# Do Gambling Related Stimuli Lead to Intrusive Cognitions?

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A research paper submitted in partial fulfilment of the degree of M.Sc by Research in Psychology, in the Dept. of Psychology, University of Kent, August, 2014.

Abstract

Studies have demonstrated that gambling stimuli can trigger attentional biases to pathological gamblers. However, with the continuous increase of exposure to gambling stimuli it is important to investigate the effect of gambling stimuli on the general population. The present research investigated whether gambling stimuli can lead to intrusive cognitions that could affect time perception, gambling decisions and could elicit craving to gamble. In study 1, using a gambling Stroop test as a prime, we showed that intrusive cognitions can affect gambling decisions and elicit desire to gamble. In study 2, using a time bisection task without any primes we did not find any such effects. In study 3, individuals had to perform the time bisection task twice with a priming task between attempts. Findings suggest that there were no intrusive cognitions as a result of a gambling related prime. There was however an overall effect of priming on time perception suggesting that mind-set could affect time perception. Future research paths are also suggested.

Pathological gambling (PG) has been well documented to share similar traits with substance addictions. It is accompanied by persistent and uncontrolled participation in gambling activities that can induce harmful psychosocial consequences (American Psychiatric Association, 1994). Furthermore, a number of studies have presented evidence that suggest that pathological gamblers also share similar symptoms, like craving and urges while abstinent, with substance addicts (e.g Hodgins and el-Guebaly, 2004; Young and Wohl, 2009).

Research in gambling has increased in volume the last years. A number of studies has focused on PG and attentional bias ( e.g McCusker and Gettings, 1997; Diskin and Hodgins, 1999; Boyer and Dickerson, 2003; Molde et al., 2010; Brevers et al., 2011), on PG and impulsivity (Specker et al., 1995; Vitaro et al., 1999; Lightsey and Hulsey, 2002), on PG and decision making ( Petry, 2001; Cavedini et al, 2002; Goudriaan et al., 2006; Lakey et al., 2007), for a review see van Holst et al. (2009). However, despite the increase in the interest in gambling, most studies focus mainly on PG and use non-pathological gamblers as control groups.

Focusing mainly on PGs, which in England and Scotland represent the 0.5% of the population (Wardle et al., 2014), could lead to under researching a broader part of the population that gambles and under the right circumstances could be at risk of developing a gambling addiction. According to the Health surveys in England and Scotland in 2012 0.5% of the population are problem gamblers, 4.2% are at risk with Problem Gambling Severity Index (PGSI) > 1 (Ferris and Wynne, 2001). Furthermore, 65% have responded that they had gambled the year before the survey. Internationally gambling participation ranges between 65 and 82 percent (for a review see Gainsbury, 2013) of the adult population.  The above clearly point to the direction that gambling prevalence is well established in the majority of the population creating a solid base for potential problem gambling.

A second element that could potentially increase the prevalence of gambling and add to problem gambling is the vast increase in the number of gambling commercial spots in TV. Ofcom (2013) reported that between 2005 and 2012 gambling spots increased from 90k to almost 1.4 million (Wardle et al., 2012). The increase is indeed very worrying as it now results to almost two gambling commercial spot viewings per day per adult increasing significantly the exposure time since 2005. Most gambling researchers agree that increasing exposure and gambling availability should lead to an increase to gambling participation and problem gambling (Binde, 2014). At the moment and to the author's best knowledge, there is no measurement of the direct impact that advertising and exposure to gambling stimuli could have on prevalence of problem gambling (Binde, 2014), although there are studies that argue that there should be a fair impact (Planzer and Wardle, 2011; Williams et al., 2012).

The above highlight the need to explore the effect of gambling stimuli on individuals. In this program of research we focused on the effects of gambling stimuli on attentional bias, time perception, and effects on risk and decision making. We hypothesized that gambling stimuli can lead to intrusive cognitions either directly (attentional bias, time perception) or indirectly (gambling priming effects on decision making, time perception, and craving to gamble).

## Attentional Bias

Generally attentional bias refers to the phenomenon where, for a number of various reasons (e.g. threat, anxiety, or addiction related stimuli), we may pay more attention to specific things to the expense of others that may be present at a given moment. For example people who suffer from arachnophobia could get distracted by the presence of a spider to expense of other stimuli in the environment or could detect a spider faster than people with no fear for spiders (e.g. Mogg and Bradley, 2006). This attentional bias towards threatening stimuli, especially in people with anxiety, has been well documented (for a review see Cisler and Koster, 2010).

Similarly, in addiction the term attentional bias refers to the phenomenon that substance users display differential attention towards their addiction related stimuli compared to neutral, non-related stimuli (e.g. Field and Cox, 2008; Field, Munafo, and Franken, 2009; Vizcaino et al., 2013). Robinson and Berridge (1993) argue that is due to increased salience for the substance related cues. Since attention is a limited resource if the bigger part of it is required to process substance related stimuli then less resources are left to process for neutral stimuli.

This attentional bias is a robust phenomenon and has been demonstrated in a number of different addictions like alcohol (Sharma, Albery, and Cook, 2001; Townshend and Duka, 2001), nicotine (Ehrman et al., 2002; Munafo et al., 2003;Walters et al., 2003), cannabis (Field, Mogg, and Bradley, 2004; Cane, Sharma, and Albery, 2009), cocaine (Copersino et al., 2004), heroine (Waters, Marhe, and Franken, 2012), and opioids (Lubman et al., 2000) among others. These studies involved a variety of methods like attentional blink, visual probe task, and Stroop test. The results from studies using the Stroop test are even more intriguing as they show that addiction stimuli can also have more persistent, carry over effect over the stimuli that follow them directly.

Originally, Stroop (1935) presented colour words either written in the same colour or different as the one they expressed (e.g. word RED written with red ink or another colour). Stroop observed that people took longer to read the word when the ink colour was different than the word. This was known as the Stroop effect and was attributed to conflicting processes. The emotional Stroop task is based on the original Stroop task, but this time the words are not colours but words that can have an emotional impact, like *war* or *kill*, again written in different colours. It has been found that people are slower in reporting the colour of the “ink” for *emotional* words compared to *neutral* words. We should note though the original Stroop effect and the emotional Stroop effect are due to different conflicting processes (McKenna and Sharma, 1995, 2004).

A further adaptation of the emotional Stroop test was the addiction Stroop test were this time emotional words were replaced with addiction related words. More specifically half the words were addiction related words and half were neutral words. Generally, substance abusers were slower in naming the colour of a substance related word compared to naming the colour for a neutral word (for a review see Cox, Fadardi, and Pothos, 2006). In most cases this addiction Stroop effect was only observed in substance abusers but not in healthy population, there are however some exceptions (e.g. Bauer and Cox, 1998; Clarke, Sharma, and Salter, 2014)

Further to the immediate (*fast effect*) interference on naming the colour of the emotional or addiction related word McKenna and Sharma (2004) also established the existence of a carryover interference of the salient stimulus to neutral items that followed it (*slow effect*). In other words substance abusers were not only slower at naming the colour of an addiction related word but also at naming the colour of neutral words that followed it directly. This is in line with the Elaborative Intrusion theory (Kavanagh, Andrade, and May, 2005) which proposes that addiction cues initiate a loop of associative and desire thoughts that could occupy a part of our cognitive resources even when the cue is no longer present (this theory will be discussed in more detail in the *Decision Making and Gambling* section).

As mentioned above even though pathological gambling is not a substance abuse addiction it still presents similarities with substance addictions. Robinson and Berridge's incentive-sensitization theory (1993, 2003) suggests that repeated gambling experiences, thus exposure to gambling related stimuli, could lead to brain sensitization increasing the salience of these stimuli and associating them with reward sensations. This association could motivate a pathological gambler to gamble even if there are no gambling cues presents. Most importantly though, this salience increase could now lead to attentional biases similar to the ones observed in substance abuses.

Indeed, there is a number of studies that used a modified addiction Stroop test (gambling Stroop test) to investigate attentional bias in pathological gamblers. The findings were consistent with other addictions, pathological gamblers were slower at reporting the colour of gambling related words than of neutral words (McCusker and Gettings, 1997; Boyer and Dickerson, 2003; Molde et al., 2010). However, as most of other studies on attentional biases in gambling that used other than Stroop paradigms, these studies compared pathological gamblers with non-pathological gamblers or with people who do not gamble at all.

In order to investigate if increased exposure to gambling stimuli (e.g. TV commercials) could potentially lead non-pathological gamblers to gamble we argue that the sample of the research should be more representative of the general population. It is therefore vital to look for intrusive cognitions and attentional biases due to gambling related stimuli in general and not just in pathological gamblers. This is highlighted even more by existing research that found attentional biases towards addiction stimuli even in healthy populations.

Studies in alcohol addiction (Bauer and Cox, 1998; Clarke, Sharma, and Salter, *experiment 1,* 2014) have found that even healthy (not addicted) drinkers demonstrated attentional bias towards alcohol related stimuli. A possible explanation for these findings could be that alcohol salience is high even in healthy population. Furthermore, in the second Clarke, Sharma, and Salter (*experiment 2*, 2014) found that when participants were not primed the attentional bias effect disappeared which highlights the need to investigate the role of priming in attentional bias.

**Time Perception**

If we imagine ourselves facing a pleasant experience, either an exciting lecture or being lucky and winning on a social poker game amongst friends, then we most probably say that time seemed to fly. On the other hand, if we imagine ourselves facing an unpleasant experience, like waiting in a hospital queue after an injury we would most probably say that time seemed to stand still. Therefore, we could argue that time perception is subjective to our emotional or arousal circumstances (Droit-Volet and Meck, 2007; Tipples, 2008; Droit-Volet and Gil, 2009; Wittman, 2009).

Scientists have argued that humans are equipped with an internal clock mechanism that allows us to accurately estimate time. The most popular internal clock model is the one proposed by the *scalar timing theory* (Gibbon, 1977; Gibbon et al., 1984). The model consists of three distinct stages, the *clock stage,* the *memory stage,* and the *decision stage* (Droit-Volet and Gil, 2009). In the *clock stage*, a *pacemaker* is generating pulses throughout the duration of an event; a *mode switch* is either allowing the pulses to be carried to the *accumulator* or not. In simple words, when our attention is focused on the event then the *mode switch* stays on and the generated pulses gather in the accumulator. When we are distracted, *mode switch* could be turned off disallowing the pulses from reaching the accumulator. The *accumulator* then passes the number of the collected pulsesto the *memory* and *decision stages* where the *comparator* concludes if the event we experienced was *short (*small number of accumulated pulses) or *long* (larger number of accumulated pulses).

Although there has been some criticism on its validity (Lewis and Miall, 2006; Mattel and Meck, 2004), the internal clock model is still the most prominent one. The main reason is that it can be used to interpret findings from a wide spectrum of studies due to the fact that the model allows different factors to interact with the *pacemaker* and the *mode switch*. Hence, it can provide the foundation for investigating the parameters that can lead to distorted time perception.

