The effect of a scarcity mindset and the encouragement of gambling biases on gambling activity

Master Thesis in
Behavioural Economics

Name student: Jordy Kok

Student ID number: 400895

Supervisor: X. Yu

Second assessor: dr. S.C van der Zee

Date thesis: 20/08/2019

Abstract

This study examines to what extent a scarcity mindset and the exposure to a statistical gambling sheet alter an individual's gambling activity. This is done by setting up an online experiment, which consists of two parts. The first part contained a questionnaire on the subject's demographics and a recall task on events which happened in the past. The second part contained a gambling game, where subjects could play up to 50 roulette rounds. The subjects were randomly allocated to one of the four groups: control, only scarcity, only gambling bias and scarcity*gambling bias. There are two approaches used to capture the gambling activity of subjects. The first approach measures the length of gambling in the roulette task, while the second approach examines the intensity of gambling in the roulette task. Mann-Whitney U tests were performed to measure the differences in the length and intensity of gambling between two groups. The first test measured the differences in gambling activity between the control and the only scarcity group, the second analysis examined the differences in gambling activity between the control and the only gambling bias group, while the third test investigated the differences in gambling activity between the only scarcity and the scarcity*gambling bias group. The findings of the analyses did not indicate that the scarcity mindset treatment led to significant differences in the length and intensity of gambling. Furthermore, providing a statistical gambling sheet did not lead to differences in gambling activity between the control and the only gambling bias group. Similar results were found for the effect of the statistical sheet treatment on the length and intensity of gambling among people in scarcity. Additionally to the Mann-Whitney U tests an ordinary least squares (OLS) test was performed. The OLS analysis indicated that subjects in the only scarcity group played significantly fewer rounds on average than subjects in the control group. This statistical significance is inconsistent with the findings of the Mann- Whitney U test. A possible explanation for this inconsistency between models is that the OLS analysis is more sensitive to outliers than a Mann-Whitney U test.

Keywords: scarcity mindset, counterproductive behaviour, gambling activity, statistical gambling sheet and gambling biases.

Table of Contents

List of Tables

List of Figures

1. Introduction

"The connection between lottery play and income is unfortunate because the purchase of lottery tickets by the poor can be considered a type of ''poverty trap''—a cycle of inefficient behaviour that prevents low-income individuals from improving their financial situations." (Haisley, Mostafa & Loewenstein, 2008a, p. 284)

Scarcity is defined as not having enough resources to satisfy the needs of individuals. However, some studies showed that the idea of having too little of something generates a scarcity mindset, which has an effect on the behaviour of individuals (Mani, Mullainathan, Shafir & Zhao, 2013; Mullainathan & Shafir, 2013; Shah, Mullainathan & Shafir, 2012). According to Shah et al. (2012), a scarcity mindset leads to counterproductive behaviour because scarce individuals inefficiently allocate their resources to fulfil their current needs. The scarcity mindset results in an increased focus on current needs and attentional neglect of other less pressing matters. A form of counterproductive behaviour that results in more long-term poverty is gambling. Although gambling is seen as an inefficient way to earn money Lee, Chae, Lee and Kim (2007) described five motivations why people gamble. These motivations might become more profound when people have a scarcity mindset (Shah et al., 2012; Mani et al., 2013). Furthermore, the study of Haisley et al. (2008a) empirically showed that people with a scarcity mindset are more likely to buy lottery tickets.

A common mistake individuals in the casino make is that they believe in representative heuristics (Bircan, Bowling & Grant, 2016). The representative heuristic discussed in this paper consists of two separate fallacies. One component is the law of small numbers, which is widely discussed by Tversky and Kahneman (1971). The law of small numbers refers to the belief that probabilities deviate to the mean in the short run. The second component of the representative heuristic is the hot hand fallacy. The hot hand fallacy refers to the idea that people think they are on a winning streak or perceive themselves as lucky that day. According to the study of Holtgraves (2008), a faulty belief in the probability of gambling results in higher gambling activity. Furthermore, individuals in scarcity respond differently when they are exposed to contextual cues (Shah, Shafir & Mullainathan, 2015; Roux, Goldsmith and Bonezzi, 2015). In this experiment, the effect of scarcity on the susceptibility to gambling biases will be tested.

In this research, I will examine the following research question:

To what extent do a scarcity mindset and a statistical gambling sheet alter an individual's gambling activity?

This research delivers a contribution to recent literature in the following ways. First of all, gambling behaviour is commonly explained by an individual's geographical and demographic characteristics (Hollander, Buchalter and DeCaria, 2000; Clotfelter & Cook, 1991). However, in this study, I will investigate the effect of a scarcity mindset on gambling behaviour. Secondly, I will examine the relationship between scarcity and the susceptibility to gambling biases. The paper of Shah et al. (2015) investigated the effect of a scarcity mindset on a person's susceptibility to contextual cues. Similar results can be found in the research of Roux et al. (2015). Furthermore, I will test whether exposure to a statistical sheet is an accurate proxy to encourages gambling biased behaviour. Gambling biases will be encouraged by the means of providing a statistical sheet on previous outcomes and hot numbers in the gambling task. The paper of Burns (2004) states that statistical evidence can encourage gambling biased behaviour.

This thesis has the following structure: chapter 2 describes the literature and hypotheses. Chapter 3 contains the research methodology, a description of the measures and an explanation of the variables. The results of the experiment are described in chapter 4. Finally, chapter 5 contains the discussion, the implications and limitations.

2. Literature review and hypothesis development

2.1. Scarcity

In classical economics, scarcity is a widely discussed topic because most if not all resources are scarce and require allocation and trade-off thinking. Scarcity captures the idea that the earth has limited resources and people have limitless wants (Ellis, 1950). The concept of scarcity states that there are not enough resources to satisfy every individual's imaginable wants. Standard economics assumes that human beings consider all resources as finite. To obtain a resource an individual has to make a decision between goods, which satisfies the wants that seem the scarcest to them. This concept of scarcity views the inability to obtain certain goods as a physical constraint. Recent literature indicates that scarcity is not just a physical constraint. Scarcity can be present in every individual that has a feeling of having "too little" of something (Shah et al., 2012, p. 682). This concept of scarcity deviates from the view of classical economics in the way there is not a clear distinction between high and low-income individuals and the feeling of scarcity is entirely subjective. When this subjective scarcity feeling arises in people, they change their mindset to an alleged scarcity mindset. When a person engages in this scarcity mindset, they alter their decision-making (Mani et al., 2013; Mullainathan & Shafir, 2013; Shah et al., 2012). This scarcity mindset is not necessarily created by the idea that your monetary resources are low. According to the research of Shah et al. (2015), the scarcity mindset in individuals can be triggered by a lot of different domains, such as time scarcity, caloric food intake or social contact. These different domains of scarcity alter decision-making in the same way as monetary scarcity.

2.2. Counterproductive behaviour

Some study findings have given evidence that poor individuals who are regarded as scarce by the notion of classical economics often behave in ways that result in long-term poverty. The poor do not spare for the future (Shurtleff, 2009), are less likely to get a health check-up (Katz & Hofer, 1994), have a higher discount rate (Lawrance, 1991), have the tendency to poorly keep track of their finances (Barr, 2012), not register in assistant programs (Bertrand, Mullainathan & Shafir, 2004) and regularly participate in lotteries (Clotfelter & Cook, 1991; Haisley, Mostafa & Loewenstein, 2008b; Shah et al., 2012; Mani et al., 2013). This is seen as counterproductive behaviour because it results in more poverty and thereby has an effect on a person's long-term happiness. According to recent literature, there is a correlation between higher income and happiness (Sacks, Stevenson & Wolfers, 2012). These decisions are regarded by an individual as rational during consumption. However, these decisions are

inconsistent with their long-term preferences. The consumption of this so-called instant gratification is met at a later stage with a form of regret (McCormick & Stone, 2007).

