of trust with the system.
- **Persuasive systems should aim at unobtrusiveness.** The opportune and inopportune moments of persuasion need to be carefully considered, and persuasive messages should never disturb users as they are completing primary tasks.
- **Persuasive systems should aim at being both useful and easy to use.** This includes many components, such as ease of access, lack of errors, convenience, positive user experience, attractiveness, and loyalty, to name a few. If a system is difficult to use, it is unlikely to have persuasive efficacy.

Several approaches to designing and developing applications with PSD exist in the HCI literature. Fogg (2003) outlined seven types of persuasive tools for use in designing applications intended to motivate attitude or behaviour change. Each tool applies a different strategy for designing methods of achieving attitude and behaviour change within an application, and can be effective when used in isolation or in combination. They are:

1. **Reduction:** make tasks as simple as possible
2. **Tunnelling:** leading users through a series of steps to achieve their goal
3. **Tailoring:** providing the target user with specific designs or information

4. **Suggestion:** intervening at the opportune moment to suggest the target action
5. **Self-monitoring:** giving users the capability of monitoring their own progress towards achieving a desired attitude or behaviour
6. **Surveillance:** allowing an external party to monitor user behaviour with the intent of motivating attitude or behaviour change
7. **Conditioning:** employing principles of operant conditioning to bring about attitude or behaviour change

Oinas-Kukkonen and Harjumaa (2009) modify and expand Fogg's persuasive tools by categorizing them into three major categories: primary task support, dialogue support and system credibility support, which is now considered the most comprehensive framework for designing and evaluating PSD (see Table 1)(Wiafe, Nakata & Moran, 2011).

Table 1: Oinas-Kukkonen & Harjumaa's 2009 Persuasive Systems Design categories for design and evaluation of persuasive systems

Primary Task Support	Dialogue Support	System Credibility Support
Reduction: turning complex processes into simple tasks, meaning behaviours are easier to perform for the user	Praise: offering praise can make users more open to persuasion	Trustworthiness: A system that is perceived as trustworthy has a greater chance of persuading
Tunneling: Using the system to guide the user through a process increases opportunities for persuasion	Rewards: a system that offers rewards to users for performing target behaviours increases persuasion	Expertise: a system that incorporates expertise (or the illusion of expertise) has a greater chance of persuading
Tailoring: tailoring information to the user with the goal of persuasion	Reminders: a system that reminds the user of target behaviours will increase the chance the user will adhere	Surface credibility: users make judgments regarding whether a system is credible or not based on initial inspection
Personalization: a system that offers personalized messages or information has a greater chance of persuasion	Suggestion: suggesting to the user that they perform target behaviours will increase the chance that they will adhere	Real-world feel: if systems leverage the organization behind the application, the content will have increased credibility
Self-monitoring: a system that facilitates self-monitoring has greater persuasive power	Similarity: individuals are more persuaded by systems that they feel are similar to themselves in some way	Authority: Systems have persuasive power when they leverage positions of authority
Simulation: systems that show direct correlations between cause and effect can have greater persuasive power	Liking: visual appealing systems will have greater persuasive power than those without visual appeal	Third-party endorsements: from credible sources, third-party endorsements can enhance the user's perception of credibility
Rehearsal: rehearsing behaviours makes them more likely to be performed, and therefore systems which offer rehearsal increase the chance for persuasion	Social Role: systems that adopt social roles have a greater chance that users will use them for the intended persuasive purpose	Verifiability: making it easy for users to verify credibility from outside sources will enhance credibility and in turn, persuasion

The PSD principles outlined by both Fogg (2003) and Oinas-Kukkonen and Harjumaa (2009) are useful for designing human-computer interfaces which intend to initiate attitude or behaviour change, and are also frequently used in evaluating existing systems to identify areas of strength and for improvement (Oinas-Kukkonen & Harjumaa, 2008; Lehto & Oinas-Kukkonen, 2009).

The Application of Persuasive Systems Design

The principles of PSD have been successfully applied to various domains where behaviour change is desired, such as obesity (Toscos et al. 2006; Tsai et al. 2007), Borderline Personality Disorder (Rizvi et al. 2011), smoking cessation (Lehto & Oinas-Kukkonen, 2009a) and alcoholism (Cohn et al. 2011; Lehto & Oinas-Kukkonen, 2009a). The most common areas for research in PSD so far have been alcoholism (e.g. Lehto & Oinas-Kukkonen, 2009b; Yap et al., 2011) and weight loss/exercise (e.g. Harjumaa et al., 2009; Segerstahl & Oinas-Kukkonen, 2011; Segerstahl et al., 2010; Enwald & Huotari, 2010; Purpura et al., 2011; Lehto & Oinas-Kukkonen, 2010).

The aforementioned papers have one commonality among them: each is promoting a pro-social and pro-society behaviour through the implementation of PSD within computer interfaces. For the purposes of this research project, a domain was needed to apply PSD principles, and therefore it was necessary to ensure this same commonality existed in the chosen domain to avoid negative ethical implications. Also, a new domain with a dearth of PSD applications was desired to further the research on PSD. Many domains with the aforementioned qualifications exist and several were considered, including aiding individuals in reducing procrastination habits, managing chronic diseases (e.g. diabetes or high cholesterol) and increasing responsible gambling.

Pathological Gambling: A Viable Domain for Persuasive Systems Design

Online gambling is becoming increasingly popularized (Griffiths et al., 2011; McBride & Derevensky, 2009), and allows 24/7 access to virtually any gambling game (Griffiths et al., 2011). Research shows that individuals who partake in online gambling are far more likely to

become problem or pathological gamblers compared with offline gamblers (Griffiths & Barnes, 2008; Griffiths, King, Delfabbro, 2009; Ladd & Petry 2002, McBride & Derevensky, 2009, Wood, Griffiths, Parke, 2007). For example, a recent survey of over 2000 offline and online gamblers revealed that almost 40% of online gamblers met the criteria for problem or pathological gambling (Wood & Williams, 2007) compared with 1-3% of their offline gambling counterparts (Wiebe & Turner, 2008). As such, it is becoming increasingly important to give attention to means of facilitating responsible online gambling, particularly as online gambling becomes more ubiquitous.

There are many reasons as to why individuals become pathological gamblers, or end up spending more time or money on gambling than they had originally intended. A few of interest to the current research include: 1) Gamblers typically exhibit poor probabilistic reasoning while gambling (Tversky & Kahneman, 1971; 1974), and therefore often believe that if they keep playing long enough they will win or at least recover losses; 2) Companies who create gambling machines and games have input measures to induce long playing sessions and separation from the real world, such as disguising actual monetary amounts as “credits” so players are less aware of their actual wins and losses (Griffiths, 1993, 1999; Loba et al., 2001); 3) While gambling, users often enter a state of heightened anxiety from both excitement of winning as well as disappointment of loss which subsequently motivates them to continue gambling (Coventry, Iain & Brown, 1993); and 4) Gambling (particularly online gambling) promotes flow states (known in the gambling literature as dissociation), and therefore users become unaware of their surroundings and the actual amount of time or money they have spent (Diskin & Hodgins, 1999).

Gambling research shows that one of the most popular and effective means of promoting responsible gambling is through pre-commitment tools, where a user sets a time limit or

spending limit for their gambling session when they are in a cold cognitive state and are able to reason properly (Ladouceur, Blaszczynski, & Lalande, 2012). This is in opposition to a hot affective state, which promotes poor decision-making when the individual is in a situation of risk (Ariely & Loewenstein, 2005; Loewenstein, 1996, 2005). Pre-commitment tools therefore can aid gamblers to remain recreational gamblers by helping them put a cap on time or money expenditure. The most common way to implement pre-commitment tools is through pop-up messages, and once engaged, it has been found that users find pre-commitment tools useful in monitoring time or money spent (Nisbet, 2005). Additionally, it has been shown that using pop-up messages as the main implementation of a pre-commitment tool increases limit adherence (Stewart & Wohl, 2013; Wohl, Gainsbury, Szteinert, & Stewart, 2012), and successfully reduces the user's dissociation, or flow state (Neilson et al., 2008; Stewart & Wohl, 2013). The procedure is simple: show each user a pop-up message before they begin play asking them to set a limit for their gambling session (See Figure 1). Then, each user receives a second pop-up message when their pre-set limit has been reached (See Figure 2). Figures 1 and 2 below are examples of a currently employed monetary limit tool that has been shown to facilitate responsible gambling (Stewart & Wohl, 2013).

Figure 1: Standard MLT set-limit pop-up window.

Figure 2: Standard MLT reached limit pop-up window.

Although the aforementioned research seems promising, there are other lines of research showing that while pre-commitment tools have proved effective, this does not take into consideration the willingness of users to make use of these tools, which is significantly lower (Griffiths et al., 2009). Another research study showed that 80% of gamblers in a study of 47,000 individuals, spent more money than their pre-set monetary limit (Broda et al., 2008). This clearly demonstrates the need for further research in how to make pre-commitment tools not only effective, but also engaging and appealing to the end user.

The gambling literature on pre-commitment tools is lacking in several key areas: HCI principles, PSD and usability were not considered when the pre-commitment tools were designed. Therefore, pathological gambling is a prime area for the application of these principles to produce a more effective, engaging, appealing and persuasive pre-commitment tool.

When PSD principles are carefully considered and implemented in a pre-commitment tool, the outcome is theorized to be increased user engagement and satisfaction with the tool. Additionally, the application of such principles should help Internet gamblers monitor their expenditure thus improving adherence to a preset limit. To our knowledge, PSD principles have not been applied to responsible gambling systems that provide money limit tools. Moreover, we are unaware of empirical research that integrates the psychological literature on pre-commitment

and monetary limit tools with the knowledge gained in the field of HCI to improve the utility and usability of such tools. Therefore, it is believed that a monetary limit tool designed with key HCI and PSD principles would yield a higher rate of pre-set limit adherence than a tool without such considerations.

Goals and Objectives

The goal of this thesis is to contribute to the PSD literature through applying select PSD and usability principles to a monetary limit tool with the intent of promoting responsible gambling. The study compared an HCI-inspired monetary limit tool with an existing standard monetary limit tool that was not designed according to HCI and PSD principles. The goal was to uncover whether a monetary limit tool designed with usability and PSD principles will further facilitate responsible gambling and possibly increase use of such tools in gambling in general.

Study Objectives

1. To determine which aspects of usability and PSD are appropriate for implementation in a monetary limit tool.
2. To implement and test a monetary limit tool designed with usability and PSD principles with the goal of assessing effectiveness in promoting responsible gambling.
3. To evaluate whether the incorporation of usability and PSD principles can increase engagement and liking of monetary limit tools.

Research Questions

1. Can the use of PSD and usability principles facilitate responsible gambling through limit adherence and engagement?

2. Can breaking specific usability principles facilitate limit adherence?
3. What aspects of a monetary limit tool designed with usability and PSD will be effective in motivating users to adhere to their pre-set limits?

Hypotheses

1. The use of a warning pop-up window including a mandatory delay before the user can select continue playing will increase the number of gamblers who choose to quit upon or before reaching their pre-set limit.
2. The pre-commitment tool will be most effective if it can promote limit-adherence without noticeably reducing or altering the user's flow state while gambling.
3. The use of features that facilitate self-monitoring, such as a visual metaphor and a player statistics window which can be accessed at any time the player desires, will be effective in aiding users manage expectations, resulting in greater adherence to their pre-set limit.
4. Visual design improvements will increase engagement and liking while subtly breaking the user's flow state, and in turn, increase limit adherence.
5. The inclusion of educational/motivational messages that are informative and clear (while avoiding any negative or punitive tone) will also be effective in helping users adhere to their pre-set limit.
6. In some cases, breaking traditional usability rules will aid in facilitating limit adherence, by slowing users down and requiring them to process additional information and taking the time to consider their decisions before making a choice to spend more money.

Overall Methodology

In order to study the aforementioned objectives and research questions, a user-centered design process was chosen. User-Centered design (ISO/IEC, 2010) is defined as involving the end users in every stage of the application development, and employs six key principles:

1. The design is based upon an explicit understanding of users, tasks and environments.
2. Users are involved throughout design and development.
3. The design is driven and refined by user-centered evaluation.
4. The process is iterative.
5. The design addresses the whole user experience.
6. The design team includes multidisciplinary skills and perspectives.

It has been shown that by following a user-centered design process and involving end users in every stage of development, systems are designed to be more effective, efficient and user-friendly (Norman & Draper, 1986; Norman, 1988; Shneiderman, 1987). Specifically in regards to pre-commitment tools, the literature reveals a lack of usability or PSD consideration in terms of development, and therefore user-centered design is strongly implicated in the research and development of an effective pre-commitment tool. Additionally, since one of the major challenges in the efficacy of pre-commitment tools is motivating gamblers to use them in the first place (Griffiths et al., 2009), involving users in every step of the design process is vital in creating the most persuasive and engaging tool possible.

The user centered design process presented within includes six phases:

- I. Preliminary User Research
- II. Persona and Storyboard Development

- III. Determining Design Elements
- IV. Heuristic Evaluation
- V. Design Implementation
- VI. Controlled Lab Experiment

Overview of the User-Centred Design Process

Six principles are identified as necessary in order for user-centered design to be effective. Each was considered and implemented throughout the design process of the responsible gambling tool. First, the design of the pre-commitment tool was based on understanding users and the contexts in which they gamble, which was employed through the preliminary user research, and creation of personas and storyboards to ensure user perspectives were thoroughly thought through and considered. Second, users were involved throughout the design and development of the pre-commitment tool, via the preliminary user research, heuristic evaluation and the controlled lab experiment. Third, each design phase was based on user-centered evaluation including the heuristic evaluation and the lab experiment, as well as the implementation of principles from usability and social psychology, which are themselves based on end user behaviour. Fourth, the process was iterative in the sense that there were several design stages that involved evaluation of the pre-commitment tool, and the design was modified based on the findings. Fifth, the design attempted to address the whole user experience including taking into account the user's cognitive processes before, during and after playing within the pre-commitment tool, although it was not possible to integrate the tool into an actual online casino environment; and sixth, the design team was multidisciplinary, including a social psychology professor (Dr Michael Wohl), a social psychology Masters student (Andrew Kim), two user-centered designers (Kristen Warren and Dr

Avi Parush), a visual designer (Monica Zaczynski), and two programmers from Psychology Software Tools Inc.

Selection of Participants

In many cases, the use of undergraduate university students as participants in experimentation is considered somewhat confounding, as this group is said to not always be representative of the general population (Falk & Heckman, 2009). However, in the case of recreational gambling, it has been found that adolescent and college-aged individuals are more at risk for developing pathological gambling habits, as this population is more likely to engage in risk-taking activities (Shaffer et al., 1999). Therefore, for the purposes of developing a pre-commitment tool with the intent of promoting responsible gambling, a university undergraduate sample is ideal.

Phase I: Preliminary User Research - Focus Groups

Before beginning the design of the pre-commitment tool, preliminary user research was necessary. Following the process of user-centered design, beginning an interface development project with user research is fundamental in ensuring the final product is useful to end users and meets their needs (ISO/IEC, 2010). The intent of the focus groups was as follows:

1. Attain insights as to how and why individuals gamble
2. Gather perceptions of responsible gambling
3. Determine whether individuals feel that they are responsible gamblers
4. Explore what responsible gambling tools have been used in the past
5. Determine appealing and effective aspects of responsible gambling tools
6. Gather opinions on a standard monetary limit tool

Focus groups were selected as our method of preliminary user research due to the tight timeline of the project given by the granting organization, the Ontario Problem Gambling Research Centre (OPGRC). Individual interviews would have been the preferred method, as focus groups are susceptible to the groupthink phenomenon (Janis, 1971), which can reduce the reliability and validity of data attained. Proven measures to avoid groupthink were taken, such as indicating to participants that each of them were to be “critical evaluators” and were to freely speak of their opinions as well as objections (Janis, 1972), giving participants a survey at the beginning of the session to write down their thoughts on the aforementioned key aspects of gambling, ensuring group members were not familiar with one another before the focus group session, and ensuring the facilitator remained impartial. Since all of the aforementioned methods have been shown to reduce groupthink in focus group scenarios (Flowers, 1977; McCauley, 1989; Zimbardo &

Andersen, 1993), it is believed that the data attained is reliable and valid regardless of potential confounds.