A number of studies has provided evidence that arousal can have a direct impact on time perception mainly by affecting the *pacemaker*, thus affecting the rate at which pulses are generated. Cheng et al. (2007) have shown that administering drugs that increase arousal results in overestimating the elapsed interval which is associated with an accelerated *pacemaker*. On the other hand, Drew et al. (2003) have shown that administering drugs that reduce arousal results in underestimation which is associated with the *pacemaker* slowing down.

Arousal also seems to play a role on how emotion affects the internal clock. Angrilli et al. (1997) found that at high arousal levels, the duration of negative pictures was overestimated compared to positive pictures, whereas at low arousal levels, the effect was reversed and the duration of negative pictures was underestimated compared to positive pictures. This could indicate again that at high arousal levels the *pacemaker* is accelerating and thus generating more pulses. Furthermore, negative stimuli are associated with avoidance strategies in order to escape threatening situations (Duckworth et al., 2002). This could result in high arousal, negative stimuli could accelerate the *pacemaker* resulting in temporal overestimation compared to positive or neutral stimuli (Droit-Volet and Meck, 2007; Tipples, 2008; Tipples, 2011; Yamada and Kawabe, 2011).

Besides arousal, attention can also affect our time perception. Losing our attention would result in the *mode switch* switching off thus not allowing the generated pulses to reach the *accumulator*. This would lead to fewer pulses being accounted thus perceiving the event as shorter (temporal underestimation). Music is known to have such a shortening effect on time perception (Droit-Volet et al., 2010). Participants listened to either happy (major key) or sad (minor key) music. Compared to control group (listened to sine wave), both sad and happy music were perceived as shorter. Even though results suggested that listening to music distracts our attention resulting in lost pulses some argue that music could also have an effect on the *pacemaker* too.

Participants may have felt more relaxed, since listening to music is mostly an enjoyable experience, resulting in a slowed down *pacemaker* (Droit-Volet et al., 2010). Distinguishing between effects on arousal or attention can pose a challenge, however Brule and Casini (2001) have shown that arousal-related and attention-related effects are independent and can have an additive effect on time perception.

A more clear demonstration on how attention can affect our time perception comes from studies that manipulated the number of changes that occur in a situation. In particular, Ahn et al. (2009) found that events with more changes are perceived as shorter compared to events with less changes. In their study participants were assigned to two different groups and were shown a slide show of five pictures being presented five times each for five seconds. The main difference was that one group show the first picture being presented five consecutive times before the second picture would be presented for another five consecutive times and so on until all five pictures were presented five times (if pictures were named as 1, 2, 3, 4, and 5 then the slide show would be 1/1/1/1/1 then 2/2/2/2/2 then 3/3/3/3/3 and so on). The second group would again see all five pictures being presented five times each but in quasirandom order (1/2/3/4/5 then 3/2/1/5/4 then 1/3/5/2/4 then 3/1/5/4/2 and finally 5/4/3/2/1). The latter slide show would be perceived to present more changes compared to the first slide show due to the fact that each current picture would be different than the previous one.

Generalising these findings one could argue that more diverse situations (more changes or details in a situation) may be perceived as shorter compared to less diverse ones (less changes or details). Furthermore, even the same situation could be perceived differently depending on the on the actual state of mind that we are in at a given moment. Hansen and Trope (2013) have hypothesised that placing ourselves in low-level or high-level construals could affect our time perception. This is due to the fact that high-level construals tend to be abstract mental representations were we focus less in details. On the other hand, low-level construals are more concrete representations were we focus more on details thus being able to perceive more changes. Therefore, individuals who are in concrete construals (either by real life factors or experimental priming) should perceive the duration of events as shorter, compared to individuals who are in abstract construals.

Summarising, one can argue that arousal, attention, and state of mind (abstract vs. concrete) can have an effect on time perception. Gambling stimuli could be associated with a harmful addiction hence be perceived as threatening stimuli and affect our *pacemaker.* They could also be associated with the recreational side of gambling, where one could have fun and perhaps win some money. In that case gambling stimuli would be more of an attentional distraction affecting our *switch mode.* In either case, our overall experience of time could be affected by the mental state that we are in at given moment (abstract vs. concrete). Hence, it is important to investigate the effects of gambling stimuli in different experimental settings not only on time perception but also look into possible effects on gambling decisions and craving to gamble.

## Decision Making and Gambling

Decision making is a rather complex topic and lies at the heart of human behaviour as we resort to it for answering a wide variety of questions, from very simple ones like what to wear this morning or to vastly more complicated ones like future career decisions (Krawczyk, 2002). A number of theories and factors have been identified to affect our decisions (varying from e.g. emotion (Paulus and Yu, 2012), self-esteem (Josephs et al., 1992), reward and punishment (Coventry, 2001), gender differences and physiological arousal (Coventry and Hudson, 2001)).

In its fundamental sense though of processing information and arriving to a decision based on probabilities and outcomes the foundations were set by von Neumann and Morgenstern (1944) with their Expected Utility theory (EU). EU stated that when faced with a number of possible decision we take the one with the highest value or utility (Josephs et al., 1992). However, this theory fails to incorporate the different psychological processes (like the ones mentioned above) and has received lots of criticism (Kahneman and Tversky, 1979).

Kahneman and Tversky (1979) have proposed the Prospect Theory (PT) that implements the factor of risk and the notion that risk in not a constant but a variable that can change depending on the situation. This distinction provides more space for psychological processes to be implemented as factors that underlie risk. Probably the most famous example from PT is the *reflection effect* between two scenarios that involve gain or loss. In the first scenario participants had to choose between a certain gain of $800 and an 85% chance of winning $1,000. Most participants demonstrated risk aversion by choosing the certainty of winning $800. However, in the second scenario participants had to choose between a certain loss of $80 and an 85% chance of losing $100. Most participants chose the 85% chance of losing $100. This change in preference is called *reflection effect*.

In gambling however behaviours are not so clearly defined. Most gambling games are designed to offer a very small chance of winning compared to losing and despite the fact that the certain win would be not to gamble people still choose to gamble. This suggests that decision making when it comes to gamble cannot be described fully by risk aversion as explained in PT. Therefore, there is the need to adopt a model that will include a sufficient number of psychological factors.

One such model is the Elaborated Intrusion theory of Desire (EI) (Kavanagh, Andrale, and May, 2005). The theory was originally formulated to explain craving for substance addiction but it can be generalised to apply to other harmful behaviours like gambling (pathological or recreational). The theory describes how automatic elaborative processes can trigger intrusive desire thoughts (see figure 1.1). External factors or events that precede the intrusive thoughts can lead to automatic components of desire and also act as cues that will then lead to the elaborative stage where cognitive processes retrieve information from the memory. This creates a vicious circle where desire thoughts have a central place and they keep being reinforced by the external factors and elaborative processing.

Figure 1.1 The Elaborative Intrusion Theory of Desire as presented in Kavanagh, Andrade, and May (2005)

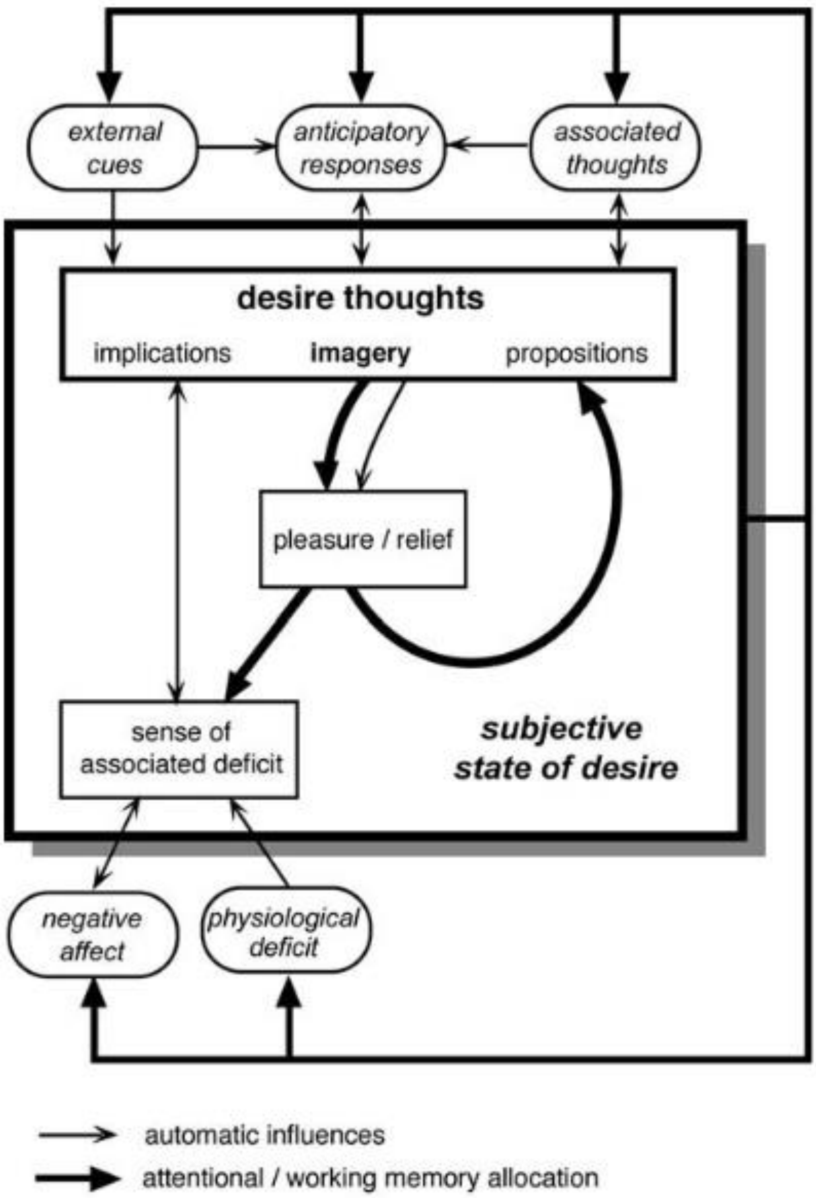


Figure 1.1 Rounded boxes represent external factors or antecedents, rectangular boxes represent the products or elaborative processes. Automatic processes (thin arrow) lead to spontaneous intrusive thoughts, then an elaborative circle (thick arrows) begins where previous experiences are associated with these intrusive thoughts to create images with the desired activity. The elaborative circle can feed back to create more automatic influence that reinforce the whole process.

Imagine you are watching a football game where betting related stimuli are presented either as commercial signs in the stadium or as commercials during half time.

These external cues are processed automatically and could initiate spontaneous thoughts about betting. At this point elaborated processes are also triggered that associate these stimuli with betting maybe linking them with previous betting experience. Desire thoughts are now being reinforced by both the betting advertising stimuli (external cues) and betting related memories (elaborative processing) creating imaginary projections (imagery) of yourself of winning money from a successful bet. This imagery stage plays a crucial role in maintaining the desire to bet and increasing craving.

The EI theory fits very well with the predictions from attentional bias since increased desire and craving should lead to intrusive thoughts making us more vulnerable to gambling stimuli. Furthermore, stronger imagery could result in a more concrete mind set where we imagine in more details the process of betting and possible outcomes. This, as discussed in the time perception section, should have a direct effect on time perception. Therefore, it is crucial to establish measurements for desire and craving to gamble, either implicit or explicit, as it is rational to argue that the stronger the desire and craving to gamble the stronger the effects of attentional bias and distorted time perception should be.