Counterproductive behaviour by low-income people is often explained by two theories. The first theory concentrates on both demographical and geographical indicators of poverty. For instance, living condition, mental health and education (Allard, 2004; Spilerman & Elesh, 1971). The second theory explains it by the personal traits which are commonly present in low-income people (Vu & Austin, 2007; Salling, & Harvey, 1981; Kane, 1987). Some traits discussed in the study of Vu and Austin (2007, p.172) are "polarized thinking", "life is lived in the moment" and "survival orientation". Companies take advantage of this counterproductive behaviour in poor people and they market their products mainly in areas with low-income people. For instance, hard-sell marketing tactics of gambling products are regarded as "exploitation of the poor" (Clotfelter & Cook, 1991, p.178). However, most of the above-mentioned studies were conducted 30-40 years ago and might not properly represent all the indicators of poverty in recent times.

Complementary to the theories of low-income people and counterproductive behaviour is the theory of depletion. The paper of Spears (2011) explains that economic decision-making in poverty depletes behavioural control. One form of poverty that affects behavioural control is the scarcity mindset. This is empirically shown by the study of Shah et al. (2012) which shows a relationship between scarcity and a tendency to overborrow. They discuss that a scarcity mindset alters the way how people evaluate certain situations. People affected by the scarcity mindset will elicit greater attention to the needs where the resources feel the scarcest. By the reasoning that attention is a limited source, increased focus on one domain will result in attentional neglect on less pressing matters. The scarcity mindset might results in counterproductive behaviour because they inefficiently allocate their resources to fulfil their current needs (Shah et al., 2012).

2.3.   Gambling as a counterproductive behaviour

Gambling behaviour results in a wealth loss of gambling participants on average. The odds are always in favour of the casino or the gambling instance. For instance, the statistical edge against an individual in a roulette game is 5.26% (Croson & Sundali, 2005). This means that a person loses on average €5.26 for every €100 they play on the roulette table. Furthermore, the Nevada State Gaming Control Board released a statistical revenue report on casinos in Las

Vegas. This report indicated that average win percentage in Las Vegas for the gambling instance is 4,25% for football, 4,72% on basketball games and 6,58% on slot machines (State Gaming Control Board, 2012).

A form of counterproductive behaviour that results in more long-term poverty is gambling. Gambling is seen as an inefficient way to earn money due to multiple reasons. When a person does not control their impulses to gamble anymore it leads to pathological gambling behaviour (Hollander et al., 2000). First of all, pathological gambling can have a major effect on people's lives. Pathological gambling is associated with a high amount of debts, leads to illegal acts to acquire money and leads to lower work productivity (Ladouceur, Boisvert, Pépin, Loranger & Sylvain, 1994). As Clotfelter and Cook (1991) stated, a lot of political instances oppose lotteries because lotteries mainly target low-income people. The structure of how certain gambling taxes are set up heavily disadvantages poor individuals. Lotteries are regressive and hurt poor individuals more than it benefits them.

2.4.   The effect of scarcity on the motivations to gamble

Although one would expect a wealth loss on average while participating in gambles there are multiple motivations for people to engage in gambling behaviour. A model that defines these motivations is the five-factor gambling motivation model (Lee et al., 2007). The five motivations described are "socialization, amusement, avoidance, excitement and monetary motives" (Lee et al., 2007, p. 21). These five motivations are proven to be effective estimators to measure individuals' gambling severity (Lee et al., 2007).

By evaluating these five gambling motivations one might expect that individuals with a scarcity mindset, put a higher valuation on the monetary motives of gambling. According to the study of Shah et al. (2012), people in poverty take unconventional loans (i.e. loans with interest rates that can reach up to 800%) to meet today's needs. Gambling might seem to be an easy way to earn money while being on a tight budget. With the notion that scarcity leads to an increased focus on current needs, a person's attention will go to the benefits of gambling and not its costs (Shah et al., 2012). The expected alteration in a person's decision-making is that monetary scarcity leads to increased gambling behaviour.

Additional to the monetary motives of gambling, psychology literature suggests that there are some gambling motivations which benefit an individual in the short-run (Lee et al., 2007).

These motives suggest that gambling is regarded as a fun and satisfying activity. The subjective feeling of scarcity might lead to a higher valuation of these short-term gambling motivations. This is supported by the paper of Mani et al. (2013), which suggests that people induced with a scarcity mindset showed significantly lower performance on cognitive control tasks. Individuals require cognitive control to withhold themselves from participating in activities which satisfies people in the short-term (Spears, 2011).

The relationship between a scarcity mindset and increased gambling motivation is amplified in the study of Haisley et al. (2008a). In their study, they showed that the subjective perception of poverty in individuals increases the chance of participating in the lottery. They make the assumption that poor individuals are more motivated to participate in lotteries due to some indicators related to their economic status. The study of Haisley et al. (2008a) empirically states that increased gambling behaviour in poor people can be explained by the idea that gambling provides an opportunity to significantly increase their wealth in a short time. They also assume that lotteries are attractive to poor people because they provide equal chances for high- and low-income people and do not discriminate among income classes.

Another psychology consequence of poverty which should be taken into account is the effect of a scarcity mindset on risk-taking behaviour (Haushofer & Fehr, 2014). The theory of Mani et al. (2013) suggests that people with a scarcity mindset experience a different cognitive load and stress level than people without a scarcity mindset. The differences between these two components might lead to differences in gambling behaviour. Some findings in previous literature suggest that cognitive load leads to reduced risk-taking behaviour (Deck & Jahedi, 2015; Whitney, Rinehart & Hinson, 2008; Gerhardt, 2013; Benjamin, Brown & Shapiro, 2013). Additionally, increased stress in scarce individuals leads to a higher risk-aversion (Haushofer & Fehr, 2014; Mather, Gorlick & Lighthall, 2009; Porcelli & Delgado, 2009; Lighthall, Mather & Gorlick, 2009). On the contrary, the study of Shah et al. (2012) suggests that cognitive load might lead to increased risk-taking behaviour. However, the above-mentioned papers solely investigated the effect of cognitive load or stress on risk behaviour. The paper of Carvalho et al. (2016) examined the effect of scarcity on risk attitude and did not found significant differences in risk attitude between people induced with a scarcity mindset and the control group.

2.5. Are casinos taking advantage of heuristics and biases?

In the casino, there are multiple images and statistical sheets which remind people to previous outcomes on the table at hand. Additional to the statistical sheet vivid images are provided, which indicate the so-called "hot" and "cold" bets. This is commonly shown in roulette, horse racing and sports bets. People take the gambling sheet into account when making gambling decisions. There are certain pages on the internet which show faulty strategies to beat the casino which are based on the statistical sheet (Angioni, 2019). However, as discussed in chapter 2.3 the odds are always in favour of the casino and there is no strategy to generate a positive expected value.

The casino might have found ways to take advantage of common heuristics and behavioural biases in customers. Common mistakes people in a casino make are the representative heuristic and preferring anecdotal information over statistical reports (Bircan et al., 2016). These heuristics reinforce people with the idea that they can predict outcomes and they can outsmart the casino. The faulty beliefs regarding the underlying probability are commonly present among problem gamblers. These faulty beliefs can lead to a higher gambling severity, which subsequently results in a higher wealth loss on average (Holtgraves, 2008; Ayton & Fischer, 2004).

The representative heuristic consists of two separate fallacies. One component is the law of small numbers, which is widely discussed by Tversky and Kahneman (1971). The law of small numbers refers to the belief that probabilities deviate to the mean in the short run. People believe that the output of a coin flip will be more likely to be cancelled out by the other output if the experimenter would flip the coin a second time. According to people that believe in the gambler's fallacy a sequence of Head-Head-Head-Tails (HHHT) is more likely to occur than a sequence of Head-Head-Head-Head (HHHH). The belief refers to the idea that the first sequence is more representative of the underlying distribution than the second sequence. According to the paper of Rabin (2002), people evaluate short sequences as if they are drawn from a limited pool without replacements. This wrong assumption that no replacement occurs, produces the gambler's fallacy.