Participants. Participants were seventeen undergraduate students at Carleton University (Group 1: 6 female, 4 male; mean age = 19.8; Group 2: 3 female, 4 male; mean age = 19.6), who had indicated in a large-scale mass-testing survey at the beginning of the academic year that they currently participated in gambling activities (Gambling activities were defined as: lottery, scratch-n-win, slots, casino, poker, sports betting, stock market, etc.). Participants preferred a mix of gambling venues: the first focus group contained participants who were more likely to play poker and table games at friends' houses, while the second group contained participants who were more likely to gamble at a local casino. Approximately 1/3 (n=6) of participants gambled online, and 4 indicated they gambled online regularly.

Facilitation. The focus group was facilitated by a professional focus group facilitator, Jeanette Bellerose, from Arcturus Solutions in Ottawa (<http://www.arcturussolutions.com/en/>). A professional facilitator was chosen despite our team having several individuals who were competent facilitators, because we believed that an objective third-party who is not part of the research team would produce less bias among participants and subsequently attain more accurate data. The research team members observed each group while taking notes, and were given the opportunity to ask any follow-up questions which resulted from the focus group discussions at the end of the each session.

Procedure. Each focus group was approximately 1.5 hrs in length. The focus groups were held in the CUGL board room at Carleton University, and participants were given \$20 remuneration for their participation as well as pizza and snacks. Before beginning facilitation, participants were asked to fill out a variety of surveys including the questions that were to be

asked during the group to increase the reliability of comments made during the focus group (to reduce groupthink). Each group began by the facilitator introducing herself and going over what would happen during the focus group session. The facilitator then began asking questions to the group. At the end, participants were shown a standard monetary limit tool implemented in a virtual casino to attain feedback. The facilitator guide was developed by the focus group facilitator (see Appendix A).

Results.

Gambling Habits and Motivations. Gambling behaviours varied greatly between participants, however some patterns were identified through analysis of comment and topic frequency. Individuals who typically get together with friends to gamble or purchase scratch tickets tended to participate in gambling activities more frequently than those who preferred to gamble at casinos. There was a gender difference in the amount of money spent while gambling: women were more likely to spend less money (\$20-\$50 on average) per gambling session, while men were more likely to indicate spending more (\$50-\$100 on average, and for some (n = 2), \$300-\$400 on average). Two participants mentioned avoiding online gambling specifically because of the added risk of over-spending.

Participants overwhelmingly indicated they gambled for the fun and excitement that they experienced. However, the participants who were online gamblers (Group 1, n = 6; Group 2, n = 2) indicated boredom as a frequent motivator for gambling behaviour. Many participants indicated they began gambling as a fun activity with friends or family, and enjoyed the social aspects of a casino outing.

Perceptions of Responsible Gambling. Surprisingly, most participants had not heard of the term “responsible gambling” and indicated this was not a consideration of theirs when engaging in gambling activities. Participants had not recalled seeing any responsible gambling tools or media/marketing, although four were able to identify the OLG’s slogan of “Know your Limit, Play Within It” (and others recalled the slogan once mentioned), but most were unsure of where they had seen or heard it. One individual in each group indicated that responsible gambling messages are more effective when they contain personal stories of individuals who have experienced negative life consequences due to their gambling behaviours.

Many participants indicated that they did have strategies for gambling responsibly (although prior to the focus group, they would not have identified these behaviours as “responsible gambling strategies”). The most common strategy mentioned by approx. 6 participants was taking a set amount of money into the casino, and leaving all debit and credit cards in their car or at home. Participants indicated this was an effective strategy in preventing over-spending. Several others reported using variations of this strategy ($n = 4$) (e.g. leaving their gambling money in one pocket and their cards and other cash in a different pocket), which were also effective. Some participants also indicated other strategies such as avoiding online gambling where over-spending is much easier ($n = 2$), taking regular breaks to get a drink or food ($n = 2$), or going to the casino with someone who does not like to gamble so they are motivated to leave earlier than if they were with someone who was highly engaged in gambling activities ($n = 1$).

Most participants indicated periodically breaking their own rules, however since they are all undergraduate students, many did not see this as a big deal because they have limited disposable cash and tend to not over spend.

Participants were asked to indicate instances where they felt they had gambled responsibly and irresponsibly, which revealed some interesting findings. First, for these individuals, being made aware of what the money they have won or are losing could pay for was motivating. Two individuals recounted stories of quitting their current gambling session when they had won several hundreds, even though their friends or family were encouraging them to continue. Knowing that the money they had won could pay for clothes or part of a vacation was sufficient to remove the motivation to gamble.

When asked why they sometimes gambled irresponsibly or spent more than they intended, the most common responses included wanting to regain losses, losing self-control due to alcohol, and boredom (particularly if the person had gone to a casino with friends and lost all of their money faster than their friends). Very few could recount instances when they gambled irresponsibly, and these circumstances were usually precipitated by the loss of a large amount of money or wanting to spend money they had just won.

Designing Effective Responsible Gambling Tools. All participants considered themselves responsible gamblers, and as such believed responsible gambling tools would offer no benefit to them personally, but could see the utility for individuals who were pathological gamblers.

Participants specifically indicated that they thought being diverted to another activity such as getting a drink or food would be a great way to maintain the fun while taking a break and “cooling down” from their gambling session. In terms of aspects they thought would not be effective, participants indicated anything punitive or that prevents them from having fun would not work, or if pop-up messages in an online pre-commitment tool were too frequent. A tool that forced the user to take a break after reaching their limit was mentioned as being

somewhat annoying but overall positive, and offering incentives to take breaks such as a drink ticket or points that can be added up and traded in for food or merchandise rewards may also be effective in motivating gamblers to take breaks.

Some participants ($n = 3$) believed the ability to see progress or charts that showed their spending over time and wins/losses over time would make an impact on their desire to gamble.

Reactions to Prototype. Participants were first asked which would be more effective: a monetary limit tool or a time limit tool. The overwhelming response was that monetary would be more effective ($n = 12$), although time limit tools may be effective for some people ($n = 3$). Monetary limit tools were more consistent with the strategies participants currently employed to avoid over-spending, and participants indicated a time limit would reduce their fun while gambling. A money countdown was indicated as more useful than a credit countdown, as many individuals cannot make credit to dollar conversions easily in their heads (especially while intoxicated, which is common while engaging in gambling activities).

Overall Takeaways. The general sense from all participants was that gambling is a fun pastime, and regardless of what a pre-commitment tool does, it should not interfere with the pleasure of gambling. A major challenge in the design of any responsible gambling tool was identified: convincing recreational gamblers to use responsible gambling tools will be difficult regardless of the design. Also, a common theme was that feeling sad or depressed increases their desire to gamble, and therefore any effective monetary limit tool needs to be positioned to make individuals feel good about themselves instead of presenting information in a negative or punitive tone. Monetary limits were seen to be more effective than time limits, and being forced to take a break was seen as a minor inconvenience compared with the associated benefits of responsible gambling.

Phase II: Persona and Storyboard Development

After the preliminary user research was completed, the next step was to begin thinking about how users would end up using a pre-commitment tool designed for online gambling – that is, how it would fit in with their gambling experiences. Three distinct personas were created, and a storyboard was developed to bring the use case of the HCI-inspired monetary limit tool (MLT) to life within an online gambling setting. Both the personas and storyboard were based on the focus group results and the gambling literature.

Persona 1

²

Name Jack Fraser

Age 24

Occupation Junior Political Analyst

Gambling Frequency Once per week

Jack is 24-years old who has recently finished a degree in political science at Carleton University in Ottawa. He has a small, close group of friends who he enjoys spending time with a few nights per week. He lives alone in Ottawa, as the rest of his family is from Alberta. Jack frequently played poker with friends and online while in university, and occasionally went to the Lac-Leamy Casino to play the slots. At the time and being a university student, Jack never spent more than \$40 - \$50 per gambling event, as that was all of the disposable cash he had. Now that Jack has attained a full-time job as a junior political analyst with the Canadian Federal Government in Ottawa, he is finding the temptation to gamble stronger as he has more disposable cash available. Jack sometimes feels guilty for betting money which he knows should be going towards repaying his student loans, but he justifies his actions by thinking that he may win big someday and his student loans will be taken care of.

² Image courtesy of imagerymajestic at FreeDigitalPhotos.net

Persona 2

3

Name Ann Spade**Age** 42**Occupation** Information Architect**Gambling Frequency** Once per month

Ann is a mother of two, a boy, 10, and a girl, 7. Ann works for a medium-sized web-design company as an information architect. She lives in a small town just outside of Toronto, and commutes into the big city every day. Ann has a fairly busy schedule working full time and bussing around her kids to various after-school activities, such as soccer practices and games, math tutors and piano lessons. Ann first began gambling a few years ago, when her weekly get-together with her girlfriends turned into a weekly trip to the local casino. At first Ann had lots of fun playing slots and table games, but lately she has been feeling the urge to gamble on her own even when her friends are not around, as a means of relieving stress and hoping that her winnings one day will take care of her kids' university tuition. One day, Ann hears that online gambling is about to be available in Ontario, and sees an opportunity to fulfill her gambling desires without leaving the comfort of her own home.

³ Image courtesy of stockimages at FreeDigitalPhotos.net

Persona 3

Name Carlos Fring**Age** 55**Occupation** Welder**Gambling Frequency** 4-5 times per week

Carlos is a 55-year old welder, with two grown-up children. He lives alone, and tends to work 50-60 hours per week. After work, he likes to relax with a beer and watch his favourite sports teams play on TV. About 20 years ago, Carlos became a problem gambler after the pressures of raising a family, marriage, and his job became too much for him to handle. Unfortunately this led to the demise of his marriage, but luckily for Carlos, this was just the wake-up call he needed to get help for his pathological gambling. After 5 years of therapy, he was considered a reformed problem gambler, and has not touched a poker chip since. However, recently Carlos has been feeling the pressures of work again, and his loneliness without his wife has left him feeling hopeless. He heard of the OLG's online gambling games and their use of monetary limit tools, and decided to start playing slots. Carlos believes that with some help from OLG's limit tools, he will be able to control his gambling this time, as long as he stays away from high-stakes poker.

Storyboard

The storyboard follows Jack (persona 1) through an evening of online gambling. Since two of the main principles in PSD are tailoring and personalization, we chose to consider each target user group individually to maximize persuasion. Therefore, one storyboard was produced which considers the user group being studied in the current research project: university undergraduate students. If other user groups are targeted, it may be indicated to create separate storyboards for each. Additionally, it has been shown that an undergraduate sample is ideal in terms of studying gambling habits (Shaffer et al., 1999), and therefore has the greatest chance of the results being generalizable to the rest of the gambling population.

The story begins on a snowy January evening, when Jack is home alone with nothing to do. He has just heard of OLG's new online gambling and decides to give it a try.

Upon entering the virtual casino Jack is asked if he would like to use one of the OLG's responsible gambling tools. Jack considers himself a responsible gambler, and thinks it can't hurt to try it. He enters a limit of \$40 and begins playing.

Jack keeps betting over and over again, as he watches the slot reels whirl by. Beginning to get frustrated by his lack of winnings, he starts pressing the buttons faster and faster. Then, something unexpected happens - a pop-up window appears.

Jack notices that he can't dismiss the pop-up window right away, and instead he is required to wait 10 seconds. Annoyed by the disruption to his play, Jack vows never to use the monetary limit tool again. Then he notices a message at the bottom of the window, telling him that if he keeps gambling at this current pace, he will lose \$20,000 in 5 years! Jack realizes that is half of his student loans, and begins to think more carefully about his gambling habits.

Finally the 10-second delay on the pop-up window has passed, and Jack continues to play. After another few minutes, another pop-up window appears. This time, Jack is ready for it.

Although Jack immediately decides he wants to keep playing to try and recover his losses, he quickly realizes that he must wait 5 minutes until he can return to his gambling session. Jack, annoyed and frustrated, decides to go check his Facebook account until he can continue gambling.

After looking at pictures of funny cats for a few minutes, Jack returns to the OLG website and realizes he can now continue playing. However, in a more sober mindset and remembering how much money he may lose over the course of a few years, he decides he doesn't want to lose any more today and returns to looking at funny pictures of cats.

Both the personas and storyboard helped to get a sense of our overall target user groups, their motivation to gamble and goals in terms of gambling. Storyboards using personas are effective ways to combine necessary elements of design together, such as the persona and their behaviours and motivations, and requirements and solutions to the main problem (in this case, facilitating responsible gambling). In that sense, storyboards can be a powerful tool for developing solutions to problems, taking into account the user experience throughout the process (Crothers, 2011). In our case, the storyboard helped to refine the design of the monetary limit tool by thinking through how the end user would use the MLT in an actual gambling session. Aspects of their gambling experience were considered, such as how they would feel upon seeing various features of the MLT and how that would affect their gambling experience. These features would be vital in the development of an effective monetary limit tool, as the goal of the MLT is to be engaging and effective, without ruining the fun or interfering too much with the user's gambling experience.

Phase III: Determining Design Elements and Implementation

After the persona and storyboards were complete, the next step was to combine the HCI research on PSD, the psychology research on attitude and behaviour change, the focus group data, and the requirements and solutions from the personas and storyboard, to identify key features which are hypothesized to be effective in aiding users to adhere to their pre-set monetary limits. The information gathered was then translated into initial design specifications for the monetary limit tool, and wire-framed prototypes were created (See Appendix B) as well as a flow chart of how the monetary limit tool would work (See Appendix C). These wire-frames were then sent to the programmers to assess feasibility of each feature, and the features that were determined to be feasible were then sent to a professional graphic designer to mock-up the final prototypes. Once designed, the monetary limit tool was evaluated using the Heuristic Evaluation technique to discover any previously unidentified issues or areas for optimization. The evaluation findings were intended to help fine-tune and revise the design specifications for optimal usability and utility as a monetary limit tool, however the findings were not able to be implemented due to time and platform limitations. The findings do provide insight into additional modifications that can be applied to real-world MLT implementations. The final prototypes were sent back to the programmers for implementation into the simulated online casino environment, before proceeding to a full lab experiment.

Design Specifications Derived from the Focus Groups. Several key findings emerged from the focus groups, which aided in the design process, including:

- Participants typically gambled for entertainment value, the thrill of a potential win, boredom, habit and social inclusion

- A money countdown would be more useful than a credit countdown, and either would be more useful than a time countdown
- Pop-ups should not occur too frequently or they may be perceived as annoying and users will simply go to a different gambling site
- Imposing a delay before the user is able to continue playing once their limit has been reached might be effective
- Participants would be discouraged if the tool takes pleasure away from gambling
- A summary of current wins and losses could be a double-edged sword
- Not explicitly stated but implied by many participants was the desire for a metaphor for aiding in tracking progress towards one's pre-set limit

Since participants indicated a monetary limit tool would be more effective than a time limit tool, we decided to focus on creation of a monetary limit tool without time-limit aspects. Participants also indicated that the tool cannot be obtrusive, annoying or “kill the fun”, otherwise it would not be adopted. Therefore, careful attention was paid to ensuring the pop-up windows were not presented too frequently (based on duration of play) or presented in a way that would annoy users. This resulted in selecting one pop-up message to set the limit before beginning play, and two pop-up messages during play: the first presented when the user reaches the last 10% of their pre-set limit (which reminds the user that they originally wanted to quit soon), and the second when the user reaches their pre-set limit. Although no research had been conducted to aid in deciding what percent users should view the “approach limit” message, it was hypothesized that 10% would be effective as this would both maximize the amount of time users could spend gambling in a flow state (i.e. 90% of their gambling session), while giving the user enough time to mentally prepare for their approaching limit (i.e. the last 10% of play). This limited number of

messages is hypothesized to not annoy the user or prevent them from having fun, but at the same time present vital information at key points in the user's decision making process of whether to quit or continue playing, resulting in greater limit adherence.