Further support to a possible mechanism that connects attentional bias and craving to gamble comes from Franken's model about substance abuse and craving (Franken, 2003). Even though the model was originally used to account for substance abuse it can be generalised to account for non-substance related addictions (Hønsi et al., 2013). Franken argues that selective attention allows the *addict* to focus on relevant stimuli and disregard irrelevant ones. Furthermore, due to increased dopamine levels, attentional bias will lead to increased craving for gamble which will eventually lead to enhanced attentional bias towards gambling related stimuli. So the model suggests that attentional bias and craving are interconnected and can lead relapse (Figure 1.2)

In more detail attentional bias could lead to gambling activities in three possible ways (Figure 1.2). First, maintaining a gambling behaviour could be due to increased likelihood to attend to gambling related stimuli in the environment. This would be an *automatic process* where gambling related stimuli are processed more easily and rapidly. Second, once attention is directed towards a gambling stimulus it is difficult to redirect attention to different stimuli. This is also in line with the EI theory's subjective state of desire and Tiffany's approach (1990), as it will be discussed in more detail below. Furthermore, in line again with the EI theory, this attentional bias towards gambling stimuli could lead to intrusive cognitions that could increase craving and urge to gamble. Finally, the automatic attention bias towards gambling stimuli could lead to reduced attention resources left to process competitive cues to gambling. As an example we could imagine a poster against gambling that does actually contain gambling images and the message "*gambling is an addiction that damages lives*". Due to attention focused on the gambling stimuli themselves limited resources are left to process the message itself, thus reducing its effectiveness.

Figure 1.2. Summary of the model as proposed by Franken (2003)

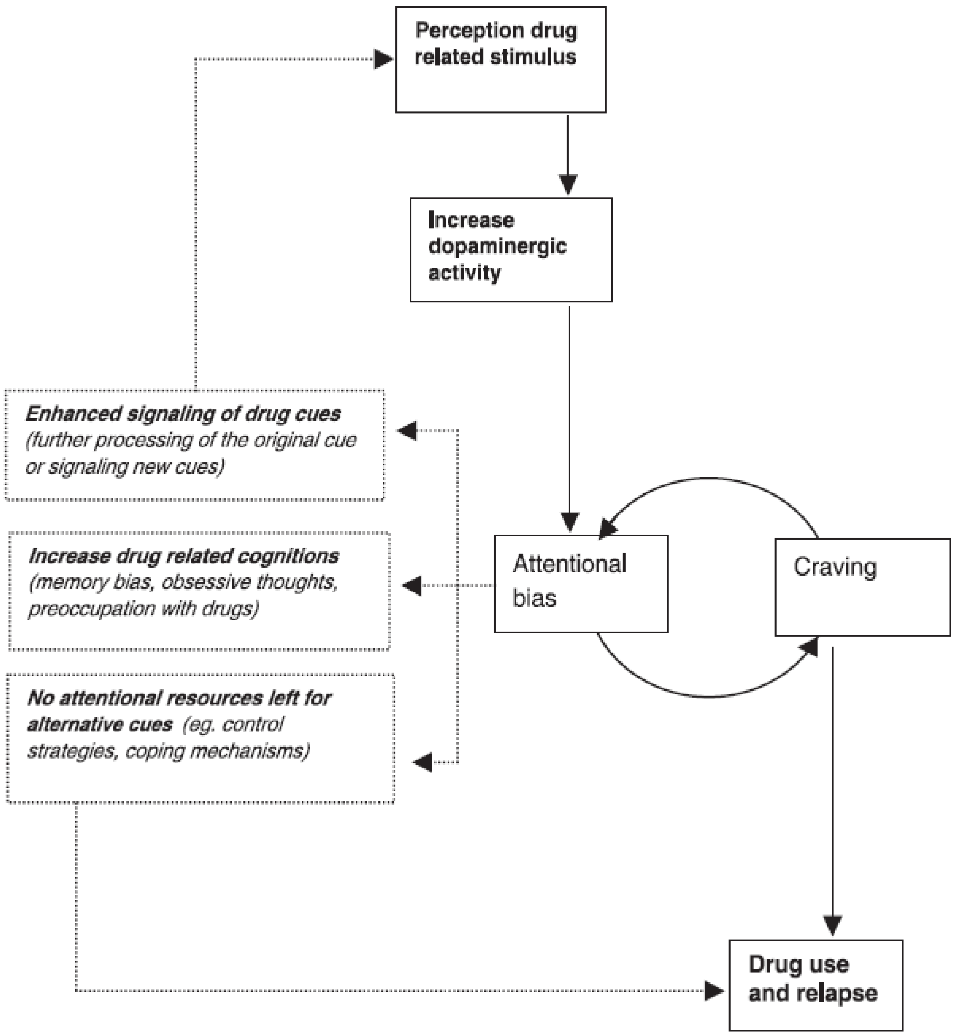


Figure 1.2. Dashed lined boxes represent the three possible ways that attentional bias towards gambling stimuli could lead to craving and relapse to gamble. Continuous line demonstrated how attentional bias and craving affect one another.

The above discussed models highlight the role that automatic and non-automatic process play in attentional bias, craving and addictive behaviours. Even though the models were originally focusing on substance abuse they can be generalised to include non-substance addiction. A third model that uses automatic activation of schemata that can activate non-automatic mechanisms that create urge and craving to relapse was proposed by Tiffany in 1990. Tiffany's approach focuses on how automatic and non-automatic processes are intertwined and can lead to creating and maintain urges to use substance. In our case we can argue that this relation can lead to increased craving to gamble.

Tiffany suggested that in addiction, behaviour is mainly controlled by automatic processes. This could mean that an addict's behaviour, and hence using and reusing substances, is largely affected by the presence of external stimuli related to his/her addiction. These external stimuli can lead to effortless attentional bias which would be difficult to counteract and direct attention elsewhere. In other words, external factors can activate substance-abuse schemata which then could activate non-automatic processes related to the addiction and lead to relapse. This "schemata activation" can then lead to non-automatic processing that can materialise into craving and urge to use addiction substance.

The implications from Tiffany's approach to gambling are in line with Franken's model and the EI theory. Gambling stimuli can automatically cause attentional bias and activate related schemata, this attentional bias can then maintain attention to the gambling stimuli making it more difficult to direct attention to non-related stimuli. At the same non-automatic processes can enhance craving and urge to relapse. This increased craving then feed back to increase attentional bias even more making it more difficult to escape the subjective state of desire as described in the EI theory.

**Assessing Craving**

The EI theory places desire thoughts and craving at the centre of the model, it is however important to highlight that desire thoughts and craving will not always result in gambling. Craving to gamble could sometimes be subtle and people who actually gamble may not always notice that they craved for gambling (Ashrafioun and Rosenberg, 2012). Therefore, it is important to develop implicit and explicit measures of intrusive cognitions that lead to craving and desire to gamble.

A number of questionnaires has been developed to assess craving to gamble since pathological gambling was listed as an impulse disorder (American Psychiatric Association, 1980), for a detailed review read Ashrafioun and Rosenberg (2012). However, for the purposes of this research program and since we are focusing on *intrusive cognitions* that could lead to desire thoughts and craving we decided to use the Gambling Craving Scale (GACS) by Young and Wohl (2009). GACS includes three factors that reflect the desire to gamble, the anticipation of gambling in the near future, and the relief from negative consequences that could follow gambling. These three subscales combined give an overall mean score of craving.

The CAGS fits very well with the traditional view of craving in substance abuse, where craving could be a product of desire for substance use or a mere product of withdrawal symptom (Tiffany and Conklin, 2000). Originally it included four different factors (desire to gamble, anticipation of positive experiences from gambling, intention to gamble, and relief from negative experiences associated with gambling) and 18 items in total. Participants had to give their responses on a 7-point scale between 1(strongly agree) and 7 (strongly disagree). After testing the questionnaire for three years with Canadian University students Young and Wohl finalised GACS with three factors and nine items in total, *Anticipation* (e.g. Gambling would be fun right now), *Desire* (e.g. I crave for gambling right now), and *Relief* (If I were gambling now, I could think more clearly). The final selected items had a factor loading $> .55$ to their respective factor, as suggested by Comrey and Lee (1992). Nine items did not meet that criterion and were dropped, also the intention to gamble factor was dropped as it was semantically very close to desire to gamble.

The CAGS has the advantage of measuring overall *craving* and providing three different subscale score using a small number of items. Furthermore, it has been used together with the Problem Gambling Severity Index (PGSI; Ferris and Wynne, 2001) and DSM-IV checklist for pathological gambling (APA, 1994), (for more information on PGSI and DSM-IV see *Study 1* methods section) which provides a valuable sample for comparison both for our current studies but also for future ones. In addition, GACS has demonstrated high level of concurrent validity with University students (Young and Wohl, *study 1*,2009; Ashrafioun and Rosenberg, 2012), this again is of high importance as our convenience sample comprises of University students. This high level of concurrent validity was also found with samples that included pathological gamblers (Young and Wohl, *studies 2 and 3*, 2009), which will allow us to compare our current findings with future replications of our studies with more diverse samples.

## Overview

In *Study 1* we tested the hypothesis that gambling stimuli can cause intrusive cognitions by using a gambling Stroop paradigm. Additionally we tested the hypothesis that these intrusive cognitions can affect time perception by comparing time production performance prior and after the gambling Stroop. Furthermore, we investigate whether participants would be willing to take higher risks in a gambling task as a result of gambling intrusive cognitions.

In *Studies 2* and *3* we focused on the effects of gambling intrusive cognitions on time perception, however we replaced the time production task with a time bisection task, either completing the task once (*Study 2*) or completing the task twice with a priming task between attempts (*Study 3*).

Finally we hypothesized that gambling intrusive cognitions would result in higher gambling craving, which was measured in all three studies together with screening participants for pathological gamblers

### Ethics

Prior to advertising all four studies and testing participants; ethics applications were submitted to the Ethics Committee of the School of Psychology in Kent University. Approval codes were, 20133012 for Study 1 and 20133041 for Studies 2 and 3. In all four studies participants were briefed both orally and by reading a print out and they provided their signed consent forms. They were informed about their right to withdraw either during the study or in the future after their participation was concluded. Upon the completion of the study they received both oral and printed debriefing where they were reminded of their right to withdraw from the study either that moment or at any point in the future if they desired so by contacting either the experimenter or the experiment supervisor.

## Study 1

In Study 1 we investigated whether gambling stimuli would result in higher intrusive cognitions compared to neutral stimuli. We used a modified gambling Stroop task where performance in naming the colour of gambling related items would be compared to the performance of naming the colour of neutral items. The addiction Stroop task in general has been modified and used in a wider spectrum of addictions (Cane et al., 2009). For this research we modified it using images instead of words, either related to gambling or not. Our first hypothesis was that participants in the gambling prime condition (containing both gambling and neutral images) would be overall slower in reporting the stimuli colour compared to participants in the neutral prime condition (containing only neutral images). Secondly, in the gambling priming condition participants would be slower in naming the colour of a gambling images compared to naming the colour of a neutral images (the fast effect), thirdly participants would be slower in naming the colour of a neutral image following a gambling image compared to a neutral following another neutral image (the slow effect).