The second component of the representative heuristic is the hot hand fallacy. The hot hand fallacy refers to the idea that people think they are on a winning streak or perceive themselves as lucky that day. This belief refers to the fact that sequential winnings are followed up by a

higher chance of winning the next round (Ayton & Fischer, 2004). The hot hand fallacy is not the opposite of the gambler's fallacy, winning your bet on tails does not mean that tails are seen as a hot number. It refers to the feeling that a particular individual is "hot" or on a hot streak and the next bet the individual places, has a higher chance of winning. According to Langer (1975), the hot hand fallacy is generated by the illusion of control. The illusion of control refers to the idea that individuals can influence the outcome of events, even though these events rely completely on randomness. A common misconception of the hot hand fallacy is present among basketball players and basketball fans. This is demonstrated in the paper of Gilovich, Vallone, and Tversky (1985), which showed that people indeed believe in the hot hand fallacy when evaluating the probability of shooting a basketball. However, the results of the study showed that there is no significant difference in the probability of scoring when the shooter made or missed the previous shot(s). This proves that basketball players and fans wrongly believe that previous outcomes are correlated with a higher chance of scoring.

It would be interesting to test whether the statistical sheet provided to people in the casino encourages heuristic thinking and leads to faulty beliefs in behavioural biases. By taking the research of Holtgraves (2008) into account which states that the belief in behavioural biases leads to a higher gambling severity, the casino might have found a way to increase their profits. The difference in gambling activity between people exposed to the statistical sheet and the control group will be tested in this paper. Furthermore, the effect of the statistical sheet on gambling behaviour in line with the hot hand fallacy or gambler's fallacy will be investigated in this research.

2.6. Scarcity mindset and the susceptibility to gambling biases

Previous literature indicates that the scarcity mindset alters a person's susceptibility to contextual cues (Shah et al., 2015). In their research, people under scarcity were more consistent in the valuation of goods. They indicate that people induced with scarcity make better use of trade-off thinking. The article of Roux et al. (2015) also found that people in scarcity react differently to contextual cues. They tested the relationship between scarcity and charitable giving. Subjects exposed to scarcity cues were more willing to donate if they had a feeling that this behaviour would be in their self-interest. By only changing the contextual cues of giving, from being in their self-interest to not being in their self-interest, scarce people were more willing to donate to charity. These studies provide evidence that people in scarcity have different susceptibility to contextual cues than people who are not in scarcity.

When people are susceptible to gambling heuristics and biases, it affects a person's gambling behaviour. People that believe in the hot hand or gambler's fallacy are expected to show a higher gambling severity on average (Holtgraves, 2008). Especially people that have a feeling of monetary scarcity might be more susceptible to gambling heuristics. The increased focus on monetary domains will make the heuristics and biases more salient. This is similar to the study of Aarts, Dijksterhuis and de Vries (2001) that found that people who are scarce in caloric intake, focus more on snack and beverage related cues. Similar behaviour is shown in the study of Kelly (1992) where people under time scarcity showed an increased focus on tasks at hand when they had to uphold a deadline. People in scarcity might be more engaged in gambling behaviour due to the increased focus of the scarcity mindset.

In this experiment, there will be looked at the relationship between the scarcity mindset and the susceptibility to gambling biases. There might be differences in gambling activity between scarce and non-scarce group when they are encouraged by gamblers and hot hand fallacy by the means of a statistical sheet.

2.7. Hypotheses

The following hypotheses were derived from the above-described literature:

Hypothesis 1: An experimentally induced scarcity mindset could lead to a higher gambling activity (i.e. playing for more rounds or placing more bets in total).

Hypothesis 2: Among the individuals with a scarcity mindset, those given a statistical gambling sheet are more likely to have a higher gambling activity (i.e. playing for more rounds or placing more bets in total), compared to those not given a statistical gambling sheet.

3. Research methodology

3.1.   Treatment groups: scarcity mindset and statistical sheet

To test the above-mentioned hypotheses the subjects were randomly allocated into four groups. The research followed a two-by-two format where the subjects can be exposed to two treatments. In the first treatment, people got induced with a scarcity mindset by the means of a scarcity recall task. The second treatment showed a statistical sheet of previous gambling rounds and hot numbers to encourage heuristic thinking. Figure 1 provides a more detailed view of the four different groups tested in this experiment.
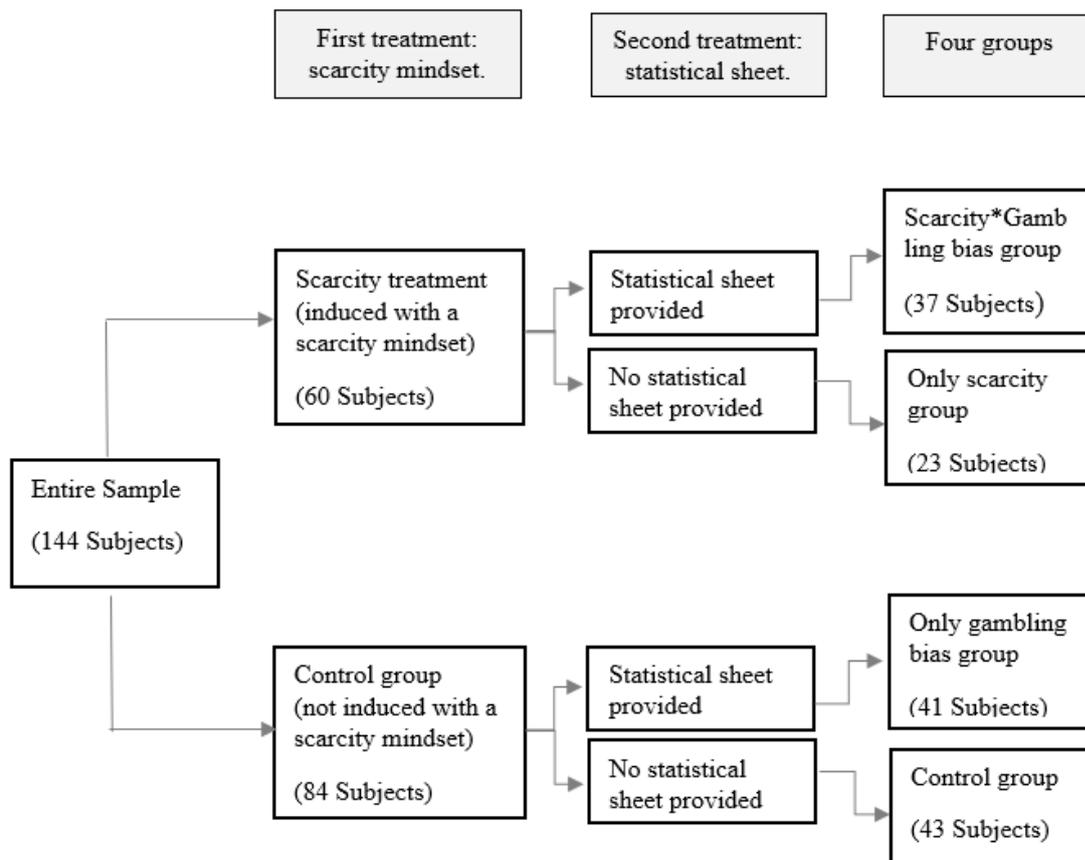
Figure 1: Allocation of the four groups

To induce a scarcity mindset in subjects a similar procedure was done as in the paper of Roux et al. (2015). They used scarcity cues to induce a scarcity mindset in participants. After being exposed to the recall task people's behaviour was similar to the behaviour of scarce individuals. The treatment group got exposed to a recall task which asked the participants to describe three events that happened in the past when they felt that they "did not have enough of something" or that they felt that "resources were scarce" (Roux et al., 2015, p. 618). When they recalled these three events, they were asked to describe two of these events in more detail.

This was followed up by the questions: "what was lacking?" and how did this make you feel? (Roux et al., 2015, p. 618). The control group was exposed to a different recall task. The subjects in this control group were asked to describe three events they did during the past week. For two of these events, they had to go further into detail and were asked what they were feeling during these events.