Inclusion of a summary of wins and losses was seen by participants to be a double edged sword: helpful to aid in self-monitoring of expenditure, but could also be harmful in that users who are constantly viewing how much they are losing may want to continue gambling to recover losses. Given that self-monitoring is a key PSD principle leading to the successful adoption of attitude or behaviour change (Oinas-Kukkonen & Harjumaa, 2009), inclusion of a wins/losses summary was vital, but needed to be designed in such a way that any potential anxiety or negative affect elicited due to losses was countered by the MLT. One method used to achieve this balance was to implement a time delay when the user had reached their pre-set monetary limit. Specifically, upon reaching their limit, users were required to wait a period of one minute before continuing to play (or they could choose to quit at any time). This specific artifact of the MLT was also based on the gambling research, showing that gamblers think more clearly in a cold cognitive state (Lowenstein & Learner, 2003), which is also the state in which the user had set their monetary limit originally. By implementing a time delay before the user can continue playing, they will return (or at least approach) this cold cognitive state before continuing to play.

Design Specifications Derived from the HCI Usability Literature

Breaking the "Flow" State. A flow state is a loss of awareness with the outside world, and is characterized by the user not knowing how long they have been interacting with an interface, not responding to external stimuli, and promotes continuous play and enjoyment (Csikszentmihalyi, 1975). Although a flow state is beneficial in that flow is correlated with pleasure (Csikszentmihalyi, 1975) and is frequently used in contexts such as video games where

the goal is to motivate the user to continue playing, it has been shown that computer interfaces that entice users into a state of flow have greater addictive power than those that do not employ such flow states (Chou & Ting, 2003). Therefore, it was an important consideration to balance the user's flow so that the user can enjoy their gambling experience, but also reduce flow states at critical points to avoid a state of dissociation that could end up promoting addiction, over-playing and subsequently, over-spending. Several elements were designed into the monetary limit tool to address flow. First, when users view a pop-up message, the rest of the screen fades to a dark grey hiding the colours underneath, breaking the visual flow of the game. Second, the sounds of the gambling machines fade noticeably, breaking the audio flow. Lastly, the user is required to perform an action on the pop-up message before returning to the game (and sometimes is required to wait a set duration before returning to game play), forcing users to shift their attention from the game to something else for a short duration, also breaking flow.

The next set of principles considered were Nielsen's 10 usability heuristics (Nielsen, 1994b), the current industry standard for usability evaluation (Hvannberg, Law & Larusdottir, 2007; Wenham & Zaphiris, 2003). Even though there are ten principles in total, not all applied to our MLT application, and therefore a sub-set of five were considered. Below is a list of the incorporated principles, along with a brief description and how each was implemented into the design of the monetary limit tool.

Visibility of System Status. The visibility of system status ensures the user is aware of what the system is doing at all times, and relays key information. This principle was incorporated in three ways: 1. The action buttons are labeled in clear language that indicate to the user what the system will do upon clicking (e.g. "Quit" would exit the user from the game and "Continue Playing" would return the user to their gambling session); 2. The action buttons (i.e. Quit,

Continue Playing) are presented clearly on each pop-up message by using a contrast colour from the background colour (bright blue buttons on a dark grey background), so users can easily identify where they need to click to get where they want to go; and 3. The most important information on each pop-up message, how many credits the user has left in relation to his or her pre-set limit, is displayed prominently and clearly as the main heading on each pop-up message.

Match Between System and the Real World. Implementing this principle ensures users comprehend the information presented with little thought required, by using terminology and language familiar to the user, and presenting information in a logical order. This principle is leveraged by ensuring all of the information presented on each pop-up message is stated in clear language (e.g. “You are approaching your pre-set limit”), as opposed to jargon (e.g. “Calculations done by the system indicates that the previous monetary limit set is approaching”). Additionally, the use of a commonly recognized metaphor to convey information is frequently utilized as a method of marrying information in computer interfaces with real world objects or concepts for ease of understanding. Metaphor inclusion can be an effective means of transferring complex information quickly, or increasing the user’s awareness of a key metric or status by associating it with a familiar object (Lakoff & Johnson, 1980). In the case of the monetary limit tool, a traffic light metaphor was chosen to convey status information in relation to the user’s pre-set monetary limit. This specific metaphor was selected due to our target user group’s familiarity with a traffic light (i.e. North American individuals over the age of 18), and the clear association of meaning for each of the three coloured lights (See Figure 3).

Figure 3: HCI-inspired MLT traffic light icon metaphor.

For example, green is associated with everything being “good to go”, yellow is associated with attention needing to be paid shortly, and red is associated with immediate attention required. These three statuses correspond well with how the monetary limit tool was envisioned: the traffic light is green after the user has set their monetary limit and has begun gambling; yellow when the user reaches the last 10% of their credits; and red upon the user reaching their monetary limit. Other metaphors considered but ultimately rejected include a gas gauge where the needle would indicate what percent of the user’s limit remains, a thermometer with a colour gradient which would “fill up” as the user approaches their limit, and a piggy bank that would drain as the user approaches their limit. The traffic light was ultimately chosen due to our target user group’s familiarity with the object and its statuses, which translated into increased potential to convey status information compared with the other metaphors.

Based on the feedback from focus group participants, it became apparent that the translation between credits and money is important to state explicitly, which is also supported in the gambling literature as an effective means of motivating gamblers to avoid over-spending (Griffiths, 1993, 1999; Loba et al., 2001). Therefore, it was decided to reveal monetary values alongside credit values so users could easily interpret the information (See Design Implementation section for further discussion).

Due to the different traffic light states (green, yellow or red), status information can easily be conveyed through the graphical icon with no text or numbers required, meaning very little cognitive load is needed on the part of the user to determine how many credits remain in relation to their pre-set limit. This use of a metaphor not only helps the user remain aware of how much they have spent in relation to their limit, but also makes the conveyance of status information unobtrusive and easily interpreted both when the icon is attended to (conscious awareness) and when the icon is not attended to (subconscious awareness). In order to solidify the association between the traffic light metaphor and status information, the traffic light was implemented on each pop-up message with either the green, yellow or red light lit (corresponding to the user's status), as well as remaining statically displayed in the bottom right corner of the screen at all times to facilitate the principle of self-monitoring (See section below: Design specifications derived from the PSD literature).

Consistency and Standards. Implementing design elements consistently and following platform standards decrease the time the user needs to learn how to interact with the interface, and increases the time that the user can spend engaging with the content that is important to them (in this case, their gambling session) (Spool, 2006). Familiarity in turn reduces the user's learning curve when interacting with a new interface and reduces cognitive load. This principle was translated into the layout design of the pop-up messages. Each message displays the information in a consistent fashion, meaning users are not required to search for a specific piece of information on the screen (see Figure 4 and Figure 5):

- The traffic light is always presented in the top left corner of the window
- The main heading is always in the largest font at the top of the window
- The buttons are always placed in the middle of the window

- The motivational messages are always placed in a subtle font at the bottom of the window

Figure 4: The HCI-inspired MLT set limit pop-up window.

Figure 5: The HCI-inspired MLT approach limit pop-up window.

In addition to consistency within the monetary limit tool, many layout and visual design aspects mirrored those found on common computer operating systems (i.e. Windows and OSX), as well as mobile operating systems (i.e. Android and iOS). For example, the most commonly used button is usually placed near the bottom right of a screen or window (e.g. “next” if the user is filling out a form or “save” if the user has made settings modifications), which is consistent in the HCI-inspired MLT. Also, the most important message (or overall message) is placed at the top of the screen in a larger font than others, which is also consistent in the current monetary limit tool.

Recognition Rather than Recall. It is easier for individuals to recognize information or objects rather than recall them. This is because recognition does not require as much cognitive load as recall, and recognizing something also does not require the user to be able to quickly access a stored memory (Tulving, 1968). In order to implement this principle, the HCI-inspired MLT continuously presents status information on the screen via an on-screen dashboard (see Figure 6). As such, users are never required to remember what their original pre-set limit was, do any calculations as to how many credits they have remaining, or remember if/when they are approaching their limit. Additionally, the amount of time the user has spent gambling was also added to the on-screen dashboard so users can easily see how long they have been gambling, as some users from the focus group indicated losing track of time was a common phenomenon when gambling.

Figure 6: The HCI-inspired MLT on-screen dashboard.

Aesthetic and Minimalist Design. Another core principle frequently applied in the MLT design was aesthetic and minimalist design. This principle asserts that presenting users with only the information they require and otherwise keeping the visual design minimalistic will ensure users can easily consume important content, and is the basis for an appealing visual design (see the *Liking* subsection below for further explication of this concept). In order to implement this principle into the monetary limit tool, we decided to ensure only critical content was placed on each pop-up message, and was designed with an easy to scan visual hierarchy using visual design principles such as alignment and font size. This created very simple pop-up messages, the content on which can easily and quickly be consumed by users, thereby not interrupting their gambling session more than necessary while still conveying critical information.

The last two usability principles were taken from Quesenbery's 5Es (Quesenbery, 2002): Effectiveness and Engaging.

Effectiveness. Effectiveness occurs when aspects of an interface are designed in a way that will be effective in aiding the end user achieve their goals (in this case, having fun while gambling and not over-spending). Providing users with reminders of their pre-set limit at key times to increase their awareness of their status as they are approaching the moment when they

should quit is hypothesized to aid in limit adherence and increase effectiveness of the MLT. This principle was employed through presenting users with an “approach limit” pop-up window (See Figure 5) when they reached 10% of their limit. Focus group participants were clear that any responsible gambling tool that decreases their fun would not be effective. Therefore, only one “approach limit” pop-up window was implemented, instead of two or three, hopefully increasing the effectiveness of the tool in allowing users to enjoy their gambling session.

In choosing the point at which individuals would view the “approach limit” pop-up message, several items were considered. First, focus group participants were adamant that if the responsible gambling tool was to be effective it could not take away from their fun. By presenting the “approach limit” pop-up message at 10% of the remaining credits, users are able to enjoy (and potentially enter a flow state) 90% of their gambling session before having to think about ending play. Second, we hypothesized that the “approach limit” message needed to be placed far enough away from the limit reached message so that users are not faced with too many pop-up messages quickly, but close enough so that participants could mentally prepare for the end of their session. Therefore, 10% was hypothesized to be the ideal point for warning users that they are approaching their pre-set limit.

Engaging. An engaging interface will draw the user into the interaction, and increase overall satisfaction with the monetary limit tool. Initial perceptions of the tool will impact engagement and overall perception of the MLT (Lindgaard et al., 2006), and therefore the visual design is key in creating an engaging interface. Therefore, we decided to use a professional graphic designer to develop the visual aspects of the MLT. Additionally, representing the visual importance of each pop-up window as the user approaches their limit by making each window

slightly larger than the last is hypothesized to increase engagement with the pop-up windows as they become increasingly important.

The final usability principle is Accessibility - a general set of guidelines for ensuring users with disabilities can utilize an interface. However, many aspects of accessibility also create good usability for all users, not only those with disabilities.

Accessibility. A percentage of users interacting with any given interface will have cognitive or physical/sensory impairments which need to be taken into consideration when designing an interface. This was especially important in the design of a monetary limit tool, as individuals with disabilities are much more likely to become problem gamblers than their non-disabled counterparts (Petry, Stinson & Grant, 2005; Morasco & Petry, 2006). Therefore, the monetary limit tool followed WCAG 2.0 guidelines to AA standard (Web Content Accessibility Guidelines 2.0, 2010). These guidelines include: 1. Ensuring the colour contrast between foreground items (e.g. text or images) and background items (e.g. background colour or image) is high enough so that individuals who are colour blind or have low vision can clearly view the content (Web Content Accessibility Guidelines 2.0, Section 1.4.3, 2010); 2. Ensuring all pop-up windows are keyboard compatible and the order of information is presented properly if a screen reader is used (Web Content Accessibility Guidelines 2.0, Section 2.1, 2010); and 3. Including explanations of key or complex concepts for individuals with cognitive impairments (e.g. how the monetary limit tool will work and how to use it, what the buttons do, how to interpret the information, etc.) and text descriptions of images for individuals with vision impairments (Web Content Accessibility Guidelines 2.0, Section 1.1, 2010).

Design Specifications Derived from the PSD Literature

Self-monitoring. Self-monitoring is one of the most important PSD principles in the facilitation of attitude and behaviour change. Self-monitoring has been shown to aid individuals in avoiding or controlling addictive behaviours by helping them to feel in control and ensure their awareness of their behaviours (McFall & Hammen, 1971; Boutelle & Kirschenbaum, 1998). This principle is implemented in the monetary limit tool in several ways: 1. Providing an on-screen dashboard with the traffic light (See Figure 3) as well as win/loss information (see Figure 6); 2. Providing pop-up messages periodically during play to entice users to self-monitor; and 3. By providing users with a “player statistics” window that they can access at any point in time, and includes information relating to their wins/losses, time played, and how much they have spent in relation to their pre-set limit. This provided the user with the ability to constantly monitor his/her own progress towards his/her pre-set monetary limit (further discussion of this principle below in the *Liking* subsection), which helps the user to feel in control, and reduces the chance that the user will be in a “hot” affective state (i.e. raised anxiety, galvanic skin response, increased heart rate, etc.) when they do reach their limit. This reduction in heightened affect is hypothesized to be critical in aiding users to adhere to their pre-set limits.

Tailoring. This PSD principle states that information presented in a way that is tailored to the user (that is, when information is personalized or “speaks” to the user in a way that is idiosyncratic) increases the likelihood that the target attitude or behaviour (in this case, adhering to a pre-set limit) is achieved. Implementation of this principle can be seen in the careful choice of wording within the pop-up messages. First, on the pop-up window that allows users to choose a monetary limit, the text reads, “Please select how many credits you are willing to lose. . .”, which focuses the user’s attention on the high probability that they will be losing the money they

are about to spend. Similarly, on the final pop-up message, the text reads, “You have reached your credit limit”, both priming the user with a reference to reaching a limit on a credit card (which has a negative affective association), as well as focusing their attention on the fact that they have lost all of the money they had originally wanted to spend.

In the focus groups, it was mentioned that anecdotal information and information on what their winnings (or losses) could purchase would be effective in motivating individuals to adhere to their limit. Therefore, it is hypothesized that adding messages such as, “Based on your current gambling habits, you will lose \$10,000 over 5 years” would be effective in promoting limit adherence.

Reminders/Suggestion. The literature review of responsible gambling tools shows that educational messages are effective in helping users adhere to their pre-set limit through reminding them of responsible gambling practices (Blaszczynski et al., 2008). Therefore, an educational message was placed at the bottom of each pop-up window in a distinct colour and font to attract attention. Examples of such educational messages include: *Know Your Limit, Play Within It; Gambling within your limit will allow you to play again and have more fun*; and, *Think about it – How much can you afford to lose?* Educational messages were developed by the research team, taking into account the focus group finding indicating positive messages are preferred, as well as considering what type of tailored information may be most effective for the target user group.

Liking. The principle of liking speaks to the impact visual design has on the end user’s satisfaction with a given interface. The visual appearance is an important part of any interface, as users quickly make decisions as to whether they like or dislike an interface (50ms-500ms), and subsequently look for confirming evidence to support their initial impression (Lindgaard et al.,

2006). Therefore, after initial prototypes were created, a professional graphic designer was hired to create the visual design of the monetary limit tool, and attention was paid to various visual design principles such as colour theory, alignment, font selection, focus, and depth. It is hypothesized that this attention to visual design will increase user engagement with the monetary limit tool, which will in turn positively impact limit adherence.

