



UNIVERSIDADE CATÓLICA PORTUGUESA

Internet gambling

The effects of colours and sounds on decision making

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Abstract

Internet gambling is a very popular way of gambling. People can gamble anytime and everywhere, at home, at their job, in a public library and 24 hours a day, with only a device connected to the internet. With this new type of gambling some questions emerge. How different is gambling online and gambling in the traditional houses? How different are the structural characteristics frames of those two distinct forms of gambling? Having that in mind, we investigate the effects of two structural characteristics – colour and sound – on gamblers behavior. We found that the colour effect seems to increase the psychological salience of losses in online gambling and this triggers in the gambler an attempt to recover previous losses.

Keywords: internet; gambling; colour; sound; experimental research.

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1. Introduction

1.1 Framing online gambling

1.1.1 The market: Global and European

The global gaming sector generated a Gross Gaming Revenue (GGR – stakes minus winnings) of €275 billion, in 2010. The European Union (EU) had a market share of 29% of the global gaming market with a GGR of €80 billion (European Commission, 2012).

Online gambling is a growing and dynamic sector in EU28. It represented about 13% of the total gaming market in 2013 and it is expected to raise to 15%, in 2015 (European Gaming & Betting Association, 2014).

In 2013, the European market was the e-gaming market worldwide leader, which represented 47,4% of the total of €26,6 billion gross win (European Gaming & Betting Association, 2014). This leadership position might be explained due to legal restriction on online gambling in USA and Asia. Online gambling is illegal in the USA and in the majority of the Asian countries. Online gambling is also illegal in some of the EU28 (Portugal, Luxemburg, Sweden, Finland, Lithuania, Romania, Hungary, Poland, Czech Republic and Slovenia) and it is forbidden in Germany (Academia das Apostas, 2012). Nevertheless, it is expected, a raise in gross win of 10,9 to 13,27 billion Euros (European Gaming & Betting Association, 2014) for the period 2013-2015.

In Europe, the sports bets are the most popular form of online gambling with 29% of the total online gambling, followed by 20% of online poker and 20% of online casino (European Gaming & Betting Association, 2014).

Figure 1 shows the countries with the biggest GGR among all Member State in 2011.



Figure 1: GGR online gambling per Member State in 2011

Source: European Commission, 2012

There is a huge difficulty in obtaining precise data regarding online gambling, mainly due to the fact that online gambling is not regulated in all the EU Members. In those countries where gambling is illegal no data exists or is provided. In addition, online gambling has a cross-border dimension, which creates hardships in knowing the players' country of origin. In fact, gamblers can be physically located in one country but betting with an IP from another country.

1.2 Responsible Gambling

The European Gaming and Betting Association is the body representing the leading online gaming and betting operators established, licensed and regulated within the European Union (EGBA standards, 2011).

The first of his 9 principles that all the members have to meet is about promotion of responsible gambling and betting:

“The EGBA Members are committed to promoting socially responsible gambling and betting, and working with customers, employees and relevant industry stakeholders to help manage and control problem gambling. EGBA

Members will ensure that proper controls are established, implemented, and enforced, and that gambling and betting takes place in a responsible gaming and betting environment” (EGBA standards, 2011).

To achieve these standards, the online betting houses have to promote the responsible gambling on their homepages, with a link to a website where they explain the risks that gamblers took when they become addicts.

They also have to meet some rules with the end of reduce pathological gambling like having a visible clock all the time, do not permit credit to the gambler and allow the gambler to set bet limits (EGBA standards, 2011).

Some gambling houses support research projects related to responsible gambling.

1.3 Online Gambling

As said before, online gambling is still a small percentage of the global gambling sector. However, some factors make the growth of the online gambling something we can count of (European Commission, 2006).

The boom of online gambling does not come with the decrease of the traditional gamble houses, because traditional gamblers continue to gamble in the traditional way (in land based houses). Online gambling houses created an opportunity for the rising of new gamblers, the house gamblers that do not have the motivation to drive to a casino to gamble but in the comfort of their home they gamble using the internet (Wood and Williams, 2007). There are several reasons for the preference for online houses: convenience, comfort and ease (it can be done at home, sitting on a sofa); the anonymity and privacy, because some gamblers have aversion of casino's environment or even because gamblers want to have secret profiles while gambling; online venues tend to offer better pay-out ratios; and because some types of online gambling do not have land based equivalent, like betting exchanges (Wood and Williams, 2007). Moreover, Griffiths (1999a) provides another reason for the use of online platforms: high-developed e-cash systems that permit to transfer or withdraw money in seconds, and also the multi-lingual service and the faster play speed.

1.3.1 Specific games and their interactive nature

In the "Industry Statistics - April 2009 to September 2013", the UK Gambling Commission propose a five main types of category for remote gambling: general betting, pool betting, bingo, casino and betting exchange.

General betting in remote gambling is the same type of gambling (e.g. sports, dogs, horses) that exists in traditional gambling houses where people can bet on

an event that will occur like who is going to win a football match or which horse is going to win the race. Pool betting is a type of gambling similar to general betting but in which, instead of using fixed odds against the house, all money bet on the result of an event by a number of people goes to a pool. The return to successful customers therefore is calculated by dividing the total pool (minus commission) by the number of winning tickets (UK Gambling Commission, 2013). The bingo and casino (e.g. card games, table games, peer to peer and slots) games are also the same type of gambling that exists in traditional gambling houses. In these three categories gamblers use a personal computer or in a Smartphone. The traditional gambling houses are replaced by a virtual house. The latter type of remote gambling, the betting exchange does not exist in traditional houses. This type of betting is similar to a stock exchange market where gamblers can buy or sell bets (UK Gambling Commission, 2013).