To encourage gambling biased thinking a statistical gambling sheet was provided to subjects allocated to the only gambling bias group and the scarcity*gambling bias group. The statistical gambling sheet was similar to the information provided in real-life casinos. The paper of Burns (2004) supports the idea that statistical information can trigger heuristic thinking in participants. This research indicated that participants believed in the hot hand fallacy when they were only provided with statistical information on random players. In this experiment, gambling biases were encouraged by providing the information to the subjects in a vivid image, which made it easier to see which streaks were building (Red-Red-Red) (see figure 2). The statistical gambling sheet contained information on the previous ten rounds with numbers and colours. The hot numbers, similar to what is showed in the casino, indicated the numbers that occurred the most in the past 25 rounds. This image changed each round and integrated the data from the previous rounds. This statistical gambling sheet is regarded as a proxy for heuristic thinking. For more examples on the statistical sheet see Appendix B.

First Round   Eighth Round
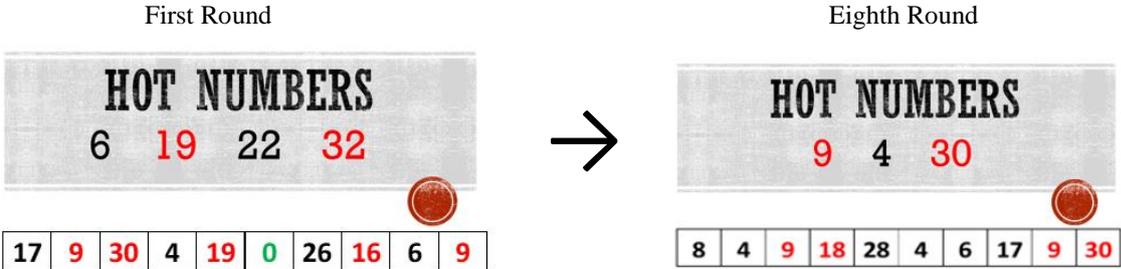
Figure 2: Hot numbers displayed in the first round and in the eighth gambling round

3.2.   Experimental design

For this experiment, there was chosen for a between-subject design over a within-subject design. In this experiment, the within-subject design would have greatly fit in with a relatively small sample size (144 subjects). However, a within-subject design also has its drawbacks. Drawbacks of a within-subject design are the experimenter-demand effect and carry-over effects. By getting exposed to both the treatment and control group, the subjects get a better grasp of the research question and alter their behaviour in subsequent events. This might result in biased responses the second time they participate in the experiment. These drawbacks are

less present in a between-subject design, where the subjects get exposed to a reduced amount of information. By just getting exposed to the control or treatment group, makes sure that subjects do not try to be consistent with their previous behaviour (Macfie, Bratchell, Greenhoff & Vallis, 1989).

In this experiment, control is required to speak of a causal inference between the treatment groups and gambling activity. In this experiment, control was established by keeping everything constant, besides the factors of interest. To speak of control, one has to take into account the counterfactual, randomisation and confounds. First of all, by changing the factor of interest and comparing the differences of outcomes between these groups, one can construct the so-called counterfactual. Another important assumption that I took into account is to randomly assign subjects to the control or treatment groups. This was satisfied by an automatic program (Qualtrics) that randomly assigned subjects in two stages. In the first stage, people were randomly assigned to be in the control or scarcity mindset groups. The second stage randomly assigned people to the control or the statistical sheet groups. Finally, to speak of a causal inference the subjects should not get exposed to other confounding effects. In some experiments where the experimenter induces scarcity, there are confounding effects present. The scarcity mindset can be triggered by asking people directly for their income, which is done in the study of Mani et al. (2013). The small sample size in this experiment made it hard to differentiate between income groups. For this reason, there is chosen for a recall task, which induced the "subjective" scarcity feeling into subjects no matter what wage they earned. A confound which is present in this experiment is the difference between the real gambling environment (casino) and the survey gambling environment (online). The behaviour of the subjects might be significantly different between these two environments (Stoop, 2019).

Although internally the experiment was sufficiently set up to speak of causal inference, there might be some limitations to this data. The subjects gathered in this experiment were contacted via various social media platforms (LinkedIn, Facebook and WhatsApp). This subject pool might have been biased due to the personal relationship between the experimenter and the subjects. This might have biased the results of the experiment because they cared about the outcome of the experiment. Subjects might change their behaviour in this experiment to behaviour that the experimenter constitutes as correct behaviour (Angrist & Pischke, 2009). People might have been overly invested to play a lot of rounds in the gambling task even if this is not in line with their true behaviour.

When the only reason to participate in an experiment is the satisfaction of helping out or the fun of the activity one speaks of intrinsic motivation. Intrinsic motivation will bias the results of the experiment because some people exert a lot more effort than other participants (Bardsley, Cubitt, Loomes, Moffat, Starmer & Sugden, 2009). It was important to eliminate as much intrinsic motivation as possible in the experiment. Literature indicates that implementing an incentive, will result in behaviour which is close to an individual's true preferences (Bardsley et al., 2009). I was unable to pay all the subjects according to their gambling decisions due to a lack of monetary resources. To introduce an incentive system in this experiment there was chosen for a variant on the random lottery incentive (RLI). The participants were notified before the experiment that one subject would be randomly selected to get their cashed out gambling balance fully paid out. According to the literature of Bardsley et al. (2009), this variant on the RLI is a sufficient way to eliminate some intrinsic motivation and reveal participants true preferences.

3.3. Five precepts: why is this a controlled economic experiment?

To speak of a properly controlled economic experiment the five precepts of Smith (1982) should be implemented. First of all, nonsatiation and saliency were satisfied with the payment method of the experiment. The potential pay-out of subjects increased gradually with their gambling balance. Participants prefer a higher gambling balance over a lower gambling balance, so nonsatiation was satisfied. Saliency is satisfied by not deceiving subjects in the experiment. After all the subjects were gathered one participant was randomly picked and paid for the entire amount the participant was entitled to. By additionally satisfying the dominance and privacy precepts one can speak of a controlled economic experiment. The privacy precept indicates that the choices of individuals are not disclosed to other participants. The subjects were not exposed to the decisions of other people within the experiment. However, the online setting of the experiment might make people talk to each other about the decisions they made during the experiment. The experiment was open to subjects for two weeks, which might have led to communication between participants. Finally, it is hard to say whether the dominance principle was satisfied. The dominance precept is satisfied when the subjects are incentivised to thoroughly consider their decisions. The decisions made in the gambling experiment could result in a substantial wealth gain. However, due to the random lottery incentive setup, people might not think that they had a fair chance to win their gambling balance. Although, these precepts were taken into account by setting up the experiment the experimental design showed some limitations.

3.4. Data collection

To collect the data, I used the online survey software Qualtrics. The data collection period started on the 5th of July 2019 and ended on the 21st of July 2019. There were no specific requirements in order to participate in the experiment. To gather my participants, I used the social media networks Facebook, LinkedIn and WhatsApp. I sent the following message: "For my master thesis I need respondents. You have a chance to win real money. Thank you in advance".

The participants were randomly assigned to one of the four groups (see figure 1). First of all, the participants needed to fill in their demographics (age, gender, education level and occupation status). There was chosen to put the demographical part in the beginning, because it resulted in a more convenient survey flow. The recall task to either induce scarcity or control for scarcity followed after the demographical sheet. In the second part, the participants got an amount of 50 tokens and each token represents €0,20, which they earned by filling in the first part of the survey. It was made clear that the participants played for real money and made real gambling decisions that would affect their earnings. One individual was picked to be randomly paid out, this was notified to the participants before the gambling task (see Appendix A4).

The participants received information on the rules of roulette and the possible gambling decisions they would get exposed to. The gambling decisions where the subjects could choose from where: red/black, 1st 12, 2nd 12, 3rd 12, trio or a single number. When people were not familiar with roulette, they could apply for general instruction on roulette. Additional to the gambling instruction, people that were assigned to the statistical gambling sheet got information about how the statistical sheet worked. The statistical sheet was provided on the same page as the gambling decisions in the second task. I refer to Appendix A4 for the information page included in the survey.