Design Specifications Derived from the Psychology Literature

Inconsistent Schema Information. Of note, however, is the decision to break the principle of consistency and standards on one occasion for purposes of persuasion. Research has shown that individuals take longer to assimilate information that does not fit an existing schema, and therefore is attended to for longer periods of time resulting in increased awareness of the artifact (e.g., Wollen et al., 1972). In addition, even in the discipline of HCI, cases were made against the indiscriminant use of consistency (e.g., Grudin, 1989). Based on this research, it was decided to implement the Quit and Continue Playing buttons in a different layout on the final pop-up message (where the user must decide whether they will continue playing after reaching their pre-set limit), and place the buttons vertically instead (see Figure 5). This was done in an attempt to increase the amount of time the user takes consume the information presented on the pop-up message, which is hypothesized to result in increased consideration of whether he/she actually wants to continue gambling.

Figure 7: The HCI-inspired MLT limit reached pop-up window.

Priming. The educational and motivational messages placed at the bottom of each pop-up window engendered the psychology phenomenon of priming: when a stimulus (subconscious preferred for maximum effect) is presented at one time and then subsequently increases the accessibility of that schema (Higgins, Rholes & Jones, 1977). The messages used were subtle, and did not immediately attract attention, as they were placed in a smaller blue font instead of larger and white. Since gamblers often just want to quickly get back to their gambling session instead of stopping to read text, it is hypothesized that these messages would not be read thoroughly, and instead consumed subconsciously. However, given the second pop-up message has a 10-second dismissal delay and the last has a one-minute dismissal delay, the longer the user plays, the more likely they are to read the messages. It is hypothesized that with the mix of subconscious and conscious priming, users will be more likely to quit upon reaching their limit.

Phase IV: Heuristic Evaluation

Following user centered design principles (e.g., Preece, Sharpe, & Rogers, 2011), the basic usability of the newly designed monetary limit tool was qualitatively assessed via heuristic evaluation (Nielsen, 1994b) before proceeding to a full experiment. The intent of the heuristic evaluation was to attain additional perspectives on the usability of the monetary limit tool with real-world users (within the target user group) to refine aspects of the monetary limit tool. Ideally, the findings from the heuristic evaluation would have revised the final HCI-inspired MLT, but unfortunately due to time and programmer limitations, it was not possible to refine the tool after the heuristic evaluation. However, if the MLT was to be deployed for public consumption, several recommendations for modification would be made based on the heuristic evaluation results.

Evaluators. The evaluators were six individuals familiar with usability principles recruited from Carleton's Masters of HCI program (4 male, 2 female; Mean age = 26), and five individuals unfamiliar with usability principles recruited from other graduate programs at Carleton (2 male, 3 female; Mean age = 28). None were current online gamblers and all had either intermediate ($n = 6$) or expert ($n = 5$) knowledge of computers. The decision to use both individuals familiar with HCI-principles and individuals not familiar was based on two findings: 1 – individual evaluators have been shown to find anywhere from 20%-51% of issues, and therefore multiple users are required to identify all areas for improvement (Nielsen & Molich, 1990); and 2 – it has been shown that using a mix of individuals familiar with HCI principles and individuals unfamiliar with HCI principles produces a superior analysis of an interface than if only one group had been chosen (Nielsen, 1992).

Procedure. Each participant was invited to participate in a one-hour individual evaluation session, and was offered \$10 as remuneration. Each evaluator was given seven key heuristic principles used to design the HCI-inspired monetary limit tool, including five from Nielsen's usability principles (1994b) (i.e. Visibility of system status, Match between System and the Real World, Consistency and Standards, Recognition rather than Recall, Aesthetic and Minimalist Design) and 2 adapted from Quesenbery's 5 E's (Quesenbery, 2002) (i.e. Effectiveness and Engaging). Evaluators were first instructed to familiarize themselves with the principles and their descriptions, and were given time to discuss each and ask any questions to ensure a common understanding. Evaluators were then asked to evaluate the MLT based on the seven aforementioned heuristics, as well as asked to rate each issue on the following scale: 1. Good Usability, Well Done; 2. Minor usability problem, Fixing this should be given low priority; 3. Major usability problem, Important to fix and should be given high priority; and 4. Critical, severe usability problem, imperative to fix.

Then, the facilitator took each evaluator through the scenario of online gambling using the HCI-inspired monetary limit tool (similar to the storyboard, but without mentioning what any specific feature was for), and revealed the tool when appropriate.

Finally, when all issues had been identified, evaluators were asked to rate the MLT on 5 usability characteristics: satisfaction, ease of use, enjoyableness, likely to use in the future, and visual design. Each was rated on a 1-7 scale (See Appendix D for the full questionnaire).

Results.

Data Saturation. The first analysis was to ensure data saturation had been reached. This is particularly important in qualitative research, as it is not until this point that new knowledge or information is unlikely to appear (Flick, 1998). In our sample, data saturation was met by the 10th

participant (see Figure 6), and therefore we can be confident that the majority of usability issues were identified.

Figure 6: Data Saturation Curve: unique issues by participant #.

Issue Identification. Results from the heuristic evaluation were then analyzed qualitatively to determine what the most important issues were both by the rating given to each issue as well as by how many evaluators identified the same issue (See Table 2).

UI Ratings. Evaluators rated the UI characteristics highly, with the lowest scores reported for enjoyableness (M=4) and the highest going to Ease of Use (M=6).

Since the results of the heuristic evaluation were not implemented, the remaining analyses can be found in Appendix E.

Table 2: Issues identified via heuristic evaluation ordered by severity.

Issue	HE Principle	Severity	Frequency
It is unclear how much money a credit is worth.	Match between System and Real World	3	5
It is unclear whether winnings are added to set monetary limit.	Visibility of System Status	3	3
The message box itself is not distinct enough	Distinction between Warning & Limit Reached Messages	3	2
One warning message is not sufficient	Other	3	2
Grey text (countdown timer) is difficult to see	Visibility of System Status	3	2
Traffic light is not sufficient to denote status	Match between System and Real World	3	1
The design does not lock people out of playing, it just makes them want to move to a different site and therefore will not be effective at deterring problem gamblers.	Effectiveness	3	1
Textual information needs to be more "catchy"	Visibility of System Status	3	1
Numbers are not prominent enough	Visibility of System Status	3	1
Consider accessibility for colour blind individuals	Visibility of System Status	3	1
There is no way of the user checking their limit in-play.	Visibility of System Status	2	4
Button placement is not consistent	Consistency & Standards	2	3
When the pop-ups appear, they are not distinct from the background	Aesthetic & Minimalist Design	2	2
Typical warning messages on computers do not include traffic lights	Effectiveness of Traffic Light Icon	2	2
Limit is not displayed on the warning or limit reached messages.	Recognition rather than Recall	2	2
I find the inconsistency of button placement annoying	Layout/Size of Action Buttons	2	2
There is no inclusion of the typical X in the top right corner to close each dialogue box	Consistency & Standards	2	1
The word "lost" in regards to not having any credits left may cause reactivity	Other	2	1
The design may be annoying/difficult to use due to button placement, confusion over credit values, small text	Effectiveness	2	1
The association between the continue playing button and the timer is not clear	Consistency & Standards	2	1
Text is not distinct enough	Distinction between Warning & Limit Reached Messages	2	1
On the warning message, "15 credits remaining" is written twice	Aesthetic & Minimalist Design	2	1
on the Approaching Limit screen, the action buttons look too far apart	Look & Feel	2	1
Limit selection box/arrow selectors are too small	Layout/Size of Action Buttons	2	1
All credits have been lost is not prominent enough	Visibility of System Status	2	1
A Universally accepted metaphor may increase engagement	Engagement	2	1
Writing in regards to losing credits should be more prominent	Look & Feel	1	4
The icon is not prominent enough	Effectiveness of Traffic Light Icon	1	3
5 mins is a long time to wait after reaching a limit	Effectiveness	1	1
10% and 15 credits provides subtle conflicting information	Consistency & Standards	1	1
"using arrows below" is redundant	Aesthetic & Minimalist Design	1	1

Discussion. Overall, the results show that the evaluators were satisfied with the MLT and thought it would aid in increasing limit adherence. The tool was seen to be usable, satisfying and had an appealing visual design. These results were promising, as one of the main design challenges was creating a tool that is engaging to use, to address the unwillingness of gamblers to use pre-commitment tools in general.

The issues identified were generally small in nature, and could be easily updated. There were a few issues that cause concern, such as the traffic light metaphor not being prominent enough, and there were several visibility of system status issues identified which, if modified, could increase the prominence of some information.

Ideally, the modifications would have aided in finalizing the design and operation of the monetary limit tool, as well as developing a set of principles and guidelines for future development of responsible gambling tools.

Phase V: Design Implementation

After creating the monetary limit tool, the next step was implementation in a simulated online casino to test the efficacy of the HCI-inspired MLT compared with a standard MLT. The standard version has two basic windows: 1 – asking the user to set a limit (see Figure 1), and 2 – notifying the user when their limit has been reached (see Figure 2). The standard MLT shown here has been proven effective at increasing gambling limit adherence in a previous controlled lab experiment (Stewart & Wohl, 2013) when compared with participants who did not see an MLT.

The CUGL at Carleton University has an online simulated casino that was custom built by Psychology Software Tools Inc. (<http://www.pstnet.com/>). The challenge was then modifying the existing casino to accommodate the features necessary for successful implementation of the HCI-inspired MLT, which included many more features than the standard MLT and required extensive programming. Built using Valve Source Engine and programmed in the C++ language, the virtual casino allows users to walk around the casino outside, enter the casino and walk around the lobby, and enter the casino and play various machine and table games.

Before proceeding to implementation, the programmers were given a “wish-list” including all of the PSD and HCI elements that were ideally to be implemented. Most of the list was eventually implemented, although several things were not implemented due to platform limitations (See Table 3).

Table 3: Requested features, whether they were implemented, and an explanation if the principle was not implemented fully or at all.

Feature	Implemented?	Explanation (if necessary)
Full customizability of font size and colour, text, and all visual aspects of the pop-up windows.	Yes	N/A
Three distinct pop-up windows: set limit, approach limit and limit reached.	Yes	N/A
The approach limit and limit reached pop-ups will present the user's pre-set limit and what percent they have spent.	Yes	N/A
Each pop-up will have: the traffic light metaphor, a motivational message, and information relative to the user's pre-set limit.	Yes	N/A
The traffic light will be statically displayed on the screen, and will change dynamically based on the user's status in relation to their limit.	Yes	N/A
A dashboard will be placed on the screen with the translation from credits to money, how much the user has won/lost, and time playing.	No	Due to time restrictions, this feature was not implemented.
The approach limit and limit reached pop-up windows will contain a "Continue Playing" button with a time delay (10 s and 5 min, respectively).	Yes	N/A
Upon clicking on the traffic light or dashboard, the user will see a "player statistics" screen.	No	Due to the engine selected, mouse input was not available in this location. Therefore, instead line of text was added that said, "Press F7 for your player statistics" to access this functionality.
The game screen background will "grey out" when the pop-up messages appear.	Yes	N/A
The game sound will decrease when the pop-up messages appear.	No	The programmers were not able to implement this feature in time.
The monetary limit selection on the set limit pop-up will include two forms of input: arrows to increase/decrease the number, or keypad entry.	Yes	This was implemented, although it was not possible to center align the number inside the text box.
The pop-up messages will have the ability to pull game statistics such as credits left, time played, etc. and display these on various windows.	Yes	
The size of each pop-up window will gradually increase.	No	Time limits prevented this aspect from implementation.
Accessibility: pop-up windows are keyboard compatible and text descriptions of objects are available.	No	Given our sample would not include individuals with disabilities, it was not necessary to include these

		features for our lab study.
Convert credits to monetary amounts on each pop-up message and the player statistics.	No	Time limits prevented this aspect from implementation.
Including tailored educational/motivational messages that indicate what their winnings or losses could purchase.	No	This would have required a great deal of programming, and the info is more effective with a longer history than one session.

Phase VI: Lab Experiment - HCI-Inspired MLT vs. Standard MLT

After the HCI-inspired MLT was implemented within the virtual online casino environment, the next step was to assess the efficacy of the HCI-inspired MLT by comparing it with a standard MLT that did not contain explicit HCI, PSD or social psychology principles. Since both MLT's involve users setting a monetary limit and receiving a notification when their limit is reached, the main goal of the study was to compare whether participants in each condition quit or continued playing upon reaching their pre-set limit. Additional metrics were taken to aid in the explication of why participants quit or continued playing, such as evaluating craving to gamble, dissociation while gambling (i.e. flow), and specific questions relating to usability principles with the opportunity for qualitative feedback via comments. In sum, the metrics should be able to identify whether the HCI-inspired MLT was more effective than the standard MLT, on which metrics it was more effective, and if there were differences, possible explanations.

Methods

Participants. Carleton University undergraduate psychology students participated in a mass-testing session at the beginning of the academic year, where they completed a broad range of questionnaires including gambling habits. Fifty-six individuals (19 males and 37 females) who reported that they currently engage in gambling activities (e.g., slots, casino, poker, etc.) were recruited to participate. The age of participants ranged from 18 to 39 years ($M = 20.38$, $SD =$

4.27). Our ideal group of participants would have included mostly individuals who were experienced in online gambling, however there were not enough online gamblers to produce an adequate sample size. Therefore, the majority of our sample comprised offline gamblers (87.7%).

Procedure and Measures. Participants were recruited for a one-hour gambling session in which they came to the Carleton University Gambling Lab (CUGL) and were asked to gamble using the simulated online casino slot machines, as well as fill out a battery of questionnaires (See Appendix H). Participants were randomly assigned to one of two conditions: 1. Gambling with the HCI-inspired MLT ($n = 29$), or 2. Gambling with the standard MLT ($n = 27$). A between subject design was selected opposed to within: A within subjects design has the potential for strong carryover effects between conditions, which may have resulted in unreliable data. Instead, a between subjects design was decided to be superior for our specific study goals, as this would ensure users were reacting to and evaluating each tool in its own right, instead of in comparison with the other.

Before gambling, participants were asked to fill out the first few questionnaires in the battery. Upon completion, participants were given a total of \$20 (80 credits) with which to gamble in the simulated online casino. To make the session as realistic as possible, participants were informed that the odds of winning were identical to those in local casinos, and a slot machine payout table was provided so users were aware of which outcome corresponded with which amount of money won. Lastly, each participant was informed that they could stop gambling at any time and would be able to keep any remaining money (See Appendix F for the full facilitator script).

When first entering the simulated online casino, participants were instructed to insert all \$20 into any slot machine, but were not required to gamble with the entire amount. Instead, participants in both conditions were asked to set a monetary limit of their choice before beginning their

gambling session. To ensure every participant reached their pre-set monetary limit, the outcome of the spins was predetermined so that the sequence of wins and losses was identical for each participant.

In the standard MLT condition, one pop-up message appeared informing the participant that they had reached their pre-set monetary limit, at which point they could choose to continue gambling or quit (e.g. “You have reached your preset limit of 40 credits. Would you like to continue gambling?”)(see Figure 8). Regardless of whether the participant chose to continue playing or quit, they were instructed to notify the experimenter and then fill in the remainder of the battery of questionnaires. If the participant had chosen to continue playing, they were permitted to do so after completing the questionnaires.

In the HCI-inspired MLT condition, participants saw two distinct pop-up messages: The first appeared when the participant had reached 10% of their pre-set monetary limit, informing them that they were approaching their pre-set monetary limit (see Figure 3); The second appeared when the user had reached their pre-set limit, and similar to the standard MLT condition, participants were given the choice to continue playing or quit (see Figure 5). However, in the HCI-inspired MLT condition, participants were required to wait for a one-minute duration before continuing. Again, regardless of whether the participant chose to continue playing or quit, they were instructed to inform the experimenter and then were instructed to fill in the remaining questionnaires.