Griffiths (1993) carried out one of the most influential studies on the influence of gambling environment on gamblers behaviour. In there, he examined structural characteristics of fruit machines gambling in relation to the gambler's behaviour and it was shown that those characteristics have the potential to induce excessive gambling.

Although, online gambling occurs in a different setting from traditional gambling, the interactive nature of online gambling platforms can also influence gamblers behaviour in dimensions similar to the traditional houses environment.

The excitement or disappointment of other gamblers cannot be observed like in traditional houses, neither the sounds of others slots machines, but the sound and colours of the platform the gambler is gambling have the potential to influence gamblers' decisions. Searching the literature there is no available research on the potential effects of such interactive environment on users'

decision making. Therefore, how these dimensions influence the gambler behaviour is a question worth asking.

1.4 Structural factors

1.4.1 Introduction to the main factors related with physical game machinery

Parke and Griffiths (2007) divided the structural characteristics of Electronic Gaming Machines (EGMs) in 6 main categories:

- a. Payment characteristics
- b. Playability characteristics
- c. Speed and frequency characteristics
- d. Educational characteristics
- e. Environment characteristics
- f. Reward characteristics

The first interaction that a player usually has with the machine is the way that a player chooses to pay the gambles. In this main characteristic there are several factors that restrict the form to get credit to gamble. It can be by insertion of "real money" (notes or coins) directly in the machine or by exchanging money for chips or smart cards. The use of real money can be more effective in controlling the money that is spent because the electronic type of cash brings psychologically less value to gamblers than physical money (Griffiths, 1993). On the other hand electronic money can be used to impose

self-limitations to gambling at the moment of exchanging the money for coins. Even so, Griffiths (1999b) shows that people gamble more using e-cash than with real cash, which makes online gamblers a potential risk group for the urge of maladaptative behaviours regarding gambling decisions.

Another issue associated with payment characteristic is the maximum bet size and the maximum bill acceptor. Research shows that setting a maximum bet size do not bring significant effects on perceived enjoyment for non-pathological and for pathological gamblers (Blaszczynski et al. (2001) and Blaszczynski et al. (2005)). In their studies, they concluded that the problems caused by gambling losses result much more from standard bet sizes for longer periods of time than from overwhelming bet sizes. Blaszczynski et al. (2005) also found that having a limiting bill acceptor has no impact in the time spent gambling because gamblers can move to a machine without that kind of limitation.

Loba et al. (2002) affirm that it is easier to pathological gamblers to stop playing, when the win or losses in real money instead of credits are showed.

The playability characteristics are related with the interactions that the player has with the machine while gambling. Those characteristics are interactive in nature, promoting a fun environment to the game in order to attract the gamblers. The involvement of gamblers in a game and the exercise of a skill are interrelated, so the introduction of buttons like “nudge”, “hold” and “play” increase the perception of participation in the game by them, and led them to a sense of “perceived skill” (Cornish, 1978; Griffiths, 1993; Langer, 1975). The feeling of being part of the game encourages the gambler to continue playing because it induces the illusion control over the course of the game.

Another characteristic that contributes to attach the player to the game is the use of a familiar theme in the machine. A theme like the well-known brand “The Simpsons” brings a sense of familiarity to the gambler that convinces him

that it is not likely that such a great machine brings many losses. Also, a gambler that is a regular viewer of the show may think that all the information that he has about it gives him an advantage while gambling in that machine (Parke and Griffiths, 2007).

At last, there is the experience of near miss (Parke and Griffiths, 2004). A near miss is an outcome that is close to the win and that scenario gives the illusion of being almost well succeeded. An example of that is a game of slot machines whose goal is to get a line of 3 similar types of fruit and the near miss is the outcome of only appearing 2 similar types of fruit and the third fruit needed appeared on the line above the main line. The near miss is the same as other loss, it does not pay any winnings, but this one gives the sense that the player was almost there and creates the desire of playing again in order to win the game.

The characteristics of speed and frequency are related with events such as frequency, bet's frequency, event's duration, in-running betting, payout interval and autoplay.

Event's frequency is the number of times that an event is available to gamble. For example, a weekly lottery only occurs once a week but on the other hand a roulette spin may occur many times in an hour. Bet's frequency is different from event's frequency since it represents the number of bets that can be placed in any given time period. Using the example of the weekly lottery, it can be bought as many tickets as gamblers may wish before the lottery draw.

The event duration will limit the bet frequency because if an event is long, like a sports event, the gambler is not able to place bets as many times per hour as he might be able to do in an event like the roulette spin that takes few seconds, so the gambler can have hundreds of events in an hour.

In-running betting refers to a new type of betting option where gamblers can bet while the event is occurring. It permits the gambler to adjust the bet

according to the progression of the game. This type of betting increases the perceived skill.

The payout interval is the time that goes from the end of the betting event to the winnings payment, in case of a winning bet. The short gap between those two events may contribute for the rise of high frequency gamble choices because the gambler does not have to wait too much time to bet again. When the gap between the bet moment and the payout is higher, gamblers have to wait more time to gamble with the money earned so they have more time to think and refresh from the winning excitement (Parke and Griffiths, 2007).