Furthermore, we wanted to test whether the possible attentional bias in the gambling Stroop would result in longer lasting intrusive cognitions. Particularly, we hypothesized that these intrusive cognitions would affect time perception. We used a time production paradigm where participants had to carry out a task for exactly 20 sec. According to time perception literature, if participants would perceive time flowing faster they should produce longer intervals, whereas if they perceived time flowing slower they would produce shorter intervals (e.g. Hansen and Trope, 2013 , Droit-Volet 2009, Droit-Volet 2004).

We also investigated whether these intrusive cognitions would affect participants' willingness to take risks and gamble. We used a gambling paradigm where participants were given a specific amount of money and offered five different risk options (Josephs et al., 1992). We hypothesized that intrusive cognitions resulted from the gambling Stroop should provide strong cues that could lead to higher risk taking (Kanavagh et al, 2005). Finally, we measured gambling craving and we hypothesized that higher intrusive cognitions effects should correlate with higher craving. As with Studies 2 and 3 all participants had to complete the DSM-IV gambling questionnaires and PGSI questionnaires, mainly to establish that our sample was representative of the general population and also use these measurements as a point of reference in future replications of the study with gambling addicted samples.

### Hypotheses

1. Time Production Task: Participants in the gambling condition will have different time perception than those in the control condition.

2. Stroop Task: Participants will be slower in reporting the colour of a gambling related image compared to a non-gambling related image (neutral image) (fast effect). Furthermore, participants in the gambling condition will be slower in reporting the colour of a neutral image if it was preceded by a gambling related image (slow effect).

3. Gambling Task: Participants in the gambling condition should be primed to gamble more compared to participants in the non-gambling condition.

4. Craving: Participants in the gambling condition should demonstrate higher craving for gambling compared to the ones in the control condition.

5. Correlations: Increased craving effects should correlate with increased effects in all above hypotheses.

## Method

### Participants

Eighty-two participants, (age range 18-50, mean age = 20.42, SD = 5.33, 74 females, eight males) were recruited via the Kent Psychology RPS website and were awarded with 2 RPS credits for their participation.

**Design**

Participants were randomly allocated in one of two priming groups, Gambling or Neutral. Both priming groups went through the same number of stages with the only difference being the images shown during the Stroop test. The Gambling prime group carried out a Gambling modified Stroop test that contained gambling and neutral stimuli (in equal proportion), the Neutral priming group carried out a Stroop test that contained only neutral stimuli, as explained further in the *Design* and *Materials* sections.

*Study 1* involved the measurement of three dependent measures and three questionnaires. For all participants the three dependent measures were recorded before presenting the questionnaires. A visual representation of *Study 1* is provided in figure 2.1.

**Gambling Stroop.** A mixed design defined by Priming Group (gambling, neutral) x Image type (gambling or neutral). Priming group was a between-subjects factors and Image type a withing-subject factor. The dependent measure was the reaction time (RT) it took to respond to the colour in which the image had been filtered with.

**Time production.** A mixed design defined by priming group (gambling, neutral) as the between subjects factor and Time Production (first or second time) as the within-subjects factor. The dependent measure was the duration (in seconds) of the task.

**Gambling Task.** A mixed design defined by priming group (gambling or neutral) x Gambling Task (0%, 50%, 75%, 90%, 99% risk). Gambling Task varied within subjects, the dependent measure was the risk percentage selected by the participant.

**Figure 2.1.** Study 1 Design and Procedure

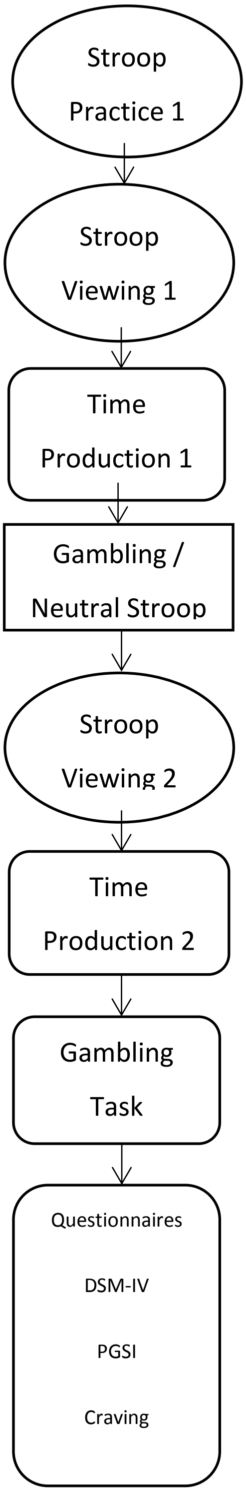


Image Stroop containing five neutral images.

Slide show of five neutral items with a total duration of 20 sec.

Image Stroop containing five images. Participants were instructed to manually stop at 20 sec.

Gambling or Neutral Stroop test depending on the Prime Condition. Twenty-four gambling and 24 neutral images shown in four different colours or 48 neutral images in four colours.

Slide show of five neutral items with a total duration of 20 sec.

Image Stroop containing five images. Participants were instructed to manually stop at 20 sec.

Gambling Task involved four questions with £250, £40, £25, and £2. Each option offered five alternative options, 0% (no gamble), 50%, 75%,

Figure 2.1. Study 1 flow chart. Rectangles represent between subjects tasks, rounded rectangles represent within subjects, and ovals represent practice or training sessions.

**Materials**

**Hardware and software.** The study was conducted in the labs of Psychology department where each participant was alone in an individual cubicle. The experiment was presented on a Psychology department Dell desktop computer with a 19 inches monitor (4:3 factor). The custom computer software used to present the stimuli was programmed in Psychopy v1.77 (Peirce, 2007 and Peirce, 2009).

**Visual stimuli.** The stimuli collection consisted of 73 neutral images and 24 gambling images. Initially we selected 24 gambling images (we used Google images for this process, using the term "gambling images" as a search criterion (Google, 2013). These objects were commonly associated with gambling and have been selecting in numerous papers on gambling (e.g. roulette, dice, cards, poker chips as in Brevers et al., 2011). Each gambling object was then matched with two neutral objects with similar physical and visual properties (e.g. shape, colour, size). This resulted in 24 triads, a further 25 neutral objects were selected for the training and practice sessions, hence the total number of 73 neutral objects.

Each image was resized to 1024x768 pixels and converted to 256 greyscale. We then applied four different filters and generated four final images from each item. These filters were applied in Adobe Photoshop® with 40% opacity and were red(255,0,0), green(0,255,0), blue(0,0,255), and yellow(255,255,0). All image sizes were smaller than 200kb in order to avoid differences in loading times. Further details on how these images were presented in the study are reported in the *procedure* section. Four separate gambling question slides were created in Microsoft® PowerPoint® in order to cover all different combinations between gambling risks (0%-50%-75%-90%-99%). These slides were exported as JPG images with dimensions 960x720.

**Questionnaires**. We used computerised versions of DSM-IV gambling questionnaire, PGSI and GACS, as mentioned in the introduction. The items and instructions were typed in exactly as shown in their paper version .The items of each questionnaire were typed in separate slides and were presented in a sequential order as in the paper versions. Both DSM-IV and PGSI ask the participant to recall activities and behaviour for the last 12 months "In the last 12 months…" (e.g. When you gamble how often do you go back another day to win back money lost?). Participants were offered the options of "*never", "sometimes"*, "*most of the time*", and "*always*" for the nine items of the PGSI (Appendix B) questionnaire and they that were scored with 0, 1, 2, 3 respectively. For nine out of ten items in the DSM-IV (Appendix A) questionnaires the options were "*never*", "*occasionally*", "*fairly often*", and "*very often*" scored with 0, 1, 2, 3 respectively. One item offered the options of "*never*", "*some of the time I lost*", "*most of the time*", and "*every time I lost*" and they were scored with 0, 1, 2, and 3 respectively. The GACS questionnaire includes nine items that ask the participant to select the response that matches his/her current feelings (Appendix C). Participants had to respond between 1 "*Strongly Agree"* and 7 "Strongly disagree"; the third item was negatively word to check for response bias (Young and Wohl, 2009). This implies that the lower average scores would reveal higher craving. Since the questionnaires were presented via computer software participants had to register their response by pressing the corresponding number on the keyboard.

**Procedure**

Upon arrival participants were briefed about the experiment and were asked to sign a consent form, they also had to complete the demographics form before proceeding in the lab. Participants were then informed that prior to each computer based task instructions will be shown on the monitor and that if those instructions were unclear they should call the experimenter for assistance. The study was made by a series of eight steps (see figure 2.1). These steps are described below in the order that the participants completed them.

**Stroop practice 1.** Participants performed an image Stroop test with five neutral items, each item was presented in red, green, blue, and yellow in random order. We used five different objects in four different filters and repeated them five times resulting in 100 trials. The participant had to respond to the colour of the image as fast and as accurately as possible by pressing A, S, K, and L for red, green, blue, and yellow respectively. There was a random intertrial interval varying from 16 to 32ms that corresponded to either one or two frame loading times. In practice there was no intertrial interval set but the frame buffer required one or two frames in order to load and show the next stimulus. The same principal applied to all the following image showing steps.

**Stroop viewing 1.** Participants were instructed that they would watch a slide show that would alst exactly 20 sec and for the duration of the slide show they would only have to watch and and not perform any actions. The slide show presented five neutral items (different than those in *Stroop practice 1*) in the four different colour filters mentioned above resulting in 20 items. The images were presented in random order and the total duration of the slide shown was exactly 20 sec. Each image would stay on the screen for a time interval randomly varying between 500ms and 1000ms to simulate the conditions of the gambling Stroop task.

**Time production 1.** Participants performed an image Stroop test with five items (different than those in the above two steps) presented in the four different colour filters mentioned above. The instructions were that they had to carry out the task for exactly 20 sec and when they felt that the elapsed time was exactly 20 sec they should terminate the task by hitting the “Enter” or “Return” key.

**Priming group.** Participants were randomly assigned to either the gambling or neutral prime group. Both groups completed the Stroop task but with different types of images. Both versions of the Stroop test included 192 items (48 items x 4 filter colours). In the gambling prime group 24 items were gambling related and 24 neutral. In the neutral prime group the 24 gambling items were replaced with a second set of 24 neutral items (neutral2). The task involved watching a stimulus appearing on the screen and the participant had to report the colour of the filter as fast and as accurately as possible by pressing the corresponding key.

**Stroop viewing 2.** Identical to *Stroop viewing 1* above but with a new stimuli set.

**Time production 2.** Identical to *Time production 1* but with a different stimuli set. This was the last task that used the visual Stroop paradigm in *Study 1*.