Once all questionnaires had been completed, the participants who indicated they wished to continue gambling were allowed to do so ($N = 10$; standard MLT group, $n = 8$; HCI-inspired MLT group, $n = 2$), and lost an average of 6.22 additional credits ($SD = 16.61$; standard MLT group, $m = 8.75$, $SD = 18.43$; HCI-inspired MLT group, $m = 3.88$, $SD = 14.71$). At the

conclusion of the gambling session, all participants were compensated \$30 for their time, regardless of how much money they had remaining at the end of the gambling session, and were debriefed.

Dependent Variables

Adherence to the Pre-Set Limit. The most important dependent variable was whether or not participants adhered to their pre-set monetary limit. Participants' choice to continue playing or quit upon reaching their pre-set monetary limit was recorded as a dichotomous variable.

Subjective Evaluation of the MLT's. An HCI questionnaire was created to evaluate participants' subjective evaluations of each MLT, including questions such as, "I found the monetary limit tool enjoyable" and "During play, I was aware of how many credits I had spent in relation to the limit I set". Users were required to rate each question on a 1-7 Likert scale (anchored by 1 = strongly disagree, to 7 = strongly agree). Some questions were reverse coded, to avoid response bias and identify any individuals who were showing signs of such a bias. Each question also had a space for users to provide comments, to attain additional qualitative data. This comment area was not mandatory however, and as such, only half of participants or less included feedback (M = 24.5% of participants responded per question)(See Appendix G for number of comments per HCI scale item). Additionally, participants in the HCI-inspired MLT condition answered several additional questions specific to their experience including effectiveness of the educational messages presented on each pop-up and effectiveness of the traffic light metaphor to relay status information in relation to their pre-set monetary limit.

Affect and Gambling Perceptions. Several questionnaires were administered to assess psychological factors pertaining to gambling. The first, the Gambling Craving Scale (GACS;

Young & Wohl, 2009), was administered as a pre-post questionnaire: that is, participants filled out the scale before beginning to gamble and after they had reached their monetary limit. The remainder of the questionnaires were administered as post-gambling measures only. Participants filled out Jacobs' (1988) Dissociation Questionnaire (JDQ), to assess dissociation during the gambling session (aka. Flow); the 9-item Problem Gambling Severity Index (PGSI) from the Canadian Problem Gambling Index (CPGI; Ferris & Wynne, 2001), which was used to assess gambling pathology; the Post-Gambling Survey (PGS) which elicited additional subjective perceptions of the monetary limit tools; and finally a demographic questionnaire (GIQ) (See Appendix H for the full battery of questionnaires, and Appendix I for the additional HCI questions posed to those in the HCI-inspired MLT condition).

Analysis Procedures. Most of the questionnaires were analyzed parametrically: GACS, JDQ, PGSI, and the GIQ. A few questionnaires necessitated a mix of parametric and non-parametric analyses, due to both nominal and dichotomous variables, as well as qualitative comments. These questionnaires include the PGS, the HCI ratings and the GIQ.

For each parametric analysis, additional analyses were also conducted to determine homogeneity of variance, normality and independence. If either homogeneity of variance or normality assumptions were violated, a non-parametric test was conducted and reported in place of a parametric test.

Results

Group Equivalency. To ensure participants were randomly assigned to the experimental conditions, analyses were conducted on demographic variables to ensure there were not significant differences between the two groups. The variables analyzed were as follows: age, sex,

ethnic/racial background, whether participants currently gamble or not, gambling pathology (i.e. PGSI), and gambling craving prior to beginning their gambling session. All variables did not show a significant difference, except for whether participants currently gamble. In this case, more participants in the HCI-inspired MLT condition did not currently gamble than those in the standard MLT condition ($\chi^2_{1, n = 56} = 6.53, p = .015$). This finding could potentially indicate that users in the HCI-inspired MLT condition were less likely to have a predisposition to gamble and exhibit gambling pathology, as their frequency of gambling behaviour was lower than their standard MLT condition counterparts. However, gambling pathology was not significant between groups ($F_{1, 54} = 2.234, p = .529$), nor was craving to gamble ($F_{1, 54} = .392, p = .594$). Since both gambling pathology and craving to gamble are superior indicators of an individual's predisposition to gamble than whether they currently gamble (which can be affected by many external factors such as available time or money), it is concluded that there is no reason to believe that a significant difference in current gambling habits between conditions will negatively impact the validity or reliability of the results.

Adherence to the Pre-Set Limit. A chi-square analysis was performed to determine whether there was a significant difference in the number of participants who quit or continued gambling when they reached their pre-set limit as a function of using the standard MLT vs. the HCI-inspired MLT. The results showed a significant difference ($\chi^2_{1, n = 48} = 5.21, p = .033$) with more participants in the HCI-inspired MLT condition quitting when they reached their limit ($n = 23$) than those in the standard MLT condition ($n = 15$) (see Figure 9).

Figure 9: Quit vs. Continue Playing by condition.

HCI-Questionnaire

Engagement. Participants were asked to rate on a 1-7 Likert scale (1 = strongly disagree; 7 = strongly agree) their level of agreement with the statement, “I found the monetary limit tool to be engaging”. A one-way Analysis of Variance (ANOVA) was used to determine whether there were significant differences between the ratings of participants in the standard MLT condition and participants in the HCI-inspired MLT condition. Results showed a significant difference ($F_{1,52} = 5.215$, $p = .026$) with the HCI-inspired MLT rated as more engaging ($M = 5.1$, $SE = .22$) than the standard MLT ($M = 4.3$, $SE = .28$).

Participants were also asked to comment after giving their 1-7 rating, and these responses were analyzed qualitatively. More individuals in the HCI-inspired MLT condition ($n = 6$) gave positive comments regarding the engagement of the MLT (e.g. “I feel like it would definitely be

a useful tool in real life”, “It made you choose how much to spend at the beginning when your mind is clear which is very important”) than those in the standard MLT condition ($n = 1$).

Ease of Use. Participants were asked to rate on a 1-7 Likert scale (1 = strongly disagree; 7 = strongly agree) their level of agreement with the statement, “I found the monetary limit tool hard to use”. Results of a one-way ANOVA were not significant between conditions ($F_{1,52} = 2.854$, $p = .132$), however the pattern of results was promising. Seventeen participants in the HCI-inspired MLT condition ($M = 1.6$, $SE = .16$) reported strong disagreement with the statement, yet only 9 participants in the standard MLT condition reported strong disagreement ($M = 2.1$, $SE = .26$), showing that participants found the HCI-inspired tool easier to use. The effect size for this analysis was small ($d = .042$), with a moderate level of power (.32).

Participants were also asked to comment after giving their 1-7 rating, and these responses were analyzed qualitatively. Participants in the new MLT condition gave exclusively positive comments such as, “very simple” and “it was very straight forward” ($n = 3$), compared with mixed comments from participants in the standard MLT condition, such as, “I was a little confused at first” and “it was simple to use” (negative comments, $n = 3$; positive comments, $n = 3$).

Enjoyableness. Participants were asked to rate on a 1-7 Likert scale (1 = strongly disagree; 7 = strongly agree) their level of agreement with the statement, “I found the monetary limit tool enjoyable”. A one-way ANOVA was used to determine whether there were significant differences between the ratings of participants in the standard MLT condition and participants in the HCI-inspired MLT condition. Results showed that there were no significant differences between conditions ($F_{1,54} = .628$, $p = .431$). Participants in the HCI-inspired MLT condition

found the tool to be slightly more enjoyable ($M = 4.2$, $SE = .23$) than those in the standard MLT condition ($M = 3.9$, $SE = .34$). See Appendix J for power and effect size values.

Participants were also asked to comment after giving their 1-7 rating, and these responses were analyzed qualitatively. Responses were mixed in both conditions, and relatively equal participants in the HCI-inspired MLT condition indicated enjoyment with the tool itself ($n = 2$) as with the in the standard MLT condition ($n = 1$).

Translation to the Real World. Participants were asked to rate on a 1-7 Likert scale (1 = strongly disagree; 7 = strongly agree) their level of agreement with the statement, “If I had the choice, I would use this monetary limit tool while gambling online on my own”. A one-way ANOVA was used to determine whether there were significant differences between the ratings of participants in the standard MLT condition and participants in the HCI-inspired MLT condition. Results showed that there was not a significant difference between groups ($F_{1, 53} = .673$, $p = .416$), yet participants in the HCI-inspired MLT condition were slightly more likely to agree ($M = 5.7$, $SE = .27$) than participants in the standard MLT condition ($M = 5.3$, $SE = .37$). See Appendix J for power and effect size values.

Participants were also asked to comment after giving their 1-7 rating, and these responses were analyzed qualitatively. Qualitative results showed that users thought the HCI-inspired MLT would be useful for online gambling ($n = 6$), and several indicated they would use it themselves ($n = 2$), compared with only 2 participants in the standard MLT condition indicating they thought the tool would be useful.

Visual Design. Participants were asked to rate on a 1-7 Likert scale (1 = strongly disagree; 7 = strongly agree) their level of agreement with the statement, “I found the visual design of the monetary limit tool to be unappealing”. A one-way ANOVA was used to determine

whether there were significant differences between the ratings of participants in the standard MLT condition and participants in the HCI-inspired MLT condition. Results again were not significant ($F_{1, 54} = .191, p = .664$), with users in the standard MLT condition rating the visual design slightly higher ($M = 2.9, SE = .29$) than those in the HCI-inspired MLT condition ($M = 3.0, SE = .26$). See Appendix J for power and effect size.

Participants were also asked to comment after giving their 1-7 rating, and these responses were analyzed qualitatively. Results showed that the visual design of either tool did not affect participants, as the majority did not comment and those that did indicated that they either could not remember the visual design or it was not impactful. One user, however, indicated that the HCI-inspired MLT disrupted the flow of the experience. Which, while seemingly negative, was one of the goals of the tool and therefore is a sign that the intended disruption to the user's flow state was effective.

Impact on Enjoyment. Participants were asked to rate on a 1-7 Likert scale (1 = strongly disagree; 7 = strongly agree) their level of agreement with the statement, "I found the monetary limit tool to be annoying". During analysis, it was found that Levene's test of homogeneity of variances was significant ($p = .03$), and therefore a parametric test was not appropriate. Instead, the Brown-Forsythe statistic was used to account for the heterogeneity of variances. Results showed that there was not a significant difference between the two conditions ($F_{1, 48.7} = .585, p = .448$).

Participants were also asked to comment after giving their 1-7 rating, and these responses were analyzed qualitatively. Participants in the standard MLT condition did not find the tool annoying, however, three users in the HCI-inspired MLT condition indicated the tool was annoying in

some respects. However, two of these users acknowledged the fact that the annoyance was minor and increased the effectiveness of the tool. The remaining participants did not comment.

Usefulness. Participants were asked to rate on a 1-7 Likert scale (1 = strongly disagree; 7 = strongly agree) their level of agreement with the statement, “The monetary limit tool helped me stick to my pre-set limit”. One-way ANOVA results showed that while there was no significant difference ($F_{1,54} = 2.46$, $p = .123$), participants in the HCI-inspired MLT condition showed stronger agreement ($M = 5.4$, $SE = .31$) than those in the standard MLT condition ($M = 4.7$, $SE = .38$). The observed power for this test was moderate (.313), and the effect size was very low ($d = .041$). The pattern of results is promising, and may have been significant with a larger sample size (see Discussion).

Participants were also asked to comment after giving their 1-7 rating, and these responses were analyzed qualitatively. One user in the standard MLT condition indicated they thought the tool was effective in keeping track of their spending, while three users in the HCI-inspired condition indicated the tool was effective. The remaining participants did not comment.

Self-Monitoring. Participants were asked to rate on a 1-7 Likert scale (1 = strongly disagree; 7 = strongly agree) their level of agreement with the statement, “During play, I was aware of how many credits I had spent in relation to the limit I set.” A one-way ANOVA was used to determine whether there were significant differences between the ratings of participants in the standard MLT condition and participants in the HCI-inspired MLT condition. Results showed no significant differences between groups ($F_{1,53} = .009$, $p = .926$).

Participants were also asked to comment after giving their 1-7 rating, and these responses were analyzed qualitatively. Of the participants who responded, most indicated that they had lost track of their spending regardless of condition. One user indicated the player statistics window

available in the HCI-inspired MLT condition was effective in aiding him in keeping track of his spending. The remaining participants did not comment.

See Table 4 for a summary of each HCI-scale item posed to all participants.

Table 4: HCI-scale items posed to all participants.

Scale Item	df	F	p	d	power
I found the monetary limit tool to be engaging.	1, 52	5.215	.026	.09	.61
I found the monetary limit tool hard to use.	1, 52	2.338	.132	.04	.32
I found the monetary limit tool enjoyable.	1, 54	.628	.431	.01	.12
If I had the choice, I would use this monetary limit tool while gambling on my own.	1, 53	.673	.416	.01	.13
I found the visual design of the monetary limit tool to be unappealing.	1, 54	.191	.664	.00	.07
I found the monetary limit tool to be annoying.	1, 48.7	.585	.448	.01	.11
The monetary limit tool helped me stick to my pre-set limit.	1, 54	2.455	.123	.04	.31
During play, I was aware of how many credits I had spent in relation to the limit I set.	1, 53	.009	.926	.00	.05

The following sections (i.e. “Impact of Warning Message” and “Impact of Educational/Motivational Messages”, “Effectiveness of Traffic Light” and “Effectiveness of Player Statistics”) were posed to participants in the HCI-inspired MLT condition only, as the standard MLT did not contain the relevant features.

Impact of Warning Message. Participants were asked to answer “yes”, “no”, or “not sure” to the following question: “Were you presented with a warning message as you approached your monetary limit?”. If users had chosen “yes”, they were then asked: “What percent of your limit remained when [the warning message] was shown?” with options of 5%, **10%**, 25%, 40%, 50% or NA (correct responses shown in **bold**). Frequencies were examined to determine the noticeability of the warning message, as well as the impact of the percent of credits left which was presented inside the pop-up window. Results showed that 71% of participants in the HCI-inspired MLT condition knew they had seen a warning message, and of those participants, 89% correctly identified 10% as the percentage of their limit that remained.

Impact of Educational/Motivational Messages. Only presented to individuals in the HCI-inspired MLT condition, participants were asked to indicate which of 4 educational/motivational messages were shown. The responses available were: 1. “Know Your Limit, Play Within It”; 2. “Think about it – How much can you afford to lose?”; 3. “Gambling is fun, but losing all your money is no fun at all.”; 4. “Gambling within your limit means you can play more and have fun.”; 5. Not sure; 6. I did not notice any messages in the pop-up windows. Analysis of frequencies showed that none correctly identified all three messages, however 3 participants (11%) correctly identified 2 messages, and 16 participants (57%) correctly identified one message. See Table 5 for frequencies by message.

Table 5: Motivational message, location within the HCI-inspired MLT, and # of users who chose that option.

Message	Location	# of users
Know Your Limit, Play Within It	“Limit Reached” pop-up window	6 (21%)

Think about it – How much can you afford to lose?	“Approaching Limit” pop-up window	12 (43%)
Gambling is fun, but losing all your money is no fun at all.	None	0
Gambling within your limit means you can play more and have fun.	“Set Limit” pop-up window	4 (14%)
Not Sure	N/A	3 (11%)
I did not notice any messages in the pop-up windows.	N/A	6 (21%)

Effectiveness of Traffic Light. Only presented to participants in the HCI-inspired MLT condition, participants were asked to rate on a 1-7 Likert scale (1 = strongly disagree; 7 = strongly agree) their level of agreement with the statement, “I found the traffic light helpful in keeping track of where I was in relation to my limit”. Because we were not examining any between group effects, frequencies were analyzed instead of an ANOVA. Results showed that 59% of participants chose 1 (strongly disagree), and 30% of participants chose either 2 or 3 ($M = 1.9$, $SD = 1.5$).