Autoplay is a feature that helps people to play the game, reducing the level of human interaction, where the player only has to push few buttons to make a bet. However, it can be interpreted as a tool to decrease the time spent per bet and, with that, to increase the player turnover, which consequently may increase the betting frequency (Parke and Griffiths, 2007).

Educational characteristics represent the game structures that only exist with the purpose of harm minimization. The main goal is to ensure that the player has all the information about how that game is played. It may contribute to the purpose of the responsible gambling but in other hand may also contribute for making the game more enjoyable while the gamblers learn how to play it (Parke and Griffiths, 2007).

Environmental characteristics represent features associated with the gambling environment or machinery that may increase or decrease the frequency of gambling behaviours. For example, it was argued that the use of clocks can be useful for a player to track the time spent gambling. However a study by Schellinck and Schrans (2002) suggested that the use of clocks had no impact on reducing the time that gamblers spent gambling.

Also, the constant appearance of expenditures can be useful for a gambler in order to track the losses he is experiencing. As stated before, it was proven by

Loba and colleagues (2002) that gamblers (especially pathological) are more aware of their losses and wins when their results are displayed in terms of real money.

The warnings or pop-up messages are messages that appear on the game display to warn or inform gamblers of the risks involved with gambling. Some warnings are proved to have some effects on reducing pathological gambling like the exposure to a 60 minute pop-up message informing players of the time spent gambling (Schellinck and Schrans, 2002).

Environment characteristics such as a different array of noisy sounds and colours which surrounds the gambling environment might have an impact on gamblers behaviour. Even not knowing exactly the level of impact of sound and colour on gambling behaviour, a variety of sound effects have been used in gambling for many years. Parke and Griffiths (2007) divided sound effects in three main categories: general sounds, verbal interactions, and music.

Some authors suggest that EGMs sound effects act as gambling inducers (Griffiths, 1993; Hess and Diller, 1969; White, 1989). The constant theme music of those machines give the sense of fun and amusement with those games, the sound of coins falling gives the idea that in that machine winning is more usual than loss (Griffiths and Parke, 2003; Parke and Griffiths, 2006).

Verbal interactions represent an effect that can enhance the amusement of gamble, because they act as gamble reinforcers by increasing gamblers' self-esteem with phrases like "well played!" when a player wins something or by giving hints during the game. Using known characters' voices seems to make the games more appealing (Parke and Griffiths, 2007).

The type of music in the machine can also modify the behaviour of the gambler. Effects of romantic music in the gambling decisions can be different from pop music or from rock music for example (Parke and Griffiths, 2007).

At last, Parke and Griffith (2007) wrote about reward characteristics. One of those characteristics is the multiplier potential that is specific visual stimulation that allows the gambler to see what he will win with the stake he is going to play. Another characteristic related to the rewards are the payout ratios. Those are the ratios of the winnings paid out to gamblers, associated with the bets they made. So, a gambler that knows that a machine is above his payout ratio is induced to choose other machine to gamble because in that machine the tendency is to have more losses than winnings in order to return to the regular payout ratio. The jackpot size is also a characteristic that affects gamblers behaviour. Although there is no research on the effect of jackpot size on gamblers behaviour, there is some empirical evidence that the higher jackpots the higher the gambling activity (Griffiths and Wood, 2001). For example, the lottery Euro-millions, the higher jackpots attract more gamblers and higher gambling amounts.

Next section explores the mechanisms involved in the influence exerted on cognitive function and behaviour by colour and sound.

1.4.2 Translational description of those structural factors to online gambling platforms

Most of the characteristics presented before have similar implications in the online gambling.

The main difference between gambling in the traditional way to gambling online is the lack of social interaction that occurs in the second one. For example, in online card games the dealer is a virtual person and the other gamblers can be real but the interaction between them is made virtually.

This difference has the ability to increase the speed and frequency of events because with the absence of human communication the game will flow faster.

The payment characteristics have also some differences from traditional gamble because it is not possible to insert coins in the computer, so the money used to get credits and to be able to gamble has to be virtual money.

Playability characteristics are the same either in online or in traditional gambling. This is because the platforms that a gambler uses to gamble are programmed to look and sounds like the ones that are in the casinos.

Like in playability, the educational and environmental characteristics have similar effects in online and traditional gambling. The platforms are the same, the colours and sounds presented in there are the same. The only thing able to vary these effects is if the gambler has the sound of his computer turned off or if the brightness and the contrast of his screen are different from the casino.

At last, the reward characteristics have also the same effects in online and traditional gambling.

1.5 Pathological gambling and gambling behaviour

Pathological Gambling (PG) has been defined as an impulse control disorder characterized by persistent and non-adaptive gambling (DSM-IV, APA, 1994). According to the Diagnostic Statistical Manual (4th edition), PG encompasses a series of behavioural symptoms such as the failure to resist the urge to gamble, feelings of restlessness while not gambling and excitement seeking through gambling. The behavioural profile of the pathological gamblers impinges several constraints to its social network as the need to gamble becomes the central and prime motivator for the individual (Blaszczynski and Nower, 2002).

Both theoretical and research based analysis of problem and pathological gambling are consensual in stating that pathological gambling represents an heterogeneous phenomenon with distinct biological, personality,

developmental, cognitive and ecological features (Blaszczynski and Nower, 2002; Gupta et al., 2013).