**Gambling Task.** Participants had to give their choice of action in four different scenarios where they had to imagine that they were given £250, £40, £25 or £2. These four scenarios were presented in random order and each contained five possible choices, no gamble (0% risk of losing), 1:2 winning odds (50% risk of losing), 1:4 odds (75%

risk of losing), 1:10 odds (90% risk of losing), and 1:100 odds (99% risk of losing). It should be noted that the winning odds were presented and not the losing risk (e.g. "Imagine you have £2, which bet would be willing to make?" choice 1. Bet at 50% chance of winning £4, choice 2. Bet at 25% chance of winning £8 and so on, for more details see Appendix D). Furthermore, there were no instructions on answering as quickly as possible, leaving each participant to answer when they felt comfortable with their choice. Once the choice was recorded for a scenario then the next scenario was presented on the screen.

**Questionnaires.** Instructions for each questionnaire were presented on the screen prior to the questionnaire. All three questionnaires were presented one after the other on the screen and participants reported their answer using keys "0-3" or "1-7" where appropriate. Completing all three questionnaires was the last phase of Study 1 at which point a message was displayed on the screen thanking the participants and notifying them to call the experimenter.

## Results and Discussion

### Questionnaires

The mean scores for all three questionnaires DSM-IV, PGSI, and GACS, were calculated for each participant. We also calculated the means for the three subscales of GACS, *Anticipation, Deisre,* and *Relief.* Two-way ANOVA's were carried out in order to investigate for effect of Prime Group (gambling, neutral). There was a significant effect of Prime Group in DSM-IV scores, $F$ = 4.09, df = 2, $p$ = .047, and the mean scores for the gambling Prime Group (M = 0.67, SD = 1.65) appeared to be higher than the mean scores for the neutral Prime Group (M = .13, SD = 0.4). There was also a significant effect of Prime group in PGSI scores, $F$ = 3.829, df = 2, $p$ = .054, with gambling Prime Group mean M = .93 (SD = 1.45) and neutral Prime Group mean M = .43 (SD = 0.75). These two findings are in line with the literature that reports DSM-IV and PGSI as highly correlating. There was also a significant effect of Prime Group on the *desire* subscale, $F$ = 3.887, df = 2, $p$ = .052, with mean scores, M = 6.17 (SD = 0.99) for the gambling Prime Group, and M = 6.58 (SD = 0.84) for the neutral group (as mentioned above, lower scores in GACS represent higher effect), which reveals a higher desire for gambling in the gambling Prime Group.

**Stroop task**

**Data preparation.** Prior to data analysis we removed all incorrect responses for each participant, this resulted in the loss of 657 cases (originally 15,744 cases, 4.01% wrong responses). We removed outliers defined as ±SD's based on each participant and condition specifin mean; this resulted in 14,757 acceptable cases. Finally, we removed any responses faster than 300ms which led to a final sample containing 14,745 cases, overall reduction of 6.4%.

**Data analysis. A** Two-way ANOVA analysis was carried out on the mean correct reactions times (RT). The Prime Group (gambling, neutral) was a between-subjects factor and Image type (gambling, neutral) was a within subjects factor. There was no significant main or interaction effect either of Priming group or Image type (all F's < 1.042, p> .300). In the gambling Prime Group gambling stimuli were reported with a mean RT of 862ms ( SD = 127.13) and the neutral stimuli with a mean RT of 870ms (SD = 148.45) (overall mean of 867ms, SD = 137.12). In the neutral Prime Group, the neutral were reported with an overall mean RT of 899ms ( SD = 156.17).The common stimuli (the same neutral stimuli that were presented in the gambling Prime Group) had a mean of 898ms (SD = 156.17). The second set of neutral stimuli (these are new neutral items that replaced the gambling items that were shown in the gambling Prime Group) had a mean of 900ms ( SD = 149.42). Furthermore, one-way ANOVA's were carried out to investigate possible slow or fast effects. There were no significant findings (all F's < .704, *p* > .311).

**Fast and slow effects analysis.** For the gambling Prime Group we also analysed correct reaction times in terms of fast and slow effects. The analysis involved a 3-way ANOVA with Prime Group as the between subjects factors, and previous image type (gambling, neutral) and current image type (gambling, neutral) as within subject factors. This analysis did not reveal any significant effects or interactions (all *F*'s < 0.704, all *p*'s > .404)

**Correlational analysis with questionnaires.** Next, correlational analysis was carried out in order to check if higher Stroop interference scores would be associated with stronger explicit measurements in the questionnaires. Two Stroop interference scores were calculated: the fast effect as the difference between gambling and neutral image type when the previous image was neutral, and the slow effect as the difference between previous gambling image and previous neutral image when the current image is neutral. Analysis revealed that the *slow effect* was significantly correlated (marginally) with the *Craving* scores, r = -.28, p = .076, with *Anticipation* subscale scores, r = -.29, p = .058. All other correlations yielded insignificant results. There were no significant correlations between the *fast effect* and the questionnaires (all - .086 < *r*'s < .148)

**Time production**

**Data preparation.** During the initial data collection we noticed that five participants have not stopped the process manually as instructed, they kept doing the task until all possible trials were displayed (four repetitions of 20 stimuli, elapsed time between 60 and 80 seconds). This posed the question whether these specific participants had understood the task and chose to continue or they had not understood the task and kept going until all the trials finished. We decided to exclude these five participants on the basis that we did not have enough evidence on whether they performed the task as instructed. Three of the excluded participants were in the Neutral condition and two in the Gambling condition, resulting in a final count of 37 participants in the Neutral and 40 in the Gambling condition.

**Data analysis.** Two-way ANOVA was carried out on the elapsed recorded durations. Prime group (gambling, neutral) was a between subjects factor and Attempt number (first, second) was a within subjects factor. There were no effects of attempt number or condition (Gambling vs Neutral group), all F's < 0.508. For the Neutral condition, the mean durations of the time productions were, 33.31 seconds (SD = 13.45) and 31.14 seconds (SD = 10.58)for the first and second attempt respectively. For the Gambling condition, the mean durations of the time productions were, 33.52 seconds (SD = 14.27) and 33.62 seconds (SD = 12.45) for the first and second attempt respectively. Furthermore, correlational analysis between first and second attempt revealed a significant correlation for the Gambling condition, $r = .54$, df = 38, $p < .001$ and an insignificant one for the Neutral condition, $r = .227$, df = 38, $p = .177$. These findings imply that in the Neutral condition participants' time perception improves and they produce a second interval closer to 20 seconds. However, in the Gambling condition both attempts are positively correlated and means are similar which could imply that there is interference from the Gambling Stroop that prevents participants from improving their time perception.

**Correlational analysis with questionnaires.** A further correlational analysis was carried out between the time difference of the two attempts (*difference)* and the questionnaire scores in order to investigate possible relationships between participants' performance in the time production task and their explicit responses. The *difference* was calculated by subtracting the *Time production 1* interval from *Time Production 2* interval. Results did not reveal any significant correlations for the Gambling conditions. However, for the Neutral condition the *difference* was significantly correlated with the *desire* subscale, $r = .456$, $p = .005$, and the *DSM* score, $r = -.357$, $p = .03$. Both are negative correlations (lower *desire* scores indicate a higher desire to gamble) suggesting that positive differences are related with reduced *desire* to gamble and lower *DSM* scores.

**Gambling Task**

**Data preparation.** Responses from each participant in each one of the gambling questions were coded as *0%, 50%, 75%, 90%, 99%* for the *"no gamble", "50% chance to win", "25% chance to win", "10% chance to win", "1% chance to win"* respectively. This would allow us to extract mean risk responses per gambling question, with higher values resulting in higher risk taking.

**Data analysis.** A two-way mixed ANOVA was carried out with Task (£250, £40, £25, £2) as within-subjects factor and Prime Group (gambling, neutral) as between-subjects factors. The analysis revealed a significant effect of *Task* (money offered to gamble), $F(3, 240) = 40.541$, $p < .001$. There was no significant interaction between *Task* and *Gambling Condition* $F(3, 240) = 0.279$, $p = .599$. These results suggest that participants are more willing to gamble when the amount of money offered is little and as this amount goes up they take less risks. The means for each *Task* and *Gambling Condition* are summarized in table 2.1. Secondly, chi-square analysis was carried out for each *Task* in order to investigate for significant differences between the Pime Group (gambling, neutral*)*. For the *Tasks* of £250, £25, and £2 there were no significant differences based on Prime group, $\chi^2(4, N = 82) = 2.867$, $p = .58$ , $\chi^2(4, N = 82) = 5.739$, p = 2.19, $\chi^2(4, N = 82) = .467$, p = .98. However, for the *Task* of £40 the responses were different based on prime group, $\chi^2(4, N = 82) = 12.525$, $p < 0.05$. This finding could possibly imply that an amount of money around to £40 could be a sensitivity area in which participants were willing to gamble more when they were in the *Gambling prime Condition*. Perhaps a future repetition of *Study 1* should focus more on finding more details on range of money that people would be more willing to risk gambling.

Table 2.1: Means and standard deviation per money offered and Prime Group

| | Task | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | £250 | | £40 | | £25 | | £2 | |
| Prime Group | M | SD | M | SD | M | SD | M | SD |
| Neutral | .35 | .31 | .63 | .32 | .65 | .32 | .88 | .21 |
| Gambling | .43 | .33 | .65 | .33 | .70 | .33 | .87 | .25 |

**Study 1 synopsis.**

In study 1 we hypothesised that we could detect that gambling stimuli could intrusive cognitions, mainly by affecting performance in the time perception task and also by causing a Stroop effect. However, our findings do not support our hypotheses. One possible explanation could be that gambling stimuli cannot cause such effects in general *healthy* (non-gamblers) population. However, it is also possible that the Stroop task is not suitable to detect these intrusive cognitions or the exposure to gambling stimuli in the Stroop task was not sufficient enough to prime participants for the gambling condition. Analysis of the questionnaires and the gambling task also did not provide evidence of intrusive cognitions than can affect time perception or desire and craving to gamble.

Upon reflecting on the internal clock model we decided that the time production task may not be the appropriate one to detect time perception distortion due to intrusive cognition, furthermore the Stroop task may not be ideal for priming non-gamblers in a gambling condition. Therefore, we decided to proceed with studies 2 and 3 where the time production task was replaced with a time bisection task that is more suitable in detecting different effects due to arousal or emotion.

## Study 2

Following up from *Study 1* we decided to investigate time perception with a task that would be more sensitive in distinguishing between attention and arousal. The main reasoning was that gambling stimuli could either be perceived as threatening stimuli associated with an addiction or as exciting stimuli related to the fun side of casual gambling. Previous work on threatening stimuli (angry faces) (Droit-Volet et al., 2004; Tipples, 2008) has revealed an association between higher arousal and overestimating time intervals. Therefore, perceiving gambling stimuli as threatening should lead to overestimating their duration compared to neutral stimuli. Furthermore, with *Study 2* we wanted to establish a baseline on gambling stimuli and their effect on time perception so we decided to remove any tasks that could have priming effects prior to the time perception task itself. However, we wanted to maintain the investigation between implicit and explicit measures and we kept the three questionnaires as offered in *Study 1*, again at the end of *Study2*

In order to measure the effect of the gambling stimuli on time perception we decided to adopt a well-used paradigm that has demonstrated robust efficiency in discriminating between the effects of attention and arousal. We adopted the time bisection task as used in a number of studies (Droi-Volet et al., 2004; Tripples, 2008; Kramer et al., 2013) using neutral and gambling related stimuli. We hypothesized that if participants would find the gambling stimuli threatening they should overestimate their duration compared to neutral stimuli, whereas if they would find them exciting they should underestimate their duration compared to the neutral ones.