To make sure that all the participants understand the experiment, a practice round was included. After the practice round the subjects were asked whether they fully understood the experiment. If not, they returned to the information page and could read into the gambling mechanic and roulette rules. After either finishing the practice round or reading the instructions for the second round, the roulette task began. In this experiment, in all the rounds the same number occurred for every participant. For example, for every participant the right number in the first round was six-black, while in the eighth round the right number was 22-black. This

sequence was randomly generated before setting up the survey. For a more detailed view on the randomly generated number sequence see Appendix B. After every round, the subject's previous decisions, new gambling balance and winnings/losses were shown. They also had the opportunity to cash out after each round. By selecting "cash-out", participants got the question "are you sure?" to overcome the trembling finger incidents. By selecting yes, participants had the opportunity to enter their email if they wanted to be randomly selected to get paid according to the amount their final gambling balance was worth.

3.5.   Dependent variables: length and intensity of gambling

To measure the differences between gambling activity of the subjects, there were two approaches used. The first approach looked at the total amount of rounds the individual's gambled. According to the paper of Holtgraves (2008), there is a correlation between gambling frequency and gambling severity. By participating in an extra gambling round, one can state that: $Gambling\ an\ extra\ round\ (Benefits - Costs) > Quit\ Gambling\ (Benefits - Costs)$. People that gambled more rounds valued the benefits of the five gambling motivations over the costs of gambling (Lee et al., 2007). This variable measured the length of a subjects gambling activity.

The second approach examined a person's gambling activity by measuring the total bets placed in the experiment. By gambling with higher monetary amount while keeping the odds of winning constant, the wealth loss will be higher on average. Certain participants might have been more focused to win in the current round, so bet more money in a single round. It assumes that a person's gambling activity was higher while needing a smaller number of rounds. The paper of Dickerson, Baron, Hong and Cottrell (1996) identified a form of gambling behaviour as the amount spent in dollars on gambling activities. This variable measured the intensity of an individual's gambling activity.

3.6.   Dependent variables of additional analysis: hot hand and gambler's fallacy

The hot hand fallacy measure investigated whether individuals in this sample bet in a pattern similar to the hot hand fallacy. The measure is similar to the hot hand fallacy measure of Croson and Sundali (2005). In their paper, they tested the hot hand fallacy, by analysing the number of bets placed after winning either an inside or outside bet the previous round. Participants placed after winning the previous round on average 0.85 outside bets while they placed on average 0.50 outside bets after losing the previous round. This was sufficient evidence to conclude that

the subjects bet in accordance with the hot hand fallacy on average. In this experiment, I followed a similar measure where there is looked at the average bets placed on the outside and inside bets after winning or losing the previous round. The difference between these two averages was a proxy for someone betting according to the hot hand fallacy.

The gambler's fallacy examined whether the subjects believed that a sequential pattern will lead to the opposite outcome. This measure looked at betting patterns in the even-money bets used in this experiment, which are Red/Black. A previous study used a similar measure to assess the gambler's fallacy in a casino by looking additionally to the even-money bets Red/Black to Odd/Even bets and Low/High bets (Croson & Sundali, 2005). When subjects placed bets against a repeated outcome of length n, these bets were analyzed as being in line with the gambler's fallacy. In this experiment, a repeated outcome of length n referred to the number of rounds consecutively the same colour (Red/Black) appeared. An example of a bet which was classified as being in line with the gambler's fallacy is that after a consecutive outcome of three times red the subject bet on black. The difference between the total amount of bets placed against a streak of length n and not being against a streak of length n was a proxy for someone betting in accordance with the hot hand fallacy.

3.7. Control variables: demographics

There was a short questionnaire included in the survey to gather data on demographical indicators. This was done on four demographical factors (Age, Gender, Education level, and Occupation). First of all, age has been shown to be negatively related to gambling activity. This relationship between gambling activity and age was explained by differences in needs in various stages of development (Mok & Hraba, 1991). Another demographical factor included in the experiment is gender. The paper of McDaniel and Zuckerman (2003) showed that there were gender differences in participating in gambling activities. This was explained by an on average higher personal traits of sensation seeking in male participants (McDaniel & Zuckerman, 2003). The survey also included a question about the current level of education. This was asked because the paper of Pietrzak and Petry (2005) showed that fewer years of education are related to pathological gambling behaviour. Another demographical factor that influences a person's gambling behaviour is occupational status. This is shown in the study of Lesieur and Heineman (1988) where the results indicated that occupational status is correlated with pathological gambling. In the experiment, differences in demographical groups should be taken into account because significant demographical differences between groups might lead to biased results. In

section 4.1.1., I tested whether the randomisation was properly performed. This test analysed whether the demographical variables were not unequally distributed between the groups.

3.8. Overview of the variables

The variables used to test the hypotheses in this experiment are further described in the following section.

Dependent variables

Gambling activity rounds (GAR): This measure investigated the total rounds gambled. This a ratio scale variable which can take a value within the range of 0-50. These numbers represent the rounds a participant played. A higher number represents a higher gambling activity.

Gambling activity bets (GAB): This measure examined the total bets an individual placed during their participation in the experiment. This is regarded as a ratio variable which can take a value within the range of 0-1750 (=35*50). A higher number of gambling activity bets represents a higher gambling activity in participants.

Hot hand fallacy behaviour (HHFB): This measure estimated the differences between the average bets placed after a win and the average bets placed after a loss of participants. This variable is an interval variable which can take negative and positive values. A positive number represents that individuals bet in line with the hot hand fallacy on average.

Gambler's Fallacy behaviour (GFB): This measure examined the difference between the total bets placed against a repeated streak of n and the total bets placed with a repeated streak of n. This variable is regarded as being on the interval scale which can take negative and positive values. A positive number represents that individuals bet in line with the gambler's fallacy on average.

Treatment variables

Only scarcity: This variable indicated whether a subject was induced with the scarcity mindset and was in the control group in the statistical sheet treatment. This variable is a dummy which can take the values 0 or 1. (0 = being in the control group, only gambling bias group or scarcity*gambling bias group; 1 = being in the only scarcity group)

Only gambling bias: This variable indicated whether a subject was exposed to the statistical gambling sheet and was the control group in the scarcity treatment. This variable is a dummy variable which can take the values 0 or 1. (0 = being in the control group, only scarcity group or scarcity*gambling bias group; 1 = being in the only gambling bias group)

*Scarcity*gambling bias:* This variable indicated whether a subject was induced with a scarcity mindset and was exposed to the statistical gambling sheet. This variable is a dummy variable which can take the values 0 or 1. (0 = being in the control group, only scarcity group or only gambling bias group; 1 = being in the scarcity*gambling bias group)

Control variables

Age: This variable indicated the specific age of participants in the experiment. Age is a ratio variable which can take any defined value.

Gender: This variable recorded the gender of participants within this experiment. This is a categorical variable which consist of three groups (1 = Male, 2 = Female, 3 = Other).

Education level: This variable recorded the education level of the subjects in the experiment. This variable is categorical variable which measure education level in five categories (1 = No schooling completed, 2 = High school graduate, 3 = Bachelor's degree, 4 = master's degree, 5 = doctorate degree).

Occupation: This variable indicated the main occupation of subjects within this experiment. This variable is a categorical variable which represents eight categories. (1 = employed full time, 2 = employed part-time, 3 = unemployed looking for work, 4 = unemployed not looking for work, 5 = retired, 6 = student, 7 = unable to work, 8 = other)

4. Results

4.1. Descriptive statistics

In this section, the descriptive statistics of the subjects which completed the survey will be discussed.

The survey has been filled in by 247 participants of which 103 participants stopped before the roulette task. These 103 subjects were excluded from the data. This high turnover ratio might have been caused by the length and/or the difficulty of the survey. Five subjects that stopped during the second task (roulette task) were regarded as finished responses with the final round being regarded as the round where the subjects cashed out. This resulted in a final sample of 144 subjects. The subjects got randomly assigned to four groups as can be seen in table 1. The big disparity between certain groups, especially with the scarcity group, is a limitation to this study but hard to overcome when randomly allocating into four groups.