The pathways model of problem and pathological gambling proposed by Blaszczynski and Nower (2002) is the first comprehensive framework model of pathological gambling that accounts with both clinical observations and research work, in the definition of subtypes of pathological gamblers, pathologic development and specific aetiologies. The model postulates the existence of three major pathways associated with pathological gambling with specific features but containing commonalities in some symptomatic features: behavioural conditioned problem gamblers, emotionally vulnerable problem gamblers and 'antisocial impulsivist' problem gamblers. Accounting with ecological factors the model starts by defining the availability and access to gambling as the starting block common to all three pathways. This block relates with public policies and regulatory legislation that promotes the acceptance of gambling behaviour (Abbot and Volberg, 1996).

The second and most relevant mechanism common to the three pathways relates with the classical and operant conditioned mechanisms that lead to an increased engagement, and the development of habituation to gambling and cognitive schemes that maintain gambling behaviour and chasing losses (Blaszczynski and Nower, 2002). The human brain has a powerful associative machine (Kahnemann, 2012) where stimuli, behaviour and consequences become linked as they co-occur with a short time interval. The classical conditioning refers to a specific type of learning where a Conditioned Stimulus – CS – (e.g. a neutral sound or a flashlight) is paired with an Unconditioned Stimulus (US), usually a biological relevant stimulus, such as food, that has the power to elicit a unconditioned reflex response (UR) like salivation. After successive pairings of CS-US, the CS alone elicits salivation that becomes the conditioned response (CR) to the CS presented alone (Pavlov, 1960). On the

other hand, operant conditioning or instrumental conditioning reflects a pattern of learning where the individual behaviour is modified by its precedents and its consequences. Here, the starting point is the individual behaviour followed by a specific consequence that could act as a reinforcer – consequence that increases the frequency of a specific behaviour – or as a punishment – consequence that decreases the frequency of a specific behaviour (Skinner, 1938).

Studies have been identified that report a positive association between gambling, increased heart rate (Griffiths, 1995) and subjective excitement report (Dickerson, Hinchy and Fabre, 1987), highlighting the possible influence of the behavioural learning principles (present in both classical and operant conditioning) to the development of pathological gambling. Here, operant conditioning occurs when intermittent wins induce a state of biological arousal, while successive pairings between wins and arousal becomes classical conditioned to the gambling environment (Dickerson, 1979; Sharpe & Tarrier, 1993) and the reduction of anxiety states promoted by winnings works as a negative reinforcer to successive gambling behaviours (Blaszczynski and Nower, 2002).

The learning principles applied to the pathogenesis of pathological gambling and problem gambling represent general learning laws possibly applied to non-pathological cases (Blaszczynski and Nower, 2002), meaning that, at some extent, both classical and operant conditioning mechanisms can account for sporadic gambling situations and have a potential to influence decisions regarding what gambles to choose, how much to gamble and when to stop gambling. Furthermore, the same principles can be applied in the development of dynamic online gambling platforms that regulate the probability of occurrence of individual maladaptive behaviours such as successive gambling and chasing losses, a behaviour where the individual successively attempt to retrieve the money expended in gambles (Griffiths, 2003; 2006).

Surprisingly, to our knowledge, there are no studies focused on the structural stimuli related factors of the online gambling platforms that have the potential to reduce or increase maladaptive gambling behaviours, both regular and pathologically driven.

1.6 Structural factors: colours and sounds

Colour or more specifically colour perception is a complex property studied in a broad range of academic disciplines (Elliott and Maier, 2014). The study of the influence of colours on the psychological functioning started in the first half of the seventeenth century with the classic theory of colours of Goethe (1810). In his seminal work, Goethe intuitively proposed that colour perception influenced positive vs negative emotional experiences: plus-colours like yellow, red-yellow and yellow-red were speculated to induce positive feelings such as lively and warm and minus-colours such as blue, red-blue and blue-red were said to induce negative emotions such as anxious and cold (Elliott and Maier, 2014).

In an attempt to conjoin Goethe ideas and his own personal observations, Goldstein (1942) proposed that the physiological reactions induced by colour perception are overtly manifested in emotions, cognitive performance and motor behaviour (Elliott and Maier, 2014), positing for the first time the axiom of the colour perception influence on behaviour and decision making. In Goldstein sense (1942), red and yellow were presented as stimulating colours to promote outward focus and to produce effortful cognitive processing whereas blue and green were presented as relaxing colours that induce inward focus and stable behaviours (Elliott and Maier, 2014). Methodologically the analysis of colour influence on emotions and behaviour goes beyond colour itself and

several work have been developed on the influence of properties such as hue, lightness and brightness on emotions and behaviour (Elliott and Maier, 2014). As we centred our analysis on structural factors of online gambling platforms that have the potential to influence behaviour we will considerer colour effects in a broader sense.

Several work have been developed regarding the influence of colour red on cognitive and motor performance (Elliott et al., 2007; Gnambs et al., 2010; Jung et al., 2011). These effects largely depend on task type and context but red seems to be related with failure and danger and evokes motivations avoidance in contexts of were attentional resources must be allocated (Elliott et al., 2007). For an extensive review of the effects of colour red on behaviour see Elliott and Maier (2014).

In terms of basic mechanisms involved, previous research suggested that viewing the colour red triggers implicit associations related with failure and danger in achievement situations (Moller et al., 2009). It has been argued that red may carry negative valence by default even in situations where no information content is available (Chien, 2011). It seems arguable for us that red colour perception is paired with negative feelings associated with aversive scenarios that by instrumental learning become conditioned by red colour presentation. This doesn't seem a mere effect of colour presentation, because for instance green presentation before or during achievement tasks are related with better performance when compared to red colour presentation (Elliott et al., 2007). However, findings are inconsistent regarding the effects of different colours on behaviour and sometimes findings suggest similar effects of global colour presentation on behaviour (Elliott and Maier, 2014).