## Method

### Participants

Forty-five participants, (age range 18-37, mean age = 20.20, SD = 2.9, 37 females, eight males) were recruited via the Kent Psychology RPS website and were awarded with 2 RPS credits for their participation.

**Design**

The design involved was a Duration (400, 600, 800, 1000, 1200, 1400, or 1600ms) x Image Type (gambling or neutral) within-subjects design followed up by the DSM-IV, PGSI, and Craving questionnaire. The dependent measure were the proportion of "long" responses as it will be described in the *Procedure* and *Results* sections and the responses from the questionnaires.

**Materials**

Following a similar design as in Kramer et al., (2013), we selected three neutral images and three gambling related images from the images used in *Study 1*. However, this time the images were left in their natural colours and were presented on 1,024 x 768 pixels frame. Regarding hardware and software, the same equipment was used as in *Study 1*, however Psychopy v1.78 was used for creating the program that would display the images on the screen for reasons that were explained earlier. The three questionnaires were adopted and used as in *Study 1* too.

**Procedure**

Similarly with *Study 1* all participants had to sign a consent form after their briefing and complete a demographics short questionnaire. Then the experimenter escorted the participants in an individual cubicle and provided them with general instructions. The experiment involved three tasks, with the first two being practice tasks and the third one the main test task. For the first practice task an image (neutral) would appear on the screen for either "short", 400ms, or "long", 1600ms, duration. Once the image would disappear the participant would have to press either "S" for short or "L" for long. After the response an inter-trial interval varying randomly between 1 and 3 seconds would follow. The sequence was predetermined to be S-L-S-L-S-L-S-L-S-L during the first practice.

For the second practice task again the same image would appear on the screen for either 400ms or 1600ms. This time the sequence was random and feedback was displayed on the screen after each response for either "correct" or "incorrect" response. The feedback was displayed for 2 seconds followed by an inter-trial interval varying randomly between 1 and 3 seconds. This task would continue until the participant would give eight consecutive correct responses. The experimenter remained in the cubicle for both the first two tasks. Instructions for the third task were shown on the screen and once the participant would respond that instructions are clear and understood the experimenter would leave the cubicle.

For the main test task all six images (three neutral – three gambling) would be displayed on the screen for the seven durations of 400, 600, 800, 1000, 1200, 1400, and 1600ms in random order. That created 42 trials which were repeated three times, resulting in a final total of 126 trials. The participant was asked again to respond if the duration was perceived as "short" or "long" by pressing "S" or "L" respectively. Similarly with the practice tasks there was an inter-trial interval varying randomly between 1 and 3 seconds. However, there was no feedback after the participant responded.

Upon completion of the main task the experimenter would return to the cubicle to initiate the computerized form of the three questionnaires. Once all three questionnaires were completed a message was displayed that the study was concluded. Other than the natural time gap occurring between the main task and the loading of the questionnaires there were no other breaks between steps.

## Results and Discussion

### Bisection Task

**Data preparation.** Following the methodology on analysing data for the bisection task (Tipples, 2008) prior to the data analysis *d'* scores, bisection point (BP), and Weber ratio (WR) (Gibbon, 1977; Gibbon, Church, and Meck, 1984) were calculated. Weber's ratio corresponds to the smallest possible change that could a significant change in behaviour. In time perception it refers to the smallest possible change in duration that will be noticeable. Lower WR scores refers to a high degree of discriminability, indicating that an individual can detect smaller changes (Kopec and Brody, 2010). First, we acquired the z scores for the ratio of long responses. We then calculated the differences *d'*, by subtracting the z score of the neutral images from the z score of the gambling images. Positive values of *d'* would reflect an overestimation for the duration of the gambling stimuli compared to the neutral stimuli.

We then calculated the BP for each participant and each type of stimuli by using probit analysis, looking for the point where *p(long)* = .5 would be achieved, meaning 0.5 ratio of long responses. Finally we calculated WR by subtracting *p*(*long*[.25]) from *p*(*long*[.75]) and then dividing that difference by 2, we then divided again by BP (Tipples, 2008). During this stage the probit analysis would not yield any results on two participants and despite out attempts to interpret why we did not come to a conclusion, therefore these two participants were excluded from the analysis.

**Data analysis.** One-way ANOVA analysis for the seven duration d' scores did not reveal any significant effects (all $F < 0.01$, $p > 0.9$). For both the BP ($t = -0.539$, df = 41, $p > .593$) and WR ($t = -0.116$, df = 41, $p > .253$) indices there were no significant differences between the gambling and neutral images. The means for BP and WR are presented in table 2.2.1

Table 2.2.1 Means and standard deviations for BP and WR per image type

| Index | Image type | M | *SD* |
|---|---|---|---|
| BP | Gambling | 1009.86 | 217.55 |
| | Neutral | 1021.5 | 190.36 |
| WR | Gambling | 177.15 | 67.88 |
| | Neutral | 194.02 | 69.56 |

The above findings suggest that there was no effect of attention or arousal from the gambling images during the time bisection task.

**Correlational analysis with questionnaires.** For both the BP and WR indices we calculated the differences between the gambling and neutral image type (*dBR* and *dWR*). We then ran correlational analysis to look for possible relations between the two differences and the questionnaire results. There were no significant relations between the differences and the questionnaire results, findings are presented in table 2.2.2

Table 2.2.2 Correlations for difference of BP, difference of WR, Craving, DSM, and PGSI

| | *dWR* | Craving overall | Craving anticipation | Craving desire | Craving relief | DSM | PGSI |
|---|---|---|---|---|---|---|---|
| *dBP* | .178 | .112 | .145 | .169 | -.021 | -.136 | -.077 |
| *dWR* | | -.026 | -.085 | .035 | -.029 | .073 | .019 |
| Craving | | | .629** | .919** | .884** | -.248 | -.215 |
| Anticipation | | | | .387** | .291 | -.293 | -.213 |
| Desire | | | | | .796** | -.153 | -.236 |
| Relief | | | | | | -.193 | -.092 |
| DSM | | | | | | | .786** |

**. Correlation is significant at the 0.01 level (2-tailed).

**Study 2 synopsis.**

In *study 2* we hypothesised that if gambling stimuli were found as exciting or threatening that would have led to distorted time perception by either underestimating or overestimating time perception. However, our results did not reveal any distorted time perception which seems to be in line with *study 1* where we did not observe any Stroop effect or increased willingness to gamble. These findings suggest that gambling related stimuli do not tend to lead to intrusive cognitions. The benefit of *study 2* was that it allows us to establish a baseline removing any priming tasks. In order to draw safer conclusions regarding the role of priming, and compare with the results of *study 1*, we thought it would be useful to implement a more explicit priming task (in contrast to the more implicit priming task, Stroop, used in *study 1*). This could also allow us to draw conclusions and generalise about how time perception is affected when we are in a gambling environment (e.g. casino, or online poker game).

## Study 3

The results from *Study 2* suggest that gambling stimuli are not salient enough to cause *intrusive cognitions* that could affect time perception. As a follow-up we decided to investigate if priming could result in distorted time perception. Priming in general could be defined as an effect to subsequent responses as a result of exposure to specific stimuli (Thush et al., 2007). Priming can be accomplished with a variety of tasks that involve reading, watching stimuli, interacting with objects and usually individuals who are primed adopt a behaviour that is in line with the prime (Rodriguez, Neighbors, and Foster, 2014). This is probably due to activation of specific constructs that are associated with the priming cues and will later affect behaviour.

Priming has been used in addiction related research, for example alcohol related stimuli can prime individuals and activate alcohol related constructs resulting in speeding up responses to alcohol pictures (Duka and Townshend, 2004). The previous is a typical example of priming leading to attentional bias to alcohol related stimuli. Furthermore, a priming task can have the effect of placing an individual in specific mind-set that could even be unrelated to the priming stimuli (Hansen and Trope, 2013). We argue then that a priming task, with gambling related stimuli, could affect time perception, either directly by making gambling stimuli more salient thus leading to attentional biases, or indirectly by triggering a mind-set that can affect time perception as research has shown that mind-set can be a factor on how we perceive time (Kramer, Weger, and Sharma, 2013; Hansen and Trope, 2013).

## Method

### Participants

Seventy-two participants (age 18-46, mean age = 19.6, SD = 3.41, 60 females, 12 males) were recruited via the Kent Psychology RPS website and were awarded 2 RPS credits for their participation.

### Design

The experiment was defined by five factors Duration (400, 600, 800, 1000, 1200, 1400, or 1600ms) x Image Type (gambling, neutral) x Prime Group (gambling, profession) x Session (first, second). Duration, Image Type, and Session were within-factors whereas Prime Group was between-subjects factor.

## Materials

The images used for the time bisection task were the same as in *Study 2* (refer to *Study 2* for details on stimuli and software used). For the Prime Group task we collected 19 words that could be associated with gambling or not (e.g., “raise”, “card”, “red”, for a list of all words see Appendix E). We selected the words using the images from *Study 1* as starting point the words selected represent characteristics that can be found in these images.

## Procedures

The experiment consisted of four separate stages. In the first stage participants had to perform the time bisection task exactly as described in the *procedure* section in *Study 2.* Once the bisection task was completed the experimenter would present an A4 sheet containing the 19 words and instruct the participants to write next to each word either a gambling related word (gambling Prime Group) or profession that is related to the given word (profession Prime Group). There was time restriction; however participants were instructed to try not to repeat words, unless they genuinely could not find another word. Once they completed the priming task they had to run the time bisection task one more time. Finally, after completing the time bisection task for the second time they had to complete the three questionnaires (DSM-IV, PGSI, and GACS

# Results and discussion

## Bisection Task

**Data preparation**. Following the same methodology as in *Study 2* we calculated *d’* scores, bisection point (BP), and Weber ratio (WR) for the *first* and *second* Attempt (Tipples, 2008).

**Data analysis**. A three-way ANOVA was carried out on the *z*-scores, BP, and WR values. As described in the *design* section, Session and Duration were within-subjects factors, whereas Prime Group was between-subjects factor. There was a main effect of priming on the *z*-scores with $F(1, 70) = 4.480$, $p = .038$. The means for *z*-scores were M = .075 (SE = 0.05) for the *profession* Prime Group, and M = -0.071 (SE = 0.05). No other main effects or interactions were significant (all $F$’s < 1.663, $p$’s > .129).

These results reveal an overestimation of time duration across all duration in the *profession* Prime Group compared to the *gambling* Prime Group.

There was also a main effect of Session on the BP scores with $F(1,70) = 2.849$, $p = .096$. The BP mean values were, M = 986.35 (SE = 22.58) for the *first* Session and M = 849.82 (SE = 81.55) for the *second* Session. No other main effects or interactions were significant (all *F*'s < 1.181, *p*'s > .25). These findings suggest that all participants perceived time to pass faster in the second session (as BP point was reached faster) compared to the first one.