	Control	Gambling bias
Control	43	41
Scarcity	23	37

Table 1: Total of the subjects in each group.

The raw data of this experiment provides an overview of the demographics present in this experiment. The subjects are on average 37 years old with a standard deviation of 16.865. In this experiment, 83 subjects are male and 60 people who completed the survey are female. The sample mainly consisted of people who are a high school graduate (N = 47), have a bachelor's degree (N = 56) or have a master's degree (N = 32). The most present occupation status of the subjects were full-time students (N = 39), subjects which are employed part-time (N = 34) and subjects which are employed fulltime (N = 52). For a more detailed view on the distribution of the demographical indicators see Appendix C1. Furthermore, on the variables: GAR, GAB, GFB, HHFB a descriptive table is provided which indicate the mean, standard deviation and frequency per group. These tables can be viewed in Appendix C2.

4.2. Composition of the observable characteristics

In this paper, the four demographical variables (age, gender, education level and occupation status) are recorded for all 144 subjects in the experiment. The raw data on the categorical variables is the frequency per category, while the descriptive tables on ratio and interval variables show the mean and standard deviation of the variables. This data is provided on a group level, so one can compare the observable characteristics between the treatment and control group. To view the raw data for each observable characteristic by group see Appendix C1.

Statistical tests were performed to test whether the control and the treatment group had a similar composition of the above-mentioned observable characteristics. This analysis is performed on two groups, where the first group is the control group and the second group is the treatment group. The first analysis measured the differences in observable characteristics between the control group and the only scarcity group. The second analysis performed a similar test which measured the differences between the only scarcity group and the scarcity*gambling bias group. The final analysis measured the differences in the composition of observable characteristics of the control group and the only gambling bias group.

Two different statistical tests were used to measure the differences in observed demographics between two groups (Chi-square and Mann-Whitney U test). On the demographical variables gender, education level and occupation status (categorical variable) a chi-square test were used. This test indicates whether two or more independent samples are significantly different from each other. The results of these tests did not indicate significant differences between one of the three pairs analysed. To test whether the median of age (continuous variable) was significantly different between the control and treatment group a Mann-Whitney U test was used. The result of this test did not indicate significant age differences between groups. The results of all three analysis did not indicate that the control was significantly different in demographical distribution from the treatment group (Control = Only scarcity, Scarcity = Scarcity*gambling bias, Control = Gambling bias) (see table 2). One can assume that randomisation was done properly and there are no significant differences in composition between the control and the treatment group of all three pairs.

Age	Statistical test	Degrees of freedom	Z-value	p-value
Control = Only scarcity	Mann-Whitney U	1	0.243	0.808
Only scarcity = Scarcity*Gambling bias	Mann-Whitney U	1	-0.320	0.749
Control = Only gambling bias	Mann- Whitney U	1	-0.632	0.527
Gender	**Statistical test**	**Degrees of freedom**	χ^2	**p-value**
Control = Only scarcity	Chi-squared	1	0.570	0.450
Only scarcity = Scarcity*Gambling bias	Chi-squared	2	1.007	0.604
Control = Only gambling bias	Chi-squared	1	2.556	0.110
Education level	**Statistical test**	**Degrees of freedom**	χ^2	**p-value**
Control = Only scarcity	Chi-squared	4	2.525	0.640
Only scarcity = Scarcity*Gambling bias	Chi-squared	3	2.328	0.507
Control = Only gambling bias	Chi-squared	4	1.754	0.781
Occupation status	**Statistical test**	**Degrees of freedom**	χ^2	**p-value**
Control = Only scarcity	Chi-squared	6	5.733	0.454
Only scarcity = Scarcity*Gambling bias	Chi-squared	6	5.602	0.536
Control = Only gambling bias	Chi-squared	6	6.214	0.400

Table 2: Analysis on differences in demographics between paired groups.

4.3. Means of the length and intensity of gambling by group

In this experiment, the relationship between certain control and treatment groups is tested. Tests on gambling activity had been executed twice, once for each measure of gambling activity. For both approaches, a higher number indicated a higher gambling activity. Before the analysis, I looked at the differences between the average rounds played of the four groups in this experiment (1 = control group, 2 = only scarcity, 3 = only gambling bias, 4 = scarcity*gambling bias). Figure 3 indicates some differences between groups in the average gambling activity. The control group shows the highest gambling activity on average, while the only scarcity group shows the lowest gambling activity on average. This was the case for both measures of gambling activity (GAR and GAB).

Figure 3: Mean of rounds played and final bets placed

4.4. Correlation analysis of the dependent and control variables.

To measure the relationship between the variables in this study a correlation matrix is set up, which indicates the correlation between the variables. When a study has a lot of strong correlations between variables, the regressions might show biased results. Strong correlations between two variables can diminish the precision of the estimations in the models. By analysing the relationship between the control variables, the matrix only indicated a weak or moderate correlation between the demographical variables. Only the correlation between the dependent variables GAR and GAB showed a strong relationship which is as expected (r = 0.8890). People that gamble more rounds are expected to place more bets in total. For the correlation matrix of the variables in this experiment, I refer to Appendix D.

4.5. Scarcity treatment on gambling activity (H1)

Result 1: There is no evidence found that people in the only scarcity group had a higher gambling intensity or length than the control group. Inducing a scarcity mindset by the means of a scarcity recall task did not lead to significantly higher gambling activity in this experiment. The findings of this analysis are not in line with hypothesis 1.

Support for Result 1: To analyse whether the scarcity treatment had an effect on gambling activity a Mann-Whitney U test was performed. The Mann-Whitney U test is a non-parametric two-sample test which identifies whether two independent samples originate from the same population. The Mann-Whitney U test examines the differences between the medians of two samples. The first independent sample is the control group (N = 43) and the second independent sample is the only scarcity group (N = 23). By measuring the differences between the control and the only scarcity group there is controlled for the effect of the statistical sheet. The differences in the medians of gambling activity between the two groups were tested twice: first on the GAR measure and secondly on the GAB measure.

The first analysis of the differences in the length of the gambling activity (GAR) did not show significant differences between the control group and the only scarcity group. Although the descriptive statistics showed that subjects in the control group gambled fewer rounds than people in the only scarcity group, the Mann-Whitney U test did not indicate significant differences (Z = 1.342, p = 0.180). Likewise, the second analysis of the differences in intensity of the gambling activity did not show significant differences in gambling intensity between the control and only scarcity group (Z = 0.821, p = 0.412). The results of these analyses can be viewed in table 3.

GAR Mann-Whitney U	Z-value	p-value	N Control	N Only Scarcity
Control = Only Scarcity	1.342	0.180	43	23
GAB Mann-Whitney U	**Z-value**	**p-value**	**N Control**	**N Only Scarcity**
Control = Only Scarcity	0.821	0.412	43	23

Table 3: Mann-Whitney U-test on gambling activity differences of the control and only scarcity group.

4.6. Intermediate analysis of the gambling bias proxy

Result 2: The intermediate analysis indicated that providing a statistical sheet to subjects did not result in a significantly higher gambling activity on average. Furthermore, subjects exposed to the statistical gambling sheet did not gamble significantly more in line with the hot hand and gambler's fallacy. In this experiment, the statistical sheet showed to be an ineffective proxy to encourage gambling biased behaviour.

Support for result 2: In section 3.1., the assumption is made that providing a statistical sheet to subjects subsequently leads to a higher gambling activity. In this intermediate analysis, the effect of providing a statistical sheet on a subjects gambling activity (GAR and GAB) is measured. Furthermore, the effect of providing a statistical sheet on behaviour in line with the gambler's and hot hand fallacy (GFB and HHFB) is tested. For both analyses, the two-sample Mann-Whitney U test is used, which measures the differences between the control group (N = 43) and the only gambling bias group (N = 41).

The first analysis of both measures of gambling activity (GAR and GAB) did not show significant differences between the control group and the only scarcity group. The statistical sheet treatment did not result in a significantly higher length (Z = -0.199, p = 0.842) or intensity (Z = 0.009, p = 0.993) of gambling. Additionally, the Mann-Whitney U test did not show that the statistical gambling sheet had a significant effect on the extent of hot hand fallacy behaviour among individuals (Z = -0.681, p = 0.496). The analysis of the gambler's fallacy behaviour as the dependent variable showed similar results (Z = 0.611, p = 0.541). For the results of the analyses, I refer to table 4 and 5.

GAR Mann-Whitney U	Z-value	p-value	N Control	N Only gambling bias
Control = Only gambling bias	-0.199	0.842	43	41
GAB Mann-Whitney U	**Z-value**	**p-value**	**N Control**	**N Only gambling bias**
Control = Only gambling bias	0.009	0.993	43	41

Table 4: Mann-Whitney U-test on gambling activity differences of the control and only gambling bias group.

GFB Mann-Whitney U	Z-value	p-value	N Control	N Only gambling bias
Control = Only gambling bias	0.611	0.541	43	41
HHFB Mann-Whitney U	**Z-value**	**p-value**	**N Control**	**N Only gambling bias**
Control = Only gambling bias	-0.681	0.496	21	22

Table 5: Mann-Whitney U-test on gambler's fallacy differences of the control and only gambling bias group.

4.7. Statistical sheet treatment on gambling activity in the scarcity groups (H2)

Result 3: The analysis of providing a statistical sheet on subjects induced with a scarcity mindset did not indicate a significant difference in gambling activity. The motivations to gamble were not strengthened by providing a statistical gambling sheet to scare individuals. The results of this analysis are not in line with hypothesis 2.

Support for result 3: In section 4.5., an intermediate analysis was done to compare the control group and only gambling bias group. This analysis was done to investigate whether the statistical sheet treatment had an effect on gambling activity or gambling biased behaviour. The results indicated that providing a statistical sheet showed to be an ineffective proxy to encourage gambling biased behaviour. The subjects in this experiment do not show the hypothesised relationship to the statistical gambling sheet treatment. Therefore, I do not expect the comparison between the only scarcity group and scarcity*gambling bias group to be different. To test whether providing a statistical gambling sheet led to a significantly higher gambling activity (GAR and GAB) among people with a scarcity mindset a two-sample Mann-Whitney U test was used. The Mann-Whitney U test examined the differences in gambling activity between the only scarcity group (N = 23) and the scarcity*gambling bias group (N = 37).

The results of the analyses on the effect of providing a statistical sheet to people with a scarcity mindset on gambling activity (GAR and GAB) did not indicate significant differences in the length ($Z = -0.532$, $p = 0.595$) or intensity ($Z = 0.875$, $p = 0.382$) of gambling. For a detailed view on the results of the above-mentioned Mann-Whitney U tests see table 6.

GAR Mann-Whitney U	Z-value	p-value	N Only Scarcity	N Scarcity* Gambling bias
Only Scarcity = Scarcity*Gambling bias	-0.532	0.595	23	37
GAB Mann-Whitney U	**Z-value**	**p-value**	**N Only Scarcity**	**N Scarcity* Gambling bias**
Only Scarcity = Scarcity*Gambling bias	0.875	0.382	23	37

*Table 6: Mann-Whitney U-test on gambling activity differences of the only scarcity and scarcity*gambling bias group.*

4.8. OLS: control variables and gambling activity

In addition to the Mann-Whitney U tests, there was an ordinary least squares (OLS) test used to analyse the effect of the treatments on gambling activity. The three possible treatments subjects could get exposed to were: only scarcity, only gambling bias, scarcity*gambling bias. First, a simple regression was performed on the GAR measure as the dependent variable and the treatment variables as the independent variable. Likewise, this analysis was repeated with the GAB measure as the dependent variable.

MODEL I

$$\text{Rounds played (GAR)} = b_0 + b_1(\text{Scarcity only}) + b_2(\text{Gambling bias only}) + b_3(\text{Scarcity*gambling bias})$$

$$\text{Total bets placed (GAB)} = b_0 + b_1(\text{Scarcity only}) + b_2(\text{Gambling bias only}) + b_3(\text{Scarcity*gambling bias})$$

The constant represents the average rounds gambled of people in the control group. The coefficient of the dummies indicates the difference in rounds gambled on average between the control group and the treatment group. The results indicated that subjects in the only scarcity group played on average 5.733 fewer rounds than people in the control group c.p. This difference was significant against a significance level of 0.05. The average rounds played of subjects in the only gambling bias group and the scarcity*gambling bias group were not significantly different from the control group. The regression was repeated for the GAB measure in a similar way. This regression did not show significant differences between the total bets placed of the control group and one of the treatment groups.

Rounds played	β	Test-statistic
Treatment		
Only Scarcity	-5.733	(2.47)*
Only Gambling bias	-2.346	(0.96)
Scarcity*Gambling bias	-2.691	(0.95)
Constant	10.907	(5.25)**
R^2	0.03	
N	144	

* $p<0.05$; ** $p<0.01$

Table 7: OLS Model 1 rounds played

Final bets placed	β	Test-statistic
Treatment		
Only Scarcity	-16.535	(1.51)
Only Gambling bias	-10.828	(1.02)
Scarcity*Gambling bias	-14.589	(1.22)
Constant	46.535	(5.35)**
R^2	0.02	
N	144	

* $p<0.05$; ** $p<0.01$

Table 8: OLS Model 1 final bets placed

The second model included the demographical variables in the regression. These variables are hypothesised to have a relationship with gambling activity. The additional variables included in Model II are Age, Gender, Education level and occupation status.

MODEL II

Rounds played (GAR) = $b_0 + b_1$(Scarcity only) +b_2(Gambling bias only) + b_3(Scarcity*gambling bias)+ b_4(Age) + b_5(Gender) + b_6(Education level) + b_7(Occupation status)

Total bets placed (GAB) = $b_0 + b_1$(Scarcity only) +b_2(Gambling bias only) + b_3(Scarcity*gambling bias)+ b_4(Age) + b_5(Gender) + b_6(Education level) + b_7(Occupation status)

The analysis of the GAR measure showed that people in the only scarcity group gambled on average significantly fewer rounds than the control group c.p. (t = 2.35, p<0.05). The regression indicated differences among demographical indicators. Females gambled significantly fewer rounds on average than males c.p. (t = 2.40, p<0.05). Likewise, people who defined their gender as "other" played significantly fewer rounds on average than males c.p. (t = 2.07, p<0.05). Subjects with a doctorate degree gambled significantly more rounds on average than people without an education c.p. (t = 4.32, p<0.01). People who defined their occupation status as other placed on average more bets than people who are employed full-time c.p. (t = 2.21, p<0.05). Although the variables doctorate degree, occupation status "other" and gender "other" indicated statistical significance the frequency of these variables is very low (see Appendix C1). The other variables did not show statistical significance in the regression.

The analysis of the GAB measure did not show significant differences in the total bets placed between the control group and the treatment groups. However, females placed significantly fewer bets on average than males c.p. (t = 2.76, p<0.01). The variable gender "other" also indicated a negative relationship with male (t = 2.92, p<0.01). Subjects with a doctorate degree gambled significantly more rounds on average than subjects without education c.p. (t = 2.56, p<0.05). However, similar to the GAR measure the frequency of the variables doctorate degree and gender "other" have a low frequency in this sample. For the other variables, the regression did not indicate a statistical significance in model II.