Regarding sound presentation effects on behaviour, aversive sound presentation have been extensively used in aversive conditioning protocols (e.g. Zald and Pardo, 2002; Baltissen and Boucsein, 1986). In a neuroimaging study,

when compared to other neutral sounds, white noise triggered activity in amygdala, a brain region involved in the establishment of aversive conditioning to neutral stimulation (Zald and Pardo). It has also been shown that exposure to white noise, when compared to sound absence is related with increased food intake, showing behavioural differences associated with white noise perception (Rasbury and Shemberg, 1971). Also, when compared with tones, white noise triggers an increase in heart rate response (Graham and Slaby, 1973), a measure consistent with the learning principles associated with stimulus reinforcement learning. Again it seems plausible that white noise presentation triggers a negative affective state towards specific situations but its effects on cognitive and task performance associated with gambling decision making remains unexplored.

1.7 Integration and research questions

Colours and sounds perceptions are related with cognitive function and can lead to different behaviour under different circumstances. How colours and sounds perception influence economic decision making, more specifically how they influence gambling behaviour is still a matter of experimental research. As stated before, the learning laws posited by the theories of classical and instrumental conditioning are fundamental for the explanation of gambling behaviour, more specifically for the pathogenesis of pathological gambling and gambling problems. The influence exerted by different colours and sounds on behaviour are also related with its capacity to elicit negative or positive emotional states that in turn predispose the individual for specific patterns of behavioural performance, a process of associative learning. However, from a behavioural economics perspective, it is possible that sounds and colours increase the psychological salience of the losses in online gambling. Humans

are loss averse even in riskless choices (Tversky and Kahneman, 1991). Loss aversion is related with a pattern of behaviour where individual seem to express greater sensitivity to losses than to equivalent gains when making decisions (Kahneman, 2011; Tom et al., 2007). This model is consistent with the pattern of loss-chasing behaviour observable in gamblers, where the aversion elicited by a loss turns an individual more prone to increase the size of a specific bet in order to recover from the previous loss (Campbel-Meiklejohn, Woolrich, Passingham and Rogers, 2008). Functional MRI data from both loss sensitivity and loss-chasing behaviour shows the engagement of brain regions associated with the dopaminergic reward system and pre-frontal brain regions and the anterior cingulated cortex (Campbel-Meiklejohn et al., 2008; Tom et al., 2007), suggesting that loss aversion may be the explanatory mechanism associated with loss-chasing behaviour.

Bringing these associations into light, to our knowledge, there is no experimental research conducted in the field of gambling that cleared the effects of the presentation of different colours and sounds in online gambling platforms on gambling behaviour. So, several research questions emerge from this work:

- a. How different colours, more specifically red and green, that are associated with different motivational states, influence individual gambling behaviour?
- b. More specifically do colours associated with threat and danger, like red colour reduce the amount of credits gambled after successive losses? Or the increased salience of the loss by colour introduction increase loss-chasing motivated behaviour?

- c. How different sounds, more specifically pleasant sound and white noise burst, that are associated with different motivational states, influence individual gambling behaviour?
- d. More specifically does white noise, aversive in nature, reduce amount of credits gambled after successive losses?
- e. Is it possible to combine sound and colour in an interactive gambling task in order to promote responsible gambling behaviour in order to loss-chasing behaviours?

1.8 Hypothesis

At the conceptual level we consider the independent effects of different colours and sounds. Regarding colour, our hypothesis states that both red and green colour will enhance the anxiety elicited by a loss increasing loss-chasing behaviours.

For sound induction, we hypothesize that white noise will trigger an aversive motivational state associated with potential danger while the sound associated with pleasant consequences, will signal a safety related motivation.

At the operational level, we expect that the presentation of red and green colours in the game platform after successive losses will increase the amount of credits betted when compared with the no colour condition. We expect that white noise presentation after successive losses will reduce the amount of credits betted when compared with the pleasant sound and no sound conditions.

At an exploratory level, we will combine colour and sounds in order to explore how colour and sound presented simultaneously and in interactive fashion influence gambling behaviour.

2. Method

2.1 Participants

Two hundred and forty five participants (mean age = 33.23, SD = 11.46, range [18, 66]), 93 females, were recruited using a publicized online Qualtrics Survey. All participants reported having normal hearing and normal or corrected vision, being free from neurologic or psychiatric illness. All participants were Portuguese native speakers. Informed consent was obtained from all participants before the beginning of the experiment. The experimental group was composed by people with similar gambling habits (they were not regular gamblers) and was not found an interaction between their gamble behaviour and the bets made in rounds.

2.2 Procedure and stimuli

The experiment consisted in a gambling game where participants had to gamble credits in four different rounds of a normal roulette game with 50% success probability. The experiment was conducted in Qualtrics and started by collecting participants' informed consent. Before the experiment starts the following cover story was presented to the participants: "you are playing in specific gambles with credits (up to a maximum of 100 in each round; if you lose the bet, the amount of credits betted in that round will be discounted from your budget; if you win the bet, the amount betted will be multiplied by 5 and added to your budget; after the experiment the total credits earned will be

converted in tickets to a enter in a draw of a gift money card”; at the end of the experiment participants were fully debriefed about the experimental manipulations of the experiment.