Participants were also asked to comment after giving their 1-7 rating, and these responses were analyzed qualitatively. Nine users indicated that they did not notice the traffic light, and 9 users noticed it but did not know what it was for. The remaining participants did not comment.

Effectiveness of Player Statistics Window. Only presented to participants in the HCI-inspired MLT condition, participants were asked to select either “Yes”, “No”, or “Not Sure” to the following question: “Did you notice the player statistics window?”. For those participants who did notice the player statistics window, they were then asked to rate on a 1-7 Likert scale (1

= strongly disagree; 7 = strongly agree) their level of agreement with the statement, “I found that the player statistics were helpful in monitoring my expenditure”. Only 7 participants (12.5%) indicated they noticed the player statistics window. Of those 7, most (78%) indicated they disagreed that the player statistics window was helpful in monitoring expenditure ($M = 2.67$, $SD = 2.18$). However, of those participants who noticed and viewed their player statistics while gambling, 50% (2/4) decided to quit immediately after viewing them, and before they had reached their pre-set limit. Additionally, those individuals who quit after viewing their player statistics accessed them only once, while the other two accessed them multiple times (5 and 8) during play.

Participants were also asked to comment after giving their 1-7 rating, and these responses were analyzed qualitatively. One user indicated that he/she did not notice the player statistics window, but if he/she had, it would have been useful. Four other users noticed it but did not use it. The remaining participants did not comment.

Further statistical detail for non-significant items from the HCI scale can be found in Appendix J.

Gambling Craving. A one-way repeated measures ANOVA was conducted to compare the effect of gambling with a MLT on a participant’s craving to gamble which was administered after participants gambled, between the standard MLT and HCI-inspired MLT conditions. Results of the analysis showed one significant result: When asked to rate agreement with the statement, “I would not enjoy gambling right now”, results were significant ($F_{1,54} = 4.76$, $p = .033$). T-tests were then performed to determine the exact location of the differences. Results for the HCI-inspired MLT group were significant ($t(28) = -2.1$, $p = .045$), with those in the HCI-inspired MLT group indicating stronger disagreement with the statement before gambling ($M=2.83$, $SD=1.42$) than after gambling ($M=3.34$, $SD=1.59$). Participants in the standard MLT

group did not show a significant difference ($t(26) = 1.07, p = .294$) (see Figure 10). This indicates that participants in the standard MLT condition were more likely to want to continue gambling after their session compared with the HCI-inspired participants.

Figure 10: Level of Agreement to the statement, “I would not enjoy gambling right now” before and after gambling, by condition.

Results for the remaining GACS items, including the other two factors, desire and relief, were not significant (see Appendix K).

Dissociation. The results of the JDQ were analyzed using a one-way ANOVA, and did not produce significant results (see Appendix L).

Perceptions of Gambling. Lastly, the PGS questionnaire was analyzed using both chi-square and ANOVA, due to the scale containing both nominal and dichotomous variables. Participants were first asked to indicate yes or no to the statement, “The pop-up message I received allowing me to set a spending limit was helpful in the amount of money I spent gambling”, and those who responded yes were asked to indicate how helpful the MLT was on a

5-pt Likert scale (1 = very unhelpful; 5 = very helpful). While the result of the chi-square was not significant (χ^2 (2, n = 54) = 1.51, p = .470), results of the ANOVA were significant ($F_{1,44}$ = 4.33, p = .043), and showed that participants in the HCI-inspired MLT condition were significantly more likely to rate the pop-up message as helpful (M = 4.08, SE = .24) than those in the standard MLT condition (M = 3.33, SE = .27). Participants were also asked to indicate yes or no to the statement, “The pop-up message that reminded me when I reached my spending limit was helpful in controlling the amount of money I spent gambling”, and those who responded yes were asked to indicate how helpful the pop-up message was on a 5-pt Likert scale (1 = very unhelpful; 5 = very helpful). Both the results of the chi-square (χ^2 (2, n = 51) = .187, p = .452) and ANOVA (F (1, 35) = .206, p = .653) were not significant. Finally, participants were asked to indicate whether they would “. . . use this limit reminder feature if it was implemented on slot machines”. A chi-square analysis was not significant (χ^2 (1, n = 55) = .296, p = .428).

Discussion

Discussion of MLT Comparison Study Findings

The most important indicator of limit adherence - whether participants quit or continued playing - was significant, and therefore it can be concluded that the HCI-inspired MLT is more effective at motivating gamblers to adhere to their pre-set limit than the standard MLT. This result is attributed to the usability and PSD principles embedded into the HCI-inspired MLT, however which principles were most effective cannot be determined based on the data attained, as the effect of each principle cannot be parsed from the others. This finding shows the viability of usability and PSD in creating principles and guidelines for designing effective pre-commitment tools to facilitate responsible gambling.

HCI Scale Ratings. The first HCI scale question assessing user engagement with the monetary limit tool (“I found the monetary limit tool to be engaging”), also showed significant results between groups. This finding addresses one of the most critical challenges in creating monetary limit tools: increasing user engagement so online gamblers are more likely to use responsible gambling tools. While further research is needed, this result indicates that usability and PSD principles can increase willingness to engage with monetary limit tools in online gambling and solve a significant challenge that responsible gambling tools currently face.

The subsequent HCI ratings were not significant, however one showed a promising pattern. Ease of use was not significant, however with a moderate level of power (.32), it is possible that a type II error was made and therefore an actual effect exists yet may not have been supported by the statistics. Regardless, the pattern of results was promising, in that users in the HCI-inspired MLT condition rated ease of use higher than those in the standard monetary limit tool condition, and

participants were more likely to report positive comments regarding ease of use in the HCI-inspired MLT condition. It is thought that this effect may become statistically significant with either a larger sample size or if a similar study was repeated using a within subjects design instead of between. Additionally, further research could be done to increase the perceived ease of use of the HCI-inspired MLT, which could also increase significance.

Interesting to note is that the HCI-scale question assessing Usefulness, “The monetary limit tool helped me stick to my pre-set limit” was not significant. This result is curious since the monetary limit tool did help users stick to their pre-set limit as shown by the first reported analysis of whether participants quit or continued playing. This seemingly contradictory evidence may be explained by the face-validity of the HCI survey. In social psychology research, it has been shown that surveys with high face validity (that is, when users know what the question is intending to measure) are much less reliable than surveys with low face validity, due to the social desirability bias (Furnham, 1986). The social desirability bias phenomenon occurs when participants are more likely to respond based on how they think they should respond opposed to how they actually feel. Also, individuals are generally poor at identifying direct causes of their own behaviour (e.g. Fundamental Attribution Error; Ross, 1977), and therefore watching the behaviour of users (i.e. whether they quit or continued playing) is much more reliable than what they think their behaviour is (i.e. whether the monetary limit tool helped them stick to their pre-set limit).

Additional HCI Scale Questions to HCI-inspired MLT Condition Participants. The findings that 71% of participants knew they had seen a warning message and 89% correctly identified 10% as their remaining credits indicates that users were in fact attending to key information presented on the pop-up message. Additionally, 12 users (43%) correctly identified

the educational message on the approach limit pop-up window, indicating that the additional information presented within the monetary limit tool was being attended to. Specifically in the case of the approach limit pop-up, a 10 second delay was implemented so that users would be required to slow down and directly attend to information opposed to immediately clicking the “continue playing” button. The results seen here show that this 10-second delay was effective in increasing user attention to the information presented, as the educational message presented on this pop-up window was correctly identified the most (43% vs. 21% for the set-limit pop up and 14% for the limit reached pop-up). This finding shows promise and presents a clear solution to increase attendance to educational messages. This is an important finding, as educational messages have been shown to increase responsible gambling practices (Blaszczynski et al., 2008), and this implementation increases the salience of the educational messages while not interfering with the player’s fun.

A somewhat contradictory finding, the educational message was least noticed on the final, “limit reached” pop-up window. Since participants were forced to wait for a duration of one minute before returning to play, it would make sense that the educational message on this window would be attended to the most. The reason for this discrepancy could be related to the amount of time users were required to wait before moving on. Although participants were required to wait one minute before returning to play, they were permitted to quit at any time. Since the majority of participants quit playing in the HCI-inspired MLT condition and only a few continued ($n = 4$), it is likely that most participants did not have adequate time to consume all information on the pop-up window, and were not required to, contributing to the lowered salience of the educational message presented.

Effectiveness of the Traffic Light Metaphor. The traffic light metaphor was not effective as a status indicator, as 89% of participants indicated they either strongly disagreed or disagreed with the statement that the traffic light was helpful in keeping track of where they were in relation to their limit. Also, the comments given for this question also showed that participants did not notice the traffic light, and the majority of those that did, failed to realize its purpose. It is hypothesized that this can be explained by the phenomenon of inattention blindness: a common occurrence where an individual does not notice features in a scene when other attention-demanding tasks are performed (e.g. Mack & Rock, 1998; Most et al., 2005). Participants may have been consumed by the task of playing the slot machine, and therefore became oblivious to items elsewhere on screen.

Since the traffic light metaphor was designed to facilitate self-monitoring which has been shown to be a significant factor in aiding individuals with addictions or those who are trying to avoid or manage addiction (Foxy & Brown, 2013; McFall & Hammen, 1971), it is important that solutions to increase the salience of self-monitoring features are explored. Several possibilities exist (and a few were mentioned during the Heuristic Evaluation process, and therefore the results may have been more promising if there was adequate time to incorporate heuristic evaluation findings) such as adjusting the visual design of the traffic light metaphor that conveys status information. The icon itself could be larger and brighter, and the change from green to yellow and yellow to red could be made more apparent by increasing the visual salience of the actual change such as enlarging the “lit” traffic light or making the lights change shape when they become lit. Another option would be to add animation: instead of having the traffic light statically placed in the corner, it could appear in the center of the screen whenever a light changes with a dimmed background and then “shrink” to its static location in the corner over a

one or two second time-span. This animation would bring the object into the user's center of attention when it changes, and then indicate to the user where they can subsequently look at the light to check their status at their leisure.

The player statistics were also not readily noticed, however the few that did notice them were appreciative of the information contained. Given the location of the player statistics was right below the traffic light, it is hypothesized that participants did not notice this for the same reason as they did not notice the traffic light – attention is paid to the constantly changing foreground items and background or external items become less salient. Therefore, increasing the salience of the traffic light may also increase the salience of the player statistics through association.

Craving Measures. Craving was a repeated measure taken both before and after participants gambled. As such, differences were expected as a function of the increased state of anxiety caused by gambling. Only one of the measures turned out significant between conditions: Question 3, which asks, “I would not enjoy gambling right now”. Results showed that individuals in the HCI-inspired MLT condition were more likely to not want to continue gambling after reaching their pre-set limit compared to their standard MLT counterparts. One hypothesis posited to explain this effect is based on the warning message participants received when approaching their limit in the HCI-inspired MLT condition. This warning message could have psychologically prepared participants for the upcoming limit-reached message, which may have lessened their hot affective state, providing users with the opportunity to cope better with ending their gambling session (Lowenstein & Lerner, 2003). Further research is needed to determine the mediating factors that caused the lowered desire to gamble.

This finding is of particular interest to gambling research, as it has been shown that preventing individuals from continuing their gambling play can lead to heightened levels of craving

(Tiffany, 1990). Therefore, the fact that most of the craving measures were not significant or showed a pattern of results in which participants in the HCI-inspired MLT showed lower craving, indicates that the features implemented in the HCI-inspired MLT do not increase craving to gamble, even though the user's gambling session was interrupted.

Dissociation. The JDQ questionnaire measured dissociation, also known as the participant's flow state. None of the measures were significant, which shows that although the HCI-inspired MLT was effective, it did not disrupt the flow state of users. This is an interesting and promising result, as it indicates that the HCI-inspired MLT was effective while allowing participants to have fun during their gambling session, addressing one of the most important needs of gamblers as per the focus group research (i.e. that the responsible gambling tool does not take away from the player's fun). Although several features were designed specifically to disrupt flow, such as pop-up windows with delayed action and dimming of the screen background, these did not seem to impact the user's enjoyment through flow state, although they may have been effective. This effect can potentially be explained by the percent at which the approach limit message was presented. Since participants did not see the approach limit until only the last 10% of their credits remained, they were able to enjoy 90% of their gambling experience without disruption. If there were more than one approach limit message (e.g. at 50% and 10%), or if the approach limit message appeared further away from the participant's pre-set limit (e.g. at 25% or 40%), the flow state of participants may have been disrupted more, and dissociation measures may have been significant (i.e. participants in the standard MLT condition would report greater levels of dissociation than those in the HCI-inspired MLT condition). Further research is also needed here to uncover both the most ideal time to present users with

their approach limit message, as well as what psychological implications in regards to dissociation are affected depending on when the message is presented.

Perceptions of Gambling. One significant result was found from the perceptions of gambling questionnaire, and showed that participants found the HCI-inspired MLT more helpful than participants in the standard MLT condition, indicating that online gamblers may also find an HCI-inspired pre-commitment tool more helpful than a standard MLT. Interestingly, when participants were asked if they would use this limit-setting feature when gambling on their own, no significant differences were found between groups. This is somewhat contradictory to the HCI engagement scale (i.e. I found the monetary limit tool to be engaging) that was designed to capture the same information, which did show a significant difference between conditions. One possible explanation for this result is the higher face validity of the PGS question opposed to the HCI-scale (participants were most likely unaware that engagement is positively correlated with rate of use), which could mean that the social desirability bias influenced participants in the former. Again, further research is needed to validate an explicatory hypothesis.

Conclusion

The goal of the current research was to implement and test a pre-commitment tool designed with usability and PSD principles with the intent of assessing viability as a means of increasing responsible gambling practices. Usability and PSD principles were also evaluated for suitability when applied to a pre-commitment tool through user research. Several hypotheses were developed in terms of how usability and PSD principles would effectively increase user engagement with the monetary limit tool, and subsequent limit adherence. It was hypothesized that the use of warning pop-up messages with delayed action would increase limit adherence, and that the MLT would be most effective if it could promote limit-adherence without reducing the fun of gambling. The principles of self-monitoring and liking (visual design) were also hypothesized to be important factors in limit adherence. Educational/motivational messages were hypothesized to aid in limit adherence, as was breaking a traditional usability rule in one circumstance. Lastly, it was hypothesized that PSD principles needed to be implemented differently based on psychology principles, such as presenting the traffic light metaphor in a highly salient way, while making educational messages more subtle.

To begin, unfortunately it is not possible to parse the various usability and PSD elements, and therefore it is not clear which produced the greatest impact on limit adherence and engagement. However, by process of elimination (e.g. self-monitoring features can be excluded as participants did not notice them), the causal mechanism can be hypothesized. Further research to evaluate each persuasion mechanism on its own in relation to responsible gambling is needed to determine definitively what was and was not effective.

The results of the study show that usability and PSD are viable methods of increasing engagement with pre-commitment tools, and increasing pre-set limit adherence. Therefore, further research into how PSD can be effectively applied to pre-commitment tools may enhance many effects shown here, specifically those that did not achieve significance between conditions (e.g. the self monitoring features of the traffic light and player statistics) or were not implemented (e.g. other principles of PSD such as personalization, tunneling, praise and rewards).