Rounds played	β	Test-statistic		Final bets placed	β	Test-statistic
Treatment				**Treatment**		
Only Scarcity	-4.930	(2.35)*		Only Scarcity	-15.936	(1.43)
Only Gambling bias	-2.509	(1.14)		Only Gambling bias	-13.152	(1.27)
Scarcity*Gambling bias	-2.618	(1.03)		Scarcity*Gambling bias	-15.283	(1.43)
Age	0.132	(1.64)		**Age**	0.289	(0.82)
Gender				**Gender**		
Female	-5.023	(2.40)*		Female	-23.777	(2.76)**
Other	-11.771	(2.07)*		Other	-78.733	(2.92)**
Education level				**Education level**		
High school graduate	3.289	(1.01)		High school graduate	17.574	(1.29)
Bachelor's degree	3.173	(0.94)		Bachelor's degree	15.558	(1.13)
Master's degree	2.333	(0.78)		Master's degree	16.488	(1.27)
Doctorate degree	31.266	(4.32)**		Doctorate degree	86.889	(2.56)*
Occupation status				**Occupation status**		
Employed part-time	2.748	(1.21)		Employed part-time	17.645	(1.89)
Unemployed not looking for work	11.807	(1.11)		Unemployed not looking for work	59.449	(1.04)
Retired	-5.879	(1.59)		Retired	-15.891	(1.00)
Student	1.691	(0.75)		Student	6.630	(0.63)
Unable to work	-0.889	(0.37)		Unable to work	7.223	(0.79)
Other	13.714	(2.21)*		Other	58.006	(1.95)
Constant	3.070	(0.71)		**Constant**	20.550	(1.14)
R^2	0.30			R^2	0.22	
N	144			N	144	

* $p<0.05$; ** $p<0.01$		* $p<0.05$; ** $p<0.01$
Table 9: OLS Model 2 rounds played		*Table 10: OLS Model 2 final bets placed*

The contradicted finding that individuals induced with scarcity played significantly fewer rounds on average than individuals in the control group, might be explained by the expectation of upcoming liquidity constraints. According to Haushofer and Fehr (2014), people in scarcity might desire a safe reward over a risky reward to alleviate liquidity problems. Another reason might be that individuals induced with a scarcity mindset are more focused on the problems of the scarcity recall task and have less attention or time for the roulette task. Instead of the hypothesized increase focus on the roulette task, it might have led to attentional neglect (Shah et al., 2012).

The OLS analysis in Model I and II showed that people in the only scarcity group gambled significantly fewer rounds on average than people in the control group. The Mann-Whitney U test did not indicate that the length of gambling was significantly different between these two groups. The difference in statistical significance can be explained by the different approaches of these statistical tests. The Mann-Whitney U test measures the significant differences between the medians of two groups, while the OLS measures the significant differences between the means of two groups. The comparison between means instead of the comparison

between medians makes the OLS more sensitive to outliers. This can explain the differences in statistical significance between the two analyses.

5. Conclusion

5.1. General

This study examined the effects of a scarcity mindset and providing a statistical sheet on an individual's gambling activity by the means of an online survey. The survey counted 144 subjects, which were divided into four different groups. The distribution of the subjects looked as follows: control group (N = 43), only scarcity group (N = 23), only gambling bias group (N = 41) and scarcity*gambling bias group (N = 37). Some demographics were included in the survey to investigate the effect of the demographics on gambling behaviour. Additionally, two measures were estimated during the participation in the gambling task. These measures were gambler's fallacy behaviour and hot hand fallacy behaviour.

Hypothesis 1 investigates whether an experimentally induced scarcity mindset could lead to a higher gambling activity. I performed a Mann-Whitney U test on the gambling activity measures as the dependent variable and the only scarcity group as the independent variable. The results did not indicate any significant differences between the average rounds played and the final bets placed between the control group and the only scarcity group. The results of this analysis are not in line with this hypothesis.

Hypothesis 2 examines whether giving a statistical gambling sheet to individuals induced with a scarcity mindset results in differences in gambling activity. An intermediate analysis was performed to investigate the effectiveness of the gambling bias proxy. The results indicated that providing a statistical sheet did not lead to differences in gambling activity (GAR and GAB) between the control group and the only gambling bias group. On the same two groups, a Mann-Whitney U test was performed to measure whether providing a statistical sheet led to differences in gambling biased behaviour (GFB and HHFB). The results of this analysis did not indicate significant differences in gambling biased behaviour between these groups. Therefore, the statistical sheet is an ineffective proxy to strengthen gambling biased behaviour. Because of the proven ineffectiveness of the gambling biased behaviour proxy, I did not expect the comparison between gambling activity of the only scarcity group and scarcity*gambling bias group to be significantly different. To verify this, a Mann-Whitney U test was performed to examine the differences in gambling activity between the only scarcity group and the scarcity*gambling bias group. The analysis indicated that the gambling activity of the only

scarcity group was not significantly different from the scarcity*gambling bias group, which is not in line with the second hypothesis.

Additionally, an OLS- regression was performed on two different models. Model I was a simple regression with the gambling activity measures as the dependent variables and the treatment groups as the independent variable. Model II included, besides the variables in model I, the demographical variables. Model I and Model II with the rounds played as the dependent variable indicated a significant negative effect on the only scarcity group compared to the control group, which was not in line with my hypothesis. Some demographical factors showed statistical significance. For the GAR and GAB measure, females and people who identified as "other" played significantly fewer rounds and placed fewer bets in total on average compared to males (c.p.). Subjects with a doctorate degree played significantly more rounds and placed more bets in total on average than subjects with no degree (c.p.). Lastly, for the GAR measure, subjects who classified their occupation status as "other" played significantly more round in comparison with subjects who are employed full-time (c.p.). Except for the statistical significance found in females, the other variables had a relatively low frequency in the sample.

By comparing the results of the Mann-Whitney U test with the OLS analysis, I found differences in the statistical significance of the results on the analysis between differences in gambling activity of the control group and the only scarcity group. An explanation for this might be that an OLS regression is more sensitive to outliers than a Mann-Whitney U test.

The hypotheses and analyses are used to answer the following research question:

To what extent do a scarcity mindset and a statistical gambling sheet alter an individual's gambling behaviour?

For all measures of either the only scarcity group, only gambling bias group and the scarcity*gambling bias group showed almost no significant results on differences in gambling activity. Only the OLS regression indicated that people in scarcity gamble fewer rounds on average than people in the control group, which was in contradiction with hypothesis one. There are two possible explanations for this measured effect. The first explanation might be that the scarcity recall task encouraged a feeling of being liquidity constrained in the future. The second explanation is that the scarcity recall task led to attentional neglect of participating in the gambling task.

5.2. Implications

The OLS analysis indicated that individuals in the only scarcity group played significantly fewer rounds on average than individuals in the control group. This might indicate that a scarcity mindset can positively affect an individual's gambling behaviour. This is in line with the paper of Shah et al. (2015), which states that a scarcity mindset can be of great value to people in scarcity. I would recommend for further research to investigate the relationship between a scarcity mindset and a reduced length of gambling.

Another result of the OLS analysis indicated that females gambled significantly fewer rounds and placed lower bets in total on average compared to males. On one hand, the policy of the government should focus more on discoursing gambling behaviour of males. On the other hand, the casinos should try to market their gambling products mainly on males.

In this experiment, the intermediate analysis showed that the statistical sheet is an ineffective proxy to encourage gambling biased behaviour. For further research, I suggest that another proxy is used instead of the statistical sheet to measure the relationship between scarcity and susceptibility to gambling biased cues.

5.3. Limitations and future research

The first limitation of this study is that I gathered a relatively small sample size (N = 144). For a small sample size, a higher effect size is needed in order to reject the null hypothesis. This might have resulted in a lack of statistical power, which makes it difficult to reject the null hypothesis of the statistical tests. Furthermore, the limitation of the small sample is strengthened by randomly allocating the subjects into four different groups. The sample sizes in the groups vary from 23 observations up to 43 observations. This big disparity between the largest and smallest group results in an even bigger loss of power. For future research, I would recommend minimizing the variance of the independent variable. This can be done by rising the sample size, decreasing the error variance or increasing the treatment level variance.

The second limitation of this study is that the participants were gathered from my own personal network. LinkedIn, Facebook and WhatsApp were used to gather subjects, which might lead to biased results. A common confounding effect is the experimenter-demand effect (Angrist & Pischke, 2009). People in this experiment might