Furthermore, there was a main effect of Session on WR scores with $F(1, 70) = 9.954$, $p = .002$. The WR mean values were, M = 0.208 (SE = 0.014) for the *first* Session and M = .254 (SE = 0.024) for the *second* Session. The findings suggest that priming decreases participants' discriminability.

**Questionnaires and correlational analysis.** Two-way ANOVA's were carried out to investigate possible main effects of Prime Group (profession, gambling) on each one of the questionnaires. There was a significant main effect of Prime Group on Anticipation with $F(1, 70) = 6.482$, $p = .013$. The mean anticipation score for the gambling Prime Group was M = 4.66 (SD = 1.68) and for the profession Prime Group M = 5.61 (SD = 1.48). There was also a significant main effect of Prime Group on DSM with $F(1, 70) = 3.383$, $p = .070$. The mean DSM score for the gambling Prime Group was M = 0.81 (SD = 0.12) and for the profession Prime Group M = 0.37 (SD = 0.07).

Furthermore, we calculated the differences for BP and WR per session and image type and ran correlational analyses between these scores. The results are summarised in Tables 3.1 to 3.4

Table 3.1: Pearson Correlations for gambling Prime Group between WR scores and questionnaires. D_WRG and D_WRN correspond to the differences between WR scores for gambling and neutral stimuli.

| | D_WRN | Craving | Anticipation | Desire | Relief | DSM | PGSI |
|---|---|---|---|---|---|---|---|
| D_WRG | -.196 | .089 | .135 | -.020 | .077 | -.241 | -.087 |
| D_WRN | | -.015 | .052 | .166 | -.343* | .295 | -.062 |
| Craving | | | .911** | .882** | .763** | -.367* | -.162 |
| Anticipation | | | | .691** | .500** | -.511** | -.314 |

| | | | |
|---|---|---|---|
| Desire | .634** | -.132 | -.057 |
| Relief | | -.161 | .099 |
| DSM | | | .553** |

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3.2: Pearson Correlations for profession Prime Group between WR scores and questionnaires D_WRG and D_WRN correspond to the differences between WR scores for gambling and neutral stimuli.

| | D_WRN | Craving | Anticipation | Desire | Relief | DSM | PGSI |
|---|---|---|---|---|---|---|---|
| D_WRG | .035 | .108 | -.036 | .075 | .311 | .069 | -.032 |
| D_WRN | | -.397* | -.192 | -.482** | -.406* | -.111 | -.063 |
| Craving | | | .832** | .908** | .794** | -.091 | -.279 |
| Anticipation | | | | .578** | .363* | -.406* | -.499** |
| Desire | | | | | .817** | .117 | -.101 |
| Relief | | | | | | .238 | .039 |
| DSM | | | | | | | .501** |

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3.3: Pearson Correlations for gambling Prime Group between BP scores and questionnaires. D_BPG and D_BPN correspond to the differences between BP scores for gambling and neutral stimuli

| | D_BPN | Craving | Anticipation | Desire | Relief | DSM | PGSI |
|---|---|---|---|---|---|---|---|
| D_BPG | -.300 | -.153 | -.165 | -.069 | -.145 | .095 | .078 |
| D_BPN | | .083 | .144 | .124 | -.127 | .437** | -.031 |
| Craving | | | .911** | .882** | .763** | -.367* | -.162 |
| Anticipation | | | | .691** | .500** | -.511** | -.314 |
| Desire | | | | | .634** | -.132 | -.057 |
| Relief | | | | | | -.161 | .099 |
| DSM | | | | | | | .553** |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 3.4: Pearson Correlations for profession Prime Group between BP scores and questionnaires D_BPG and D_BPN correspond to the differences between BP scores for gambling and neutral stimuli

| | D_BPN | Craving | Anticipation | Desire | Relief | DSM | PGSI |
|---|---|---|---|---|---|---|---|
| D_BPG | .563** | .269 | .332 | .146 | .148 | -.104 | -.158 |
| D_BPN | | .213 | .266 | .021 | .210 | -.178 | -.205 |
| Craving | | | .832** | .908** | .794** | -.091 | -.279 |
| Anticipation | | | | .578** | .363* | -.406* | -.499** |
| Desire | | | | | .817** | .117 | -.101 |
| Relief | | | | | | .238 | .039 |
| DSM | | | | | | | .501** |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

**Study 3 synopsis.**

In *study 3* we wanted to investigate whether a gambling related state of mind would affect time perception. We found that there was a main effect across both priming conditions which could probably mean that discovered a practice effect that is more related to the repetition of the time perception task itself than the priming task. Results also suggest that time discriminability was reduced, but again this was across both groups, which suggests that it could be a practice effect. Finally, the analysis of *z*-scores suggests that participants underestimated time duration when in the *gambling* condition compared to when in the *profession* condition. This could be an interesting finding as it suggests that we do have distorted time perception when primed for gambling, however this was not supported by our BP's and WR's analysis and it needs to be investigated more before we draw safer conclusions.

## General Discussion

The present research investigated whether gambling related stimuli could lead to *intrusive cognitions*. More particularly we looked for possible interference due to gambling stimuli either on the task at hand or for interference that was carried over to following tasks. In *Study 1* we used a gambling modified Stroop task that served both as measurement of direct *gambling intrusive cognitions* and as a priming gambling mechanism for following up tasks. There were no findings that could indicate the presence of either a *fast* or *slow effect* suggesting that the gambling stimuli were not salient enough for such an effect as literature suggests regarding addiction or emotional Stroop (e.g. Blanchete and Richards, 2013). There was however a significant correlation with *Craving* and *Anticipation.* This was a rather interesting finding as it suggests that gambling stimuli could have a slower carried over effect and even though they did not interfere with the Stroop test they managed to increase *Craving* and *Anticipation* to gamble.

This could be in line with the EI theory that suggests that in the presence of cues a loop is initiated that could lead to desire thoughts for gambling. This finding is further reinforced by some of the results from the time production task in *Study 1*. Even though there were no significant effects of gambling stimuli on the duration of the intervals that were produced there was a significant correlation between first and second attempt for participants who belong to the gambling Prime Group. For the neutral Prime Group no such significant correlation was found. This could suggest that in the neutral Prime Group the two attempts were not correlated because participants improved and were more accurate in the second attempt. The same could not be said for the gambling Prime Group revealing perhaps an interference that prevented them from improving, possibly due to cognitive resources being used by the desire thoughts that we mentioned above.

We also argued that a possible effect of these *intrusive cognitions* would be to make participants gamble more, or take bigger risks. Such an effect was not observed overall, as we mainly saw the amount of money as a decisive factor. However, there was a significant difference between gambling and neutral Prime Group when the amount of money was £40. This could suggest that the specific amount of money could perhaps be a sensitivity boundary that participants were more willing to gamble. It would be interesting in further replications of *Study 1* to focus on sums that are closer to £40 and see how people will behave.

Finally the GACS questionnaire revealed a significant difference in *Desire* scores between the gambling and neutral Prime Group. Again this could be another indication that gambling stimuli presented in the Stroop test, although they did not produce any Stroop effects, could possibly produce an effect that was slower to develop and was materialised in subsequent tasks as the EI theory proposes. The above provide substantial reasons for examining more the effects on gambling Stroop on subsequent tasks in future studies.

In *Study 2* we wanted to investigate whether gambling stimuli could affect time perception without the presence of previous priming mechanisms (like the gambling Stroop task used in *Study 1*). We based our hypothesis mainly on previous research that showed that threatening stimuli can affect the *pacemaker* and exciting stimuli can affect the *mode switch* (e.g. Droit-Volet, 2004). For this reason we used a time bisection task and not a time production task, since the first has the ability to better discriminate between arousal and attention effects on time perception.

However, we did not find any evidence that gambling stimuli can affect time perception in a time bisection task. Similarly to *Study 1* gambling stimuli were not salient enough to lead to immediate *intrusive cognitions.* In addition, we did not observe any significant correlations between BP, WR *Craving*, DSM, and PGSI questionnaires. This could suggest that the task itself could not initiate *intrusive cognitions* that could lead to desire thought as proposed in the EI theory. One explanation could be that in the gambling Stroop participants in the gambling Prime Group would see a total of 96 gambling related stimuli whereas in the time bisection task there were only 63 presentations of gambling stimuli (if we take into consideration all durations). So perhaps the number of stimuli or the total exposure time to gambling stimuli were not enough either to initiate desire thoughts or maintain them. Another explanation could be that in gambling Stroop task participants were instructed to respond as fast and as accurately as possible, which could have resulted in them being more focused and allocated more attentional resources on the task.

Having established that gambling stimuli could not have an immediate effect on time perception we wanted to investigate whether priming would facilitate *intrusive cognitions*. Our hypothesis was based on research suggesting that priming can have an effect on attentional bias in both problem and social drinkers (Clarke, Sharma, and Salter, 2014) and self-reported drinking can prime participants and affect their responses (Rodriguez, Neighbors, and Foster, 2014). Furthermore, the mind-set that we are in could have an effect on time perception (e.g. Hansen, and Trope, 2013; Kramer, Weger, and Sharma, 2013).

Firstly, we observed an overall shift to the right for the *z*-scores for the gambling Prime Group compared to the profession Prime Group. The fact that there was no interaction with the Image Type indicated that participants that were in the gambling Prime Group underestimated time compared to participants in the profession Prime Group. Furthermore, session affected both the overall BP and WR scores. BP was lower in the second session indicating that the priming task made participants overestimate durations. The fact that there was no interaction with the type of priming suggests that these changes are not due to making gambling stimuli more salient but more due to creating a specific mind-set that was common in both Prime Groups.

This is reinforced even more by the fact that there was also a main effect of session on WR. This time WR increased from *first* to *second* session, making participants less able to detect smaller changes in durations. Again there was no interaction present with the Prime Group. So we have the image of participants overestimating time and at the same time reducing their discriminability. As mentioned above, these findings are more in line with the mind-set explanation than with perceiving gambling stimuli as threatening or exciting. Overestimating time means people are rather in an abstract mind-set than a concrete one which suggests that our priming tasks probably created an abstract mind-set rather than increasing the salient of gambling stimuli.

However, this is not a clear implication as our priming task was not designed for creating an abstract or concrete mind-set. It is therefore vital to replicate *Study 3* making the priming task even more specific and control for abstract and concrete mind-set. A different explanation for this universal change in time perception (regardless of specific Prime Group) could be that the original words could still create gambling cues even though participants had to think of *professions* since they are related to gambling. Therefore, another alternative for future research could be to select a different priming task that can clearly distinguish between gambling priming and non-gambling priming. Another dimension that is worth investigating in the future is that of the emotion in gambling where we could present positive or negative gambling stimuli. That way we could compare the results directly with findings from the study of the effect of emotion in time perception.