The gambling rounds were structured in three parts: (1) a text page with the event game and the bet bar where participants had to choose between 1 and 100 credits to bet; (2) the wait page with 7 seconds duration; and (3) the gamble result page. Figure 2 illustrates the structure of a round.

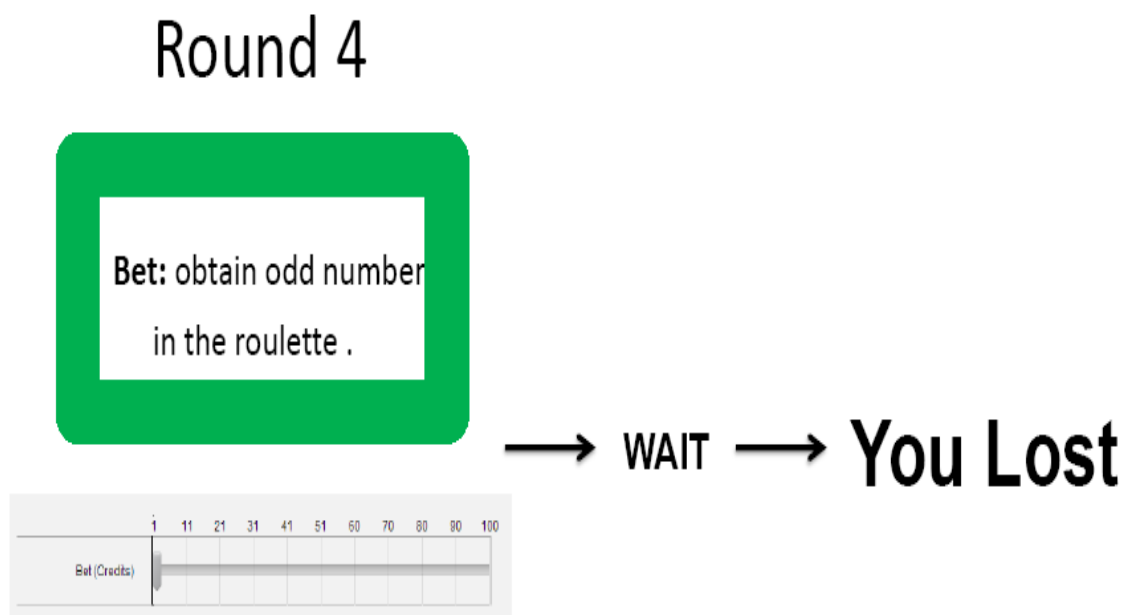


Figure 2: Structure of one gambling round example in the green colour condition

Unbeknownst to the participants the gamble result in the first three rounds was manipulated and was always loss. In the fourth round nine different between subjects conditions were tested, where visual, auditory or visual and auditory combined stimuli were presented in order to enhance the salience of the loss and of the fourth gamble:

1. the visual stimuli consisted in a rectangular frame enclosing the loss and the fourth gamble – the colour of the frame was red in the red colour condition and green in the green colour condition;
2. the auditory stimuli consisted in two stimuli presented with 1 second duration at the time of the loss – one white noise burst in the white noise condition and one pleasant winning related sound in the pleasant burst condition;
3. the visual and auditory conditions combined add four experimental conditions to the experiment: 3.1 white noise auditory stimuli at the moment of the loss and red or green frame enclosing the fourth round event and 3.2 pleasant auditory stimuli at the moment of the loss and red or green frame enclosing the fourth round information.
4. The control condition consisted in a simple round structure without colour adds or auditory stimuli.
5. After the four rounds participants completed a brief questionnaire where information about age, gender, education, residence, gambling habits, visual impairments, auditory impairments, mental illnesses were collected.
6. We also check for the sound output of the device used to conduct the Qualtrics experiment as participants allocated in the auditory manipulations without sound output in the device were excluded from the sample.

2.3 Main statistical analysis

Running experimental research about the effects of colours and sounds in decision making posits several control issues. For colour there is the problem of property variation such as wavelength and brightness and for sound there is a

problem for intensity variations. The present experiment was conducted in Qualtrics, an online tool for data collection which in turn impairs direct comparisons between different colours and different sounds. This can be counterbalanced by conducting an analysis of the independent effects of colour and sound presence with the control condition (Elliott and Mayer, 2014). As so, we conducted independent samples t test analysis on the differences between each one of the experimental conditions of sound and colour effects when compared with the control condition in the fourth round of the gambling game. Whenever the principle of equality of variances was violated proper corrections were reported, including the significance of the Levene's test. In order to analyse the effects of different manipulations in the pattern of betting from the first to the fourth round we conducted a Repeated Measures ANOVA with rounds (1st to 4th) as within-subject factor and experimental condition as between-subjects factor. The Greenhouse-Geisser correction for violations of sphericity was used when appropriate.

3. Results

The online survey posits several concerns regarding the reliability of the collected data. In order to eliminate non-collaborative behaviour from the participants we exclude participants that betted 1 or 100 credits in all four rounds of the gambling game.

Sample size, means and standard deviations for age and gambling habits for each experimental group are displayed in Table 1.