Several hypotheses were made in regards to how the HCI-inspired MLT would increase responsible gambling. First, it was hypothesized that the use of a warning pop-up message with a mandatory delay when users were approaching their limit would increase limit adherence. This hypothesis appears to be proven, as it is clear that participants attended to the information presented on the approach limit pop-up more than others, and in the end participants were more likely to adhere to their pre-set limit in the HCI-inspired MLT condition. Next, it was hypothesized that a pre-commitment tool would be most effective if responsible gambling could be promoted without taking away from the fun of gambling. This hypothesis is assumed to be true based on the results, as there was no significant difference in dissociation between conditions. It was also hypothesized that self-monitoring features would increase limit adherence. This hypothesis was not confirmed due to the lack of attention paid to the self-monitoring features, and therefore further research is needed to determine if the self-monitoring principle is effective in promoting responsible gambling. Visual design was hypothesized to increase liking and engagement with the tool, which may be true as engagement was significant between conditions, although visual design showed no significant difference between conditions and therefore other factors could have produced the increase in engagement (e.g. the addition of

an approach-limit pop-up message). This could be explained by the fact that a between subjects design was chosen instead of a within subjects design, meaning participants did not have a measure of comparison for either MLT. Educational/motivational messages were hypothesized to promote limit adherence, which seems to be true especially in the case of the delayed action approach limit pop-up window, as it was found that the messages were not only attended to, but participants were able to recognize the messages after they had finished playing. Lastly, it was hypothesized that in some cases breaking traditional usability rules would increase limit adherence. This was applied by laying out the continue playing and quit buttons on the final pop-up message in a different order than they had previously been presented, with the intention of inducing gamblers to slow down and think carefully about their choice. This effect was most likely lost though, since in addition to the re-arrangement of the action buttons, participants were also forced to wait at least one minute before continuing to play.

Limitations

The most significant limitation of the current work is that it is not clear which persuasive elements were effective. Although many results of the comparison study were significant, it is not clear which features were the cause of each result. Therefore, future work is necessary to examine the level of effectiveness of each feature.

Additionally, due to time limitations the heuristic evaluation results were not implemented into the final monetary limit tool. This was unfortunate, as there were several findings that could have increased the effectiveness of the self-monitoring features, including increasing the salience of the traffic light feature. Also, careful attention to the heuristic evaluation findings could have potentially increased significance of other features as well, as adding this additional iteration of the monetary limit tool could have increased the end-user participation in its design.

Due to platform and time limitations, many aspects of PSD were not implemented, which is hypothesized to lower the overall persuasive effectiveness.

Self-monitoring features have proven effective in addiction research when attempting to manage impulses and control addiction, and also encompasses a key principle in PSD. Since our self-monitoring features were not effective, this is a significant limitation of the current work.

Lastly, the chosen study design was between-subjects. While there are many benefits of using a between-subjects design, such as avoidance of carry-over effects, there are several drawbacks such as lowered power and effect size. It is hypothesized that if the study was repeated using a within-subjects design, some effects may have reached significance between tools such as subjective visual design ratings and engagement ratings.

Future Work

There are several areas of future work implicated based on the findings. Given that some features were not successful, additional research is needed to reveal exactly how PSD principles need to be implemented in order to achieve maximum effectiveness in changing target attitudes or behaviours, specifically in the case of the self-monitoring features. The ineffectiveness of some features reveal implications from the psychology literature, and may implicate psychology research integration when considering behavioural models such as PSD. For example, change blindness is a reasonable hypothesis to explain the lack of attention paid to the traffic light, and therefore examination of the psychology literature on change blindness may reveal solutions to increase salience of this important feature. Additionally, face validity of the HCI scales may have caused discrepancies between participant's actual behaviour and their reports of their behaviour,

and therefore research methodology from social psychology may aid in more accurate quantitative and qualitative data across the field of HCI in general. This is a fundamental issue, as there is much research in the field of psychology that is not currently being leveraged, and could inform user-centered design and PSD to create more effective interfaces promoting pro-social goals.

An element that is not clear is whether the increased engagement of the HCI-inspired monetary limit tool will translate to increased usage of such a responsible gambling tool over time. Therefore, a longitudinal comparison study of gamblers in the same two conditions used here (i.e. standard MLT vs. HCI-inspired MLT) to evaluate whether online gamblers would use such a pre-commitment tool over time while gambling on their own would be useful. If such a study is not possible, a usage analysis of an implemented tool may also reveal whether engagement over time is increased via the use of an HCI-inspired pre-commitment tool.

A few users from the focus groups indicated a time-limit tool may be effective in some circumstances. Given the success of usability and PSD principles in increasing limit-adherence as well as engagement, identical or similar principles are implicated for time-limit tools as well. As such, future research is necessary to determine which usability and PSD principles would be appropriate for implementation in a time-limit tool, and their relative effectiveness.

Several principles were not able to be incorporated due to platform and time limitations of the research project; further research to determine the efficacy of artifacts such as clearly translating credits to money, using tailored personalized messages based on the player's gambling habits, or increasing salience of each pop-up message by increasing their respective size is warranted.

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Appendix A – Focus Group Discussion Guide

Introduction (5 mins)

- Thank you for participating. Intro to moderator/research.
- Today's topic is gambling. You were all invited here because you have something in common: you engage in some form of gambling
- Role of participants
 - Speak openly and frankly about opinions
 - No wrong answers – just want your opinions and experiences
 - No need for everyone to agree (nor to reach consensus)
- Role of moderator
 - Ask questions
 - Timekeeper
 - Objective/no vested interest
- Length of session 1.5 hrs
- Recording/observers
- Confidentiality
 - Remain on a first name basis
 - Recording for research use only
 - Comments not linked to individuals
- Questions?

Participants' Introductions (5 mins)

1. Let's start by introducing each other to the group. I'll start and then we'll go around.
Please state your:
 - a. First name
 - b. Major
 - c. Something fun about yourself that you want others to know

Warm-Up: Current Habits and Motivations (15 mins)

2. What gambling activities do you engage in?
3. Where do you prefer to gamble (e.g. online, casino, etc.)
4. Do you gamble every week? How often?
5. On average, how much money do you spend gambling weekly?
 - a. Do you make or lose money? How much in a week?

6. Why do you gamble?

Probe if not mentioned spontaneously:

- To try and win money?
- For excitement and entertainment?
- To escape negative feelings?

Notion of Responsible Gambling (15 mins)

7. Had you heard the term, “Responsible Gambling” before seeing it in the questionnaire? If so, where?

8. What does gambling responsibly mean to you?

Probe if not mentioned spontaneously:

- Set a money limit
- Set a time limit
- Don’t gamble alone
- Don’t gamble at all

9. Do you use any strategies to help you gamble responsibly?

Hand Count:

- Who does on a regular basis?
- Who does not?
- For those of you who don’t, why not?
- Now, for those who do. What strategies to you use?

10. Do you find the strategies you use to be effective? Why/why not?

Examples of Responsible/Irresponsible Gambling (15 mins)

Ask if one person could give a very good example where they gambled responsibly. Choose only one, maybe two if time permits.

11. Can someone describe an incident in which you gambled responsibly?
 - a. Why did you decide to gamble responsibly that particular time?

Ask if one person could give a very good example where they DID NOT gamble responsibly.

Choose only one, maybe two if time permits.

12. Now, can someone describe an incident in which you did not gamble responsibly?
13. Why did you decide not to gamble responsibly that time?
14. Please indicate any factors that were important in your decision to continue gambling.

Probe if not mentioned spontaneously:

- Thought they could win the money back
- Thought luck was around the corner
- Negative feelings from losing money they could not afford

15. What, if anything, would have helped you to stop gambling in that situation?
 - a. And the others, what do you think would have helped him/her to stop gambling in that situation?

Perceptions and Utility of Responsible Gambling Tools (25 mins)

16. Have you ever encountered any responsible gambling tools online or in casinos? These could be pop-ups, messages asking you to set a limit on money or time spent, and/or educational information.
 - a. If yes, what type of tool did you encounter and what were your impressions of these tools?
 - b. Did they work?
 - i. What made them work?
 - ii. Why didn't they work?
17. Are you likely to use responsible gambling tools?
 - a. What makes the tools viable to use? What do you like about the tools?
 - b. Why would you not use responsible gambling tools?
18. Do you think that most people who gamble are likely to use responsible gambling tools?
 - a. What do you believe would be more likely to encourage gamblers to use such tools?
 - b. Why do you believe other gamblers would not use responsible gambling tools?
19. What would you like to see included in a responsible gambling tool?
 - a. These could be money limits, time limits, educational material, etc.

20. For yourself, in what form would you prefer a responsible gambling tool to be? These could be pop-ups, running meters, etc.
21. Is your overall impression of responsible gambling tools positive or negative? Please elaborate.
 - a. Do you think they are effective? If yes, what makes them effective?
 - b. Would you use them?
 - c. If you would not use them, why not? What would need to happen for you to use these tools?
22. What is your impression specifically about money limit tools?
 - a. And what about time limit tools?
23. If you could design one, what would be your ideal responsible gambling tool? One that would really work for you?

Demo of Monetary Limit Tool Prototype (10 mins)

Reactions to Monetary Limit Tool Prototype (15 mins)

24. What's your first impression of these monetary limit tools?
 - a. Do you think a monetary limit tool such as this would be effective? Why or why not?
 - b. Would you use a monetary limit tool like this when gambling online on your own?
25. What aspects do you like about the monetary limit tools presented? And what aspects don't you like about the monetary limit tools presented?
 - a. What do you think of the visual appeal of the tool?
 - b. Was the text in the pop-up message useful and informative? Why or why not?
 - c. What did you think of the frequency of the pop-up messages? Too frequent or not frequent enough?
26. Are there any aspects missing from the tools that you would find useful?
27. How can the current tools be modified so that they are more engaging and appealing?

Open Q&A with Observers (12 mins)

In Conclusion (3 mins)

28. To conclude, are there any other suggestions you would like to make to the researchers to help them improve responsible gambling tools?

Thanks for your time and participation

Appendix B - Initial Wire-Framed Prototypes of HCI-inspired Monetary Limit Tool

First pop-up: player chooses whether to use a pre-commitment tool

Second pop-up: player is approaching his/her limit

Third pop-up: player has reached his/her limit

Player Statistics Window

Appendix C – Pre-Commitment Tool Flow Chart

Appendix D – Heuristic Evaluation Instructions and Questionnaire

Heuristic Evaluation Instructions

Thank you for participating in our Heuristic Evaluation of Monetary Limit Tools!

Below is a list of 7 Usability Heuristic principles, which will be the basis of the evaluation today. We would like you to keep these principles in mind while looking at the monetary limit tool, and you will be asked to give your opinion on how well the monetary limit tool achieves each heuristic, as well as a few other questions about your experience with the tool. You may refer back to this sheet for reference when filling out the questionnaire.

Please keep in mind that while you will view portions of the virtual casino to access the features of the monetary limit tool, the virtual casino is NOT the focus of the heuristic evaluation. We would like you to ignore the virtual casino and focus only on the monetary limit tool for evaluation purposes.

Visibility of system status

The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

Match between system and the real world

The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

Consistency and standards

Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

Recognition rather than recall

Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

Aesthetic and minimalist design

Dialogues should not contain information that is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

Effectiveness

How completely and accurately will the interface aid users in achieving their goals.

Engaging

How well the interface draws the user into the interaction and how pleasant and satisfying it is to use.

Heuristic Evaluation Questionnaire

For each usability heuristic principle, list all potential problems that arise. Please indicate the severity of each problem by using the following scale:

4 – Critical: Severe usability problem: Imperative to fix

3 – Major: Major usability problem: Important to fix, and should be given high priority

2 – Minor: Minor usability problem: fixing this should be given low priority

0 – Good usability: Well done!

99 – Comment: Not good or bad, just a suggestion or thought

When considering how to categorize issues, please refer to the following chart (Nielsen, 1992):

% of users likely to encounter problem			
	Few	Many	
Impact	Small	1 ,0	2 ,3
	Large	2 ,3	4

How well do you think the Monetary Limit Tool used today achieves the principle of: **Visibility of System Status**?

How well do you think the Monetary Limit Tool used today achieves the principle of: **Match between System and the Real World**?

How well do you think the Monetary Limit Tool used today achieves the principle of: **Consistency and Standards?**

How well do you think the Monetary Limit Tool used today achieves the principle of: **Recognition rather than Recall?**

How well do you think the Monetary Limit Tool used today achieves the principle of: **Aesthetic and Minimalist Design?**

How **Effective** do you think the Monetary Limit Tool used today is?

How **Engaging** to you think the Monetary Limit Tool used today is?

Is there a clear distinction between the warning message and the limit-reached message? If there is not, what could be changed to make this distinction clearer?

Does the traffic light icon convey a clear and purposeful message in terms of status? If not, what could be done to make this clearer?

What do you think of the inconsistency in the layout and size of the action buttons?

What do you think about the “look and feel” of the pop-up messages?

How satisfied are you with the monetary limit tool shown here (please circle):

1	2	3	4	5	6	7
Not at all Satisfied			Neutral			Very Satisfied

Do you think the monetary limit tool would be easy to use?

1	2	3	4	5	6	7
Not at all Easy to Use			Neutral			Very Easy to Use

How enjoyable do you think the monetary limit tool would be to use?

1	2	3	4	5	6	7
Not at all Enjoyable			Neutral			Very Enjoyable

How likely are you to use this monetary limit tool or look for a similar one while gambling on your own?

1	2	3	4	5	6	7
Very Unlikely			Neutral			Very Likely

How did you find the visual design of the monetary limit tool?

1	2	3	4	5	6	7
Not at all Appealing			Neutral			Very Appealing

Demographic Questions:

Age: ____

Current Academic Program: _____

What is your experience level with Windows?

1	2	3	4	5
Novice		Intermediate		Expert

What is your experience level with Online Gambling (e.g. play for money via online slots, poker, blackjack, etc.)?

1	2	3	4	5
Never played before		Play Infrequently (few times a year)		Play frequently (weekly or more)

Appendix E – Remaining Heuristic Evaluation Analyses

Average rating for each UI Characteristic

Total issues vs. Total unique issues* per usability principle

* “Total issues” is defined as each issue identified added up including duplicate issues raised by separate evaluators, while “total unique issues” does not include repeated issues.

Appendix F – MLT Comparison Study Facilitator Script***Participant will be standing outside 6211***

Hi there, I'm Andrew/Kristen/Justin, are you here for the gambling study? Are you _____?

Great, thank you for agreeing to participate in this study.

Please come on in and have a seat. Let me take a couple moments to explain what this study is all about. This study concerns your thoughts and feelings while gambling. As such, in just a couple minutes, you will be playing slots in a simulated online casino. To make this session as realistic as possible the odds of winning have been set in consultation with the Ottawa and Gatineau casinos (the Rideau-Carleton Raceway and Lac Leamy Casino). That is, the odds of winning in this casino are the same as those in casinos around Ottawa.

Before that, I am going to ask you to read this informed consent form, which will tell you a little more about the purpose of the study and what you will be doing in the study. If you agree to participate, please sign your name and date at the bottom of the page.

(Participant signs informed consent form)

Thank you. Why don't we start the study.

Before you start gambling on the slot machines, you will have five minutes to get used to the environment by practicing walking around the town outside the casino, as well as entering and walking through the casino. Please note that it is important you do not start gambling at this time. This is an opportunity for you to get used to and feel comfortable interacting in the casino environment. You will also be able to use this time to get used to the navigational controls and interactions with objects in the environment by using the keyboard and mouse.

Do you have any questions so far?

In order to move around inside the casino, you must use these four keys (point to the **WASD** keys). The **W** key will allow you to move forward, the **A** key will allow you to move to the left while the **D** key will allow you to move right. Finally the **S** key will allow you to move backward. In order to open the doors of the casino, you must press the “E” key.

So again, to move forward use W, S to move back, A to move left and D to move right.

It might take some time getting used to, which is why we would like you to simply walk around the downtown environment for a bit.

(Participant does the 5 minute acclimatization period)

Ok, now that you are more comfortable navigating around the simulated online casino environment, there are a few things I would like to explain. First, in this session you will be gambling on the slot machines and will have the opportunity to win money, depending upon the outcome of the spins. I am going to give you 80 credits to gamble with on the slots to start. At 25 cents a credit you will have a total of \$20 in which to gamble with. You will be allowed to trade in any remaining credits at the end of the session for money, which you will be allowed to keep. So if you end up with 100 credits, you will walk away with \$25 and if you end up with 40 credits, you walk away with \$10. Make sense? Know that you can gamble as long as you want or until all of your credits are gone.