A possible limitation for this research could be the fact that there no validated gambling stimuli that could be used, which could imply that the findings depend on selected stimuli. The items used in the three studies though were items that are commonly associated with gambling (see also conclusion section regarding stimuli limitations). Furthermore, our participants were mostly 18 and 19 years old possibly with not many gambling experiences (either positive or negative). Therefore, it would be ideal to replicate the studies with older participants or include questionnaires that measure participation in gambling and attitudes towards gambling.

**Conclusion.**

The main aim of this research was to establish whether gambling stimuli can lead to *intrusive cognitions* which can result in distorted time perception and increased craving for gambling. Despite the use of different time perception and priming tasks we did not find evidence that gambling stimuli can cause such *intrusive cognitions*. One possible limitation of our methodology was that we used pictorial stimuli which someone could argue that they are ecologically more valid than words when it comes to gambling.

Given the fact that no prior work was done on time perception and gambling, to the knowledge of the author, there was no valid collection of pictorial stimuli that we could have used for our studies. This led us to create our own stimuli. Even though we tried to match the gambling related stimuli with neutral stimuli with regards to geometrical and colour features in every image one could still argue that these images could be unmatched in other aspects (e.g. emotional impact or arousal). Therefore, future studies could try to replicate the methodology used but with words instead of images.

The above mentioned lack of conclusive evidence, the possible limitations with the use of pictorial stimuli over words and the lack of prior work on the use of time bisection task with gambling stimuli suggest that the findings of this research thesis should be view as informative and not conclusive. Future research is needed to address the above mentioned issues before we can draw safer conclusions on whether gambling stimuli can cause *intrusive cognitions* to non-gamblers.

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Appendix A

## DSM-IV gambling questionnaire

In the last 12 months…

When you gamble, how often do you go back another day to win back money you lost?

Every time I lost Most of the time I lost Some of the time I lost Never

How often have you found yourself thinking about gambling

Very often Fairly often Occasionally Never

Have you needed to gamble with more and more money to get the excitement you are looking for?

Very often Fairly often Occasionally Never

Have you felt restless or irritable when trying to cut down gambling?

Very often Fairly often Occasionally Never

Have you gambled to escape from problems or when you are feeling depressed, anxious or bad about yourself?

Very often Fairly often Occasionally Never

Have you lied to family, or others, to hide the extent of your gambling?

Very often Fairly often Occasionally Never

Have you made unsuccessful attempts to control, cut back or stop gambling?

Very often Fairly often Occasionally Never

Have you committed a crime in order to finance gambling or to pay gambling debts?

Very often Fairly often Occasionally Never

Have you risked or lost an important relationship, job, educational or work opportunity because of gambling?

Very often Fairly often Occasionally Never

Have you asked others to provide money to help with a desperate financial situation caused by gambling?

Very often Fairly often Occasionally Never

# Appendix B

## PGSI questionnaire

In the last 12 months how often…

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

Almost always Most of the time Some of the time Never

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

Almost always Most of the time Some of the time Never

Have you gone back to try to win back the money you'd lost?

Almost always Most of the time Some of the time Never

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

Almost always Most of the time Some of the time Never

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

Almost always Most of the time Some of the time Never

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

Almost always Most of the time Some of the time Never

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

Almost always Most of the time Some of the time Never

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

Almost always Most of the time Some of the time Never

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

Almost always Most of the time Some of the time Never

Appendix C

**GACS Questionnaire**

Gambling would be more fun right now

1. Strongly Agree 2. Agree 3. Agree somewhat 4. Undecided

5. Disagree somewhat 6. Disagree 7. Strongly Disagree

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

1. Strongly Agree 2. Agree 3. Agree somewhat 4. Undecided

5. Disagree somewhat 6. Disagree 7. Strongly Disagree

I would not enjoy gambling right now

1. Strongly Agree 2. Agree 3. Agree somewhat 4. Undecided

5. Disagree somewhat 6. Disagree 7. Strongly Disagree

I crave gambling right now

1. Strongly Agree 2. Agree 3. Agree somewhat 4. Undecided

5. Disagree somewhat 6. Disagree 7. Strongly Disagree

I need to gamble right now

1. Strongly Agree 2. Agree 3. Agree somewhat 4. Undecided

5. Disagree somewhat 6. Disagree 7. Strongly Disagree

I have an urge to gamble

1. Strongly Agree 2. Agree 3. Agree somewhat 4. Undecided

5. Disagree somewhat 6. Disagree 7. Strongly Disagree

If I were gambling right now, I could think more clearly

1. Strongly Agree 2. Agree 3. Agree somewhat 4. Undecided

5. Disagree somewhat 6. Disagree 7. Strongly Disagree

I could control things better right now if I could gamble

1. Strongly Agree 2. Agree 3. Agree somewhat 4. Undecided

5. Disagree somewhat 6. Disagree 7. Strongly Disagree

Gambling would make me less depressed

1. Strongly Agree 2. Agree 3. Agree somewhat 4. Undecided

5. Disagree somewhat 6. Disagree 7. Strongly Disagree

## Appendix D

Scenario 1 (note that each participant would be randomly presented with one of the five different variations)

Imagine you have £250, which bet would you be willing to make?

1. No bet. Keep the £250
2. Bet at 50% chance of winning £500
3. Bet at 25% chance of winning £1,000
4. Bet at 10% chance of winning £2,500
5. Bet at 1% chance of winning £25,000

Imagine you have £250, which bet would you be willing to make?

1. Bet at 1% chance of winning £25,000
2. No bet. Keep the £250
3. Bet at 50% chance of winning £500
4. Bet at 25% chance of winning £1,000
5. Bet at 10% chance of winning £2,500

Imagine you have £250, which bet would you be willing to make?

1. Bet at 10% chance of winning £2,500
2. Bet at 1% chance of winning £25,000
3. No bet. Keep the £250
4. Bet at 50% chance of winning £500
5. Bet at 25% chance of winning £1,000

Imagine you have £250, which bet would you be willing to make?

1. Bet at 25% chance of winning £1,000
2. Bet at 10% chance of winning £2,500
3. Bet at 1% chance of winning £25,000
4. No bet. Keep the £250
5. Bet at 50% chance of winning £500

Imagine you have £250, which bet would you be willing to make?

1. Bet at 50% chance of winning £500
2. Bet at 25% chance of winning £1,000
3. Bet at 10% chance of winning £2,500
4. Bet at 1% chance of winning £25,000
5. No bet. Keep the £250

Scenario 2 (note that each participant would be randomly presented with one of the five different variations)

Imagine you have £40, which bet would you be willing to make?

1. No bet. Keep the £40
2. Bet at 50% chance of winning £80
3. Bet at 25% chance of winning £160
4. Bet at 10% chance of winning £400
5. Bet at 1% chance of winning £4,000

Imagine you have £40, which bet would you be willing to make?

1. Bet at 1% chance of winning £4,000
2. No bet. Keep the £40
3. Bet at 50% chance of winning £80
4. Bet at 25% chance of winning £160
5. Bet at 10% chance of winning £400

Imagine you have £40, which bet would you be willing to make?

1. Bet at 10% chance of winning £400
2. Bet at 1% chance of winning £4,000
3. No bet. Keep the £40
4. Bet at 50% chance of winning £80
5. Bet at 25% chance of winning £160

Imagine you have £40, which bet would you be willing to make?

1. Bet at 25% chance of winning £160
2. Bet at 10% chance of winning £400
3. Bet at 1% chance of winning £4,000
4. No bet. Keep the £40
5. Bet at 50% chance of winning £80

Imagine you have £40, which bet would you be willing to make?

1. Bet at 50% chance of winning £80
2. Bet at 25% chance of winning £160
3. Bet at 10% chance of winning £400
4. Bet at 1% chance of winning £4,000

5. No bet. Keep the £40

Scenario 2 (note that each participant would be randomly presented with one of the five different variations)

Imagine you have £25, which bet would you be willing to make?
1. No bet. Keep the £25
2. Bet at 50% chance of winning £50
3. Bet at 25% chance of winning £100
4. Bet at 10% chance of winning £250
5. Bet at 1% chance of winning £2,500

Imagine you have £25, which bet would you be willing to make?
1. Bet at 1% chance of winning £2,500
2. No bet. Keep the £25
3. Bet at 50% chance of winning £50
4. Bet at 25% chance of winning £100
5. Bet at 10% chance of winning £250

Imagine you have £25, which bet would you be willing to make?
1. Bet at 10% chance of winning £250
2. Bet at 1% chance of winning £2,500
3. No bet. Keep the £25
4. Bet at 50% chance of winning £50
5. Bet at 25% chance of winning £100

Imagine you have £25, which bet would you be willing to make?
1. Bet at 25% chance of winning £100
2. Bet at 10% chance of winning £250
3. Bet at 1% chance of winning £2,500
4. No bet. Keep the £25
5. Bet at 50% chance of winning £50

Imagine you have £25, which bet would you be willing to make?
1. Bet at 50% chance of winning £50
2. Bet at 25% chance of winning £100
3. Bet at 10% chance of winning £250
4. Bet at 1% chance of winning £2,500

5. No bet. Keep the £25

Scenario 2 (note that each participant would be randomly presented with one of the five different variations)

Imagine you have £2, which bet would you be willing to make?
1. No bet. Keep the £2
2. Bet at 50% chance of winning £4
3. Bet at 25% chance of winning £8
4. Bet at 10% chance of winning £20
5. Bet at 1% chance of winning £200

Imagine you have £2, which bet would you be willing to make?
1. Bet at 1% chance of winning £200
2. No bet. Keep the £2
3. Bet at 50% chance of winning £4
4. Bet at 25% chance of winning £8
5. Bet at 10% chance of winning £20

Imagine you have £2, which bet would you be willing to make?
1. Bet at 10% chance of winning £20
2. Bet at 1% chance of winning £200
3. No bet. Keep the £2
4. Bet at 50% chance of winning £4
5. Bet at 25% chance of winning £8

Imagine you have £2, which bet would you be willing to make?
1. Bet at 25% chance of winning £8
2. Bet at 10% chance of winning £20
3. Bet at 1% chance of winning £200
4. No bet. Keep the £2
5. Bet at 50% chance of winning £4

Imagine you have £2, which bet would you be willing to make?
1. Bet at 50% chance of winning £4
2. Bet at 25% chance of winning £8
3. Bet at 10% chance of winning £20

4. Bet at 1% chance of winning £200
5. No bet. Keep the £2

# Appendix E

List of the 19 words used for the priming task in *Study 3* and sample of replies depending on the Prime Group

| | Gambling Prime Group | Profession Prime Group |
|---|---|---|
| Raise | Auction | engineer |
| Chair | Dealer | mechanic |
| Table | Blackjack | teacher |
| Money | Gamble | CEO |
| Chips | Poker | manager |
| Coins | Slot machine | banker |
| Lose | Broke | lawyer |
| Card | Suit | accountant |
| Risk | Loss | surgeon |
| Twenty-one | Win | physician |
| Straight | M | doctor |
| Black | Spades | Police officer |
| Red | Diamonds | chemist |
| Spin | Black | ballerina |
| Zero | Green | doctpr |
| Ball | White | athlete |
| Numbers | Counting cards | mathematician |
| Pot | Play | chef |
| Joker | cards | entertainer |