	N	Age		Gambling Behaviour	
		Mean	SD	Mean	SD
Control	48	33.94	13.36	1.50	1.13
Red	46	34.02	11.82	1.52	1.11
Colour					
Green	44	31.34	9.50	1.66	1.06
Colour					
WNB	18	31.83	11.00	1.39	0.85
PS	16	30.13	9.08	1.75	0.78
WNB +	17	32.29	11.07	1.41	0.94
Red					
WNB +	19	35.21	12.82	1.21	0.54
Green					
PS + Red	17	36.29	12.08	1.41	0.80
PS + Green	20	33.95	10.95	1.25	0.55
Total	245	33.23	11.46	1.49	0.96

Table 1: Samples size, means and standard deviations for age, and gambling habits for each experimental condition.

Legend: WNB – White noise burst; PS – Pleasant Sound; SD – Standard Deviation.

3.1 Effects of colour on decision making

Two independent samples t tests comparing both red and green colour conditions with the control condition revealed a significant difference between green and control conditions [$t(90) = 2.84, p=.006$] with green colour ($M=42.84; SD=27.19$) eliciting higher bets than the control condition ($M=28.25; SD=21.94$) and a marginal significant difference between red and control conditions [$t(92) = 1.96, p=.053$] with a tendency for red colour ($M=38.59; SD=28.93$) eliciting higher bets than the control condition ($M=28.25; SD=21.94$). Figure 3 illustrates the differences between conditions.

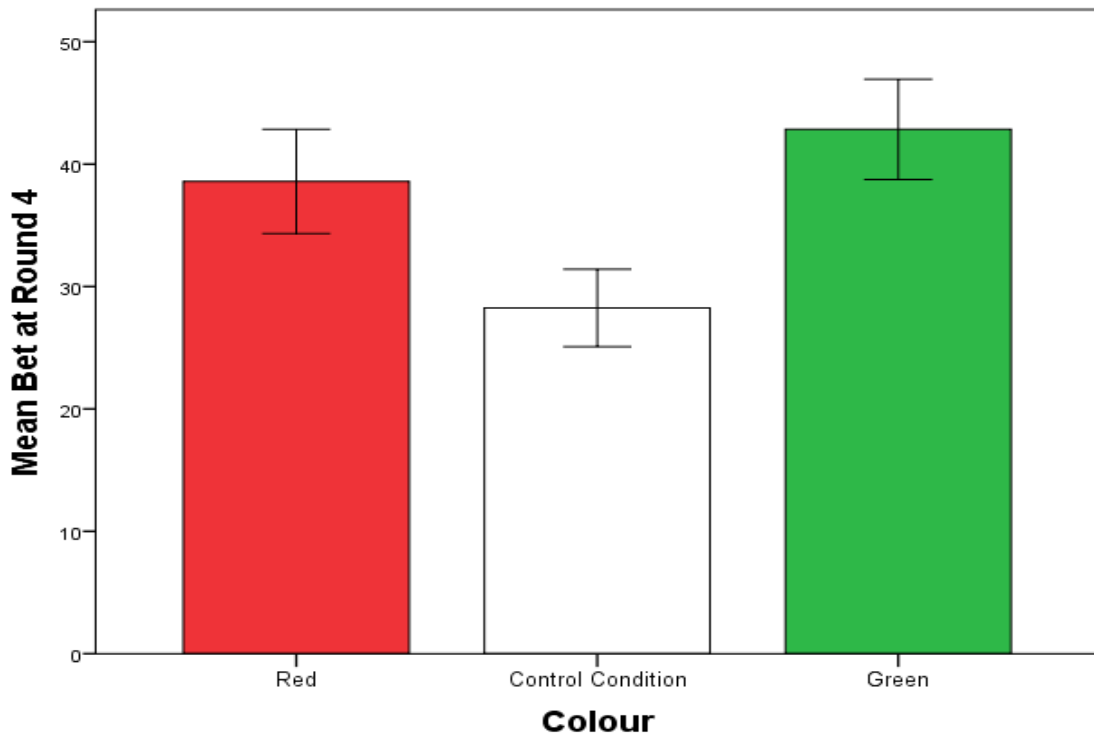


Figure 3: Mean bets at round 4 for red, green and control conditions. Error bars are displayed for +/- 1 SE.

3.2 Effects of sound on decision making

Two independent samples t tests comparing both white noise burst and pleasant sound with the control condition revealed no significant differences between white noise burst ($M=31.06$; $DP=32.03$) and the control condition ($M=28.25$; $SD=21.94$) in betting behaviour [$t(64)=0.406$; $p=.67$] and no significant differences between pleasant sound ($M=40.13$; $SD=32.42$) and the control condition ($M=28.25$; $SD=21.94$) in betting behaviour in the 4th round [$t(62)=1.65$; $p=.10$].

3.3 Combined effects of colour and sound on decision making

Four independent samples t tests comparing white noise burst + red colour, white noise burst + green colour, pleasant sound + red colour and pleasant sound + green colour conditions with the control condition revealed no significant differences between white noise burst + red colour ($M=30.12$; $DP=27.82$) and the control condition ($M=28.25$; $SD=21.94$) in betting behaviour [$t(63)=0.281$; $p=.78$], no significant differences between white noise burst + green colour ($M=22.21$; $DP=16.68$) and the control condition ($M=28.25$; $SD=21.94$) in betting behaviour [$t(65)= -1.081$; $p=.28$], no significant differences between pleasant sound + red colour ($M=23.82$; $DP=17.87$) and the control condition ($M=28.25$; $SD=21.94$) in betting behaviour [$t(63)=0.458$; $p=.46$], and no significant differences between pleasant sound + green colour ($M=36.80$; $DP=35.19$) and the control condition ($M=28.25$; $SD=21.94$) in betting behaviour [$t(25.38)=1.008$; $p=.32$], with this comparison being the only one where the principle of equal variances was violated (Levene test with $p<.05$).