Once you begin, you must enter the casino. When you enter, a message will appear that will ask you to set a limit on the amount of credits you wish to spend gambling.

That is, you will be asked how many of the 80 credits you would like to use in this gambling session. It is completely up to you what you want your credit limit to be. You will be able to indicate this limit by using the arrows on screen or typing it into the box that will appear using the number pad on the keyboard.

In order to start gambling, please walk up to any slot machine in the casino that doesn't already have someone sitting at it and ***press the "E" key***. You must then put all of your \$20 into the slot machine. To do this, you must press the ***ENTER button*** on the keyboard. Also, it is important that you do this **four times** in order to put all of your \$20 into the machine. You will know that you have put in all of the money when it shows that you have 80 credits.

In order to start gambling, you must press the ***CTRL button*** to place a bet and then the ***space bar*** to spin the reels. *Please make sure to bet only 1 credit per spin, using the CTRL button. There may be a slight delay from when you press the CTRL button to when the credit shows up. Please be sure to press the CTRL button only once!* So, each time you gamble, you have to press ***CTRL*** and then the ***space bar***. Before that, I am going to ask you to complete this questionnaire. (**Give questionnaire, GACS**) Thank you, now you may start to gamble on the slot machine.

(Participant hits limit and notifies the experimenter)

Great, thank you for letting me know. The reason it asked you to notify me is that I would like you to complete a couple questionnaires at this time. Thank you.

(Give participant the questionnaires; Participant finishes questionnaires)

(If participant chose continue playing) You may now continue gambling.

(If participant choses Quit or continues gambling but asks to stop or cash out. . .)

Ok, now we have reached the end of the study. Thank you again for participating. Before you leave however, I would like to go over what happened here today and why. (*Read debriefing*)

I will also ask that you read this form, which asks your permission to use your data for research and teaching purposes. If you agree to do so, please print and sign your name on the space provided. (*Participant signs form*)

That's great, here is your \$30 for participating in the study. Thanks again.

Appendix G – Frequencies of Participant Comments per HCI-Scale Item

HCI Scale Item	Number of Participants who commented in the HCI-inspired MLT condition	Number of Participants who commented in the standard MLT condition	Percent of total Participants
1. I found the monetary limit tool to be engaging.	8	4	21%
2. I found the monetary limit tool hard to use.	3	6	16%
3. I found the monetary limit tool enjoyable.	5	4	16%
4. If I had the choice, I would use this monetary limit tool while gambling online on my own.	8	4	21%
5. I found the visual design of the monetary limit tool to be unappealing.	8	2	18%
6. I found the monetary limit tool to be annoying.	6	4	18%
7. The monetary limit tool helped me stick to my pre-set limit.	6	4	18%
8. During play, I was aware of how many credits I had spent in relation to the limit I set.	6	3	16%
11. I found the traffic light helpful in keeping track of where I am in relation to my limit.	19	N/A	68%
13. I found that the player statistics were helpful in monitoring my expenditure.	6	N/A	33%

Appendix H - Standard MLT Comparison Study Questionnaire Booklet

VIRTUAL REALITY CASINO STUDY

A study sponsored by

The Carleton University Gambling Lab

Ottawa, Ontario

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SIM

Please make a tic anywhere along the line to answer the following question.

How strong is your craving to gamble?

Not very strong

Very strong

1 10 20 30 40 50 60 70 80 90 100

GACS

Instructions: Please indicate your agreement or disagreement with the following statements by circling the appropriate number.

1. Gambling would be fun right now.

1	2	3	4	5	6	7
Strongly Disagree				Strongly Agree		

2. If I had an opportunity to gamble right now I would probably take it.

1	2	3	4	5	6	7
Strongly Disagree				Strongly Agree		

3. I would not enjoy gambling right now.

1	2	3	4	5	6	7
Strongly Disagree				Strongly Agree		

4. I crave gambling right now.

1	2	3	4	5	6	7
Strongly Disagree				Strongly Agree		

5. I need to gamble now.

1	2	3	4	5	6	7
Strongly Disagree				Strongly Agree		

6. I have an urge to gamble.

1	2	3	4	5	6	7
Strongly Disagree				Strongly Agree		

7. If I were gambling now I could think more clearly.

1	2	3	4	5	6	7
---	---	---	---	---	---	---

Strongly Disagree	Strongly Agree
-------------------	----------------

8. I could control things better right now if I could gamble.

1	2	3	4	5	6	7
Strongly Disagree				Strongly Agree		

9. Gambling would make me less depressed.

1	2	3	4	5	6	7
Strongly Disagree				Strongly Agree		

**PLEASE STOP HERE AND INFORM THE
RESEARCHER THAT YOU ARE
FINISHED**

***** REMINDER:**

For purposes of anonymity, we reiterate that the experimenter will not be aware of any of your responses.

GACS

Instructions: Please indicate your agreement or disagreement with the following statements by circling the appropriate number.

1. Gambling would be fun right now.

1	2	3	4	5	6	7
Strongly Disagree				Strongly Agree		

2. If I had an opportunity to gamble right now I would probably take it.

1	2	3	4	5	6	7
Strongly Disagree				Strongly Agree		

3. I would not enjoy gambling right now.

1	2	3	4	5	6	7
Strongly Disagree				Strongly Agree		

4. I crave gambling right now.

1	2	3	4	5	6	7
Strongly Disagree				Strongly Agree		

5. I need to gamble now.

1	2	3	4	5	6	7
Strongly Disagree				Strongly Agree		

6. I have an urge to gamble.

1	2	3	4	5	6	7
Strongly Disagree				Strongly Agree		

7. If I were gambling now I could think more clearly.

1	2	3	4	5	6	7
---	---	---	---	---	---	---

Strongly Disagree	Strongly Agree
-------------------	----------------

8. I could control things better right now if I could gamble.

1	2	3	4	5	6	7
Strongly Disagree				Strongly Agree		

9. Gambling would make me less depressed.

1	2	3	4	5	6	7
Strongly Disagree				Strongly Agree		

JDQ

During your period playing slots just now, how much did you.....

1.....lose track of time?

0	1	2	3	4
Never	Rarely	Occasionally	Frequently	All the time

2.....feel like you were a different person?

0	1	2	3	4
Never	Rarely	Occasionally	Frequently	All the time

3.....feel like you were outside of yourself, watching yourself gamble?

0	1	2	3	4
Never	Rarely	Occasionally	Frequently	All the time

4.....feel like you were in a trance?

0	1	2	3	4
Never	Rarely	Occasionally	Frequently	All the time

5.....experience a memory blackout for things that happened while you were gambling?

0	1	2	3	4
Never	Rarely	Occasionally	Frequently	All the time

PGS

Instructions: Please answer the following questions in relation to the period in which you just played slots.

- 1) I decided to stop playing slots when I received the pop-up informing me that I reached my pre-set money limit.

Yes

No

- 2) What led you to make the decision to stop or keep playing once the pop-up informed you that you reached your money limit? (please be as descriptive as possible. If it was because you hit your limit, was there a reason you decided to stick to it? If you hit your limit and decided to keep playing, why was that decision made?)

- 3) The pop-up message that allowed me to set a spending limit was helpful in controlling the amount of money I spent gambling.

Yes

No

If yes, please rate how helpful you think this feature was in controlling your gambling expenditure.

1	2	3	4	5
Very unhelpful			Very helpful	

- 4) I would use this limit setting feature if it was implemented on slot machines.

Yes No

- 5) The pop-up message that reminded me when I reached my spending limit was helpful in controlling the amount of money I spent gambling.

Yes No

If yes, please rate how helpful you think this feature was in controlling your gambling expenditure.

1	2	3	4	5
Very unhelpful			Very helpful	

- 6) I would use this limit reminder feature if it was implemented on slot machines.

Yes No

HCI Rating of Monetary Limit Tool

1. I found the monetary limit tool to be engaging.

1	2	3	4	5	6	7
Strongly Disagree			Strongly Agree			

Comment:

2. I found the monetary limit tool hard to use.

1	2	3	4	5	6	7
Strongly Disagree			Strongly Agree			

Comment:

3. I found the monetary limit tool enjoyable.

1	2	3	4	5	6	7
Strongly Disagree			Strongly Agree			

Comment:

4. If I had the choice, I would use this monetary limit tool while gambling online on my own.

1	2	3	4	5	6	7
Strongly Disagree			Strongly Agree			

Comment:

5. I found the visual design of the monetary limit tool to be unappealing.

1	2	3	4	5	6	7
Strongly Disagree			Strongly Agree			

Comment:

6. I found the monetary limit tool to be annoying.

1	2	3	4	5	6	7
Strongly Disagree			Strongly Agree			

Comment:

7. The monetary limit tool helped me stick to my pre-set limit.

1	2	3	4	5	6	7
Strongly Disagree			Strongly Agree			

Comment:

8. During play, I was aware of how many credits I had spent in relation to the limit I set.

1	2	3	4	5	6	7
Strongly Disagree			Strongly Agree			

Comment:

9. a) Were you presented with a warning message as you approached your monetary limit (please circle)?

Yes No Not Sure

9. b) If yes, what percent of your limit remained when it was shown (please circle)?

5% 10% 25% 40% 50% N/A

PGSI

In the past 12 months how often ...

1. Have you bet more than you could really afford to lose?

0	1	2	3
Never	Sometimes	Most of the time	Almost Always

2. Have you needed to gamble with larger amounts of money to get the same feeling of excitement?

0	1	2	3
Never	Sometimes	Most of the time	Almost Always

3. Have you gone back another to try and win back the money you lost?

0	1	2	3
Never	Sometimes	Most of the time	Almost Always

4. Have you borrowed money or sold anything to get money to gamble?

0	1	2	3
Never	Sometimes	Most of the time	Almost Always

5. Have you felt that you might have a problem with gambling?

0	1	2	3
Never	Sometimes	Most of the time	Almost Always

6. Have you felt that gambling has caused you any health problems, including stress or anxiety?

0	1	2	3
Never	Sometimes	Most of the time	Almost Always

7. Have people criticized your betting or told you that you have a gambling problem, whether or not you thought it is true?

0	1	2	3
----------	----------	----------	----------

Never	Sometimes	Most of the time	Almost Always
-------	-----------	------------------	---------------

8. Have you felt your gambling has caused financial problems for you or your household?

0	1	2	3
Never	Sometimes	Most of the time	Almost Always

9. Have you felt guilty about the way you gamble or what happens when you gamble?

0	1	2	3
Never	Sometimes	Most of the time	Almost Always

GIQ

1. Age _____

2. Sex

_____ Male

_____ Female

3. Ethnic/racial background

_____ Caucasian/European origin

_____ Asian (Chinese, Japanese, Korean)

_____ South Asian (East Indian, Pakistani, Punjabi, Sri Lankan)

_____ South East Asian (e.g., Cambodian, Indonesian, Laotian)

_____ Black (e.g., African, Haitian, Jamaican, Somali)

_____ Hispanic and South American Origin

_____ Middle Eastern

_____ Native Canadian/American

_____ Other or multi-ethnic origin

4. Do you currently gamble?

_____ YES, I currently gamble

_____ NO, I used to but I haven't gambled in the last the last 6 months

5. If you answered YES to question 4, how often do you gamble?

_____ More than once a day

_____ More than once a week

_____ More than once a month

_____ More than once every 3 months

_____ Less than once every 3 months

6. When was the last time you gambled? _____

7. How long have you gambled for? (Please answer in years, then months) _____

8. What is your favorite form of gambling (e.g., cards, sports betting, slot machine gambling, horse racing, lottery tickets, etc)?

9. When do you typically gamble? (circle one):

- ☐ Morning
☐ Afternoon
☐ Evening

10. Do you typically place limits on the amount of money you will spend in a gambling session?

- ☐ YES
☐ NO

11. If you answered YES to question 10, how much are your typical money limits?

12. Do you typically place limits on the amount of time you will spend in a gambling session?

- ☐ YES
☐ NO

13. If you answered YES to question 12, how much are your typical time limits?

14. When you gamble, how much money do you spend on average? _____

15. When you gamble, how many hours do you typically spend in a given session? _____

16. Where do you typically gamble (e.g., home/internet, casino, etc.)? _____

Please provide a short answer to the following items.

17. Have you heard of the term “Responsible Gambling?”

YES

NO

IF YES, Where?

18. What does “Responsible Gambling” mean to you?

19. How likely are you to set a money limit when gambling?

1	2	3	4	5	6	7
Not likely				Very likely		

20. How likely are you to set a time limit when gambling?

1	2	3	4	5	6	7
Not likely				Very likely		

21. Please describe a time in which you decided to set a limit on your play and were able to adhere to that limit

22. Please describe a time in which you decided to set a limit on your play and were NOT able to adhere to that limit. What would have helped you adhere to the limit

Appendix I – Extra HCI Questions for HCI-inspired MLT condition

10. Inside the pop-up messages, there was an educational/motivational message.
Please indicate which message appeared by checking the appropriate box:

- ☐ Know Your Limit, Play Within It
- ☐ Think about it – How much can you afford to lose?
- ☐ Gambling is fun, but losing all your money is no fun at all.
- ☐ Gambling within your limit means you can play more and have fun.
- ☐ Not sure
- ☐ I did not notice any messages in the pop-up windows.

11. I found the traffic light helpful in keeping track of where I was in relation to my limit.

1	2	3	4	5	6	7
Strongly Disagree			Strongly Agree			

Comment:

12. a) Did you notice the player stats window?

Yes No Not Sure

13. b) If yes, please rate your agreement with the following statement: I found that the player statistics were helpful in monitoring my expenditure.

1	2	3	4	5	6	7
Strongly Disagree			Strongly Agree			

Comment:

Appendix J – Non-significant HCI-Scale Items

Non-significant HCI scale items: ANOVA table including power and effect size.

Scale Item	df	F	p	d	power
I found the monetary limit tool enjoyable.	1, 54	.628	.431	.012	.122
If I had the choice, I would use the monetary limit tool while gambling online on my own.	1, 53	.673	.416	.013	.127
I found the visual design of the monetary limit tool to be unappealing.	1, 54	.191	.664	.004	.071
I found the monetary limit tool to be annoying.	1, 54	.585	.448	.011	.117
During play, I was aware of how many credits I had spent in relation to the limit I set.	1, 53	.009	.926	.000	.051

Appendix K – Non-significant Gambling Craving (GACS) Items

Non-significant GACS scale items: repeated-measures ANOVA results, power and effect size

Scale Item	df	F	p	d	power
Gambling would be fun right now.	1, 54	1.3	.259	.024	.202
If I had an opportunity to gamble right now I would probably take it.	1, 54	2.531	.117	.045	.346
I crave gambling right now.	1, 54	.000	.983	.000	.050
I need to gamble now.	1, 54	1.124	.294	.020	.180
I have an urge to gamble.	1, 54	.539	.466	.010	.111
If I were gambling now I could think more clearly.	1, 54	.002	.962	.000	.050
I could control things better right now if I could gamble.	1, 54	.256	.615	.005	.079
Gambling would make me less depressed.	1, 54	2.067	.156	.037	.292

Appendix L – Non-significant Dissociation (JDQ) Scale Items

Non-significant JDQ scale items: ANOVA results, power and effect size

Scale Item: During your period playing slots just now, how much did you. . .	df	F	p	d	power
. . . lose track of time?	1, 54	2.290	.136	.041	.318
. . . feel like you were a different person?	1, 54	.208	.650	.004	.073
. . . feel like you were outside of yourself, watching yourself gamble?	1, 54	.886	.351	.016	.152
. . . feel like you were in a trance?	1, 54	.019	.890	.000	.052
. . . experience a memory blackout for things that happened while you were gambling?	1, 54	.033	.856	.001	.054