3.4 Repeated Measures analysis of variance

We conducted a Repeated Measures ANOVA with round as within-subject factor with four levels (round 1, 2, 3 and 4) and condition as between-subjects factor with 9 levels, each one of the experimental conditions. Considering the within subjects effect, the test revealed a significant effect of round [$F(2.57, 607.01)=4.90$; $p=.004$; $\eta^2p=.02$; $\epsilon=.86$; $p<.001$]. LSD multiple comparisons test revealed general higher bets in the 4th round ($M=33.84$; $DP=27.36$) when compared with the 1st round ($M=30.09$; $DP=19.57$) with $p=.044$ and with the 2nd round ($M=27.59$; $DP=19.90$) with $p=.001$, and higher bets in the 3rd round ($M=31.16$; $DP=22.96$) when compared with the 2nd round ($M=27.59$; $DP=19.90$) with $p=.002$. Within-subjects contrast analysis revealed a significant linear contrast [$F(1, 236)=6.441$, $p=.012$] revealing a tendency for higher bets after consecutive losses. Regarding the interaction between round and condition, no significant effect was found [$F(20.58,607.01)= 1.408$, $p=.108$].

3.5 Effects of gambling habits on decision making

In order to analyse possible differences between gambling habits in the experimental groups we conducted a one-way ANOVA with gambling habits as dependent variable and conditions as between subjects' factor. The test revealed no significant differences [$F(8,236)= 0.727$; $p=.67$] on gambling habits between the experimental groups. In order to analyse potential effects of gambling habits on global betting behaviour we conducted a repeated measures ANOVA with round as main factor with four levels (1st to 4th round) and gambling habits as covariate. No significant interaction between round and gambling behaviour was found [$F(3,729)=1.976$, $p=.116$].

4. Discussion

There are several studies relating the impact of colour and sound in human behaviour (e.g. Elliott and Maier, 2014; Graham and Slaby, 1973). More recently, the impact of colour and sound on gambling behaviour was studied (Parke and Griffiths, 2007). However, there are room to research on the effect of colour and sound on online gambling. As said before, there are similarities between traditional gambling and online gambling but we noticed too that, online gambling has some structural differences from the traditional house. The current study was set up to analyse if those conditions also have impact on online gambling behaviour.

The main findings of this study confirm that colour has significant impact on online gambling decision making. People subjected to green or red effect betted significantly more credits in the last round than people subjected to the control condition. The results also show that people had a generalized linear tendency to increase their bet amount after a loss. This finding is revealed by the contrast analysis with rounds as within-subjects factor in the Repeated Measures procedure. One possible explanation is the chasing losses; that is, gamblers bet more as an attempt to retrieve the credits lost in the previous rounds (Griffiths,2003; Campbel-Meiklejohn, Woolrich, Passingham and Rogers, 2008). Taking into consideration the findings described above, the colour effect seems to increase the psychological salience of losses in online gambling which triggers an attempt to recover previous losses.

The sound tests did not revealed any significant difference between their effects on betting and bets without them. This could induce that sound effect does not increase the psychological salience of the losses, but we believe that the results could be biased by the uncontrolled sound environment where people made that experiment and with proper conditions the study of the white noises effect triggering the stimulus reinforcement learning from Graham and Slaby, 1973 could be replicated to online gambling, using a controlled experimental environment where sound manipulation could be conducted with all possible variables associated with sound delivery under control, like in a laboratorial environment. We also had to drop some participants due to technical problems and this reduced our sample.

Identical results and identical conclusions can be drawn with the test made by combining colour and sound effects. The results combining aversive sound with green and red colour and combining pleasant sound with green and red colour did not revealed significant differences between them and the control condition, but we also believe that those results could be different if they were made under controlled sound environment. Like we said before because some participants had technical problems we needed to cut off their tests.

We faced some limitations in this study. This experiment was performed online and participants gambled on their personal computers and in a location unknown for us. So, we were not able to control the environment where they gambled, we cannot control the brightness or the lightning settings of the screen, we cannot control if they have their sound turned on and we cannot control the volume of that, we do not know if they gambled in a quiet or in a noisy place, if they gambled alone or accompanied, if they were only focused on the game or if they were doing something else at the same time.

The main result achieved, the influence of the colour, could be influenced by the level of brightness or the lightning of the screen of the participant but we

believe that the results obtained were strong enough to face that limitation and also, we compared colour presentation with its absence as suggested by Elliott and Maier (2014).

5. Final remarks

The online gambling is a growing sector. Therefore, we believe that studies on decision making process in the context of online gambling need to be explored. In this study, we focus on the effects of colour and sound of online platforms on gambling decisions and we demonstrate that colour presentation after successive losses significantly increase bets in following gambles. In further research, we think it would be useful to retry the same experiment with the sound effects but this time in a controlled environment in the laboratory, to make sure that all the participants are able to receive the same sound stimuli. We believe that other structures are useful to be studied like the appearance of real amount of money instead of credits, the “near miss” effect (Parke and Griffiths, 2004), the use of clocks, and the warning messages. All these structural characteristics are worth to be studied because there are no studies about them relating to the online gambling. Learning about their impact on decision making process might be useful to develop measures (1) to reduce pathological gambling behaviour and (2) to increase the frequency of responsible gambling behaviours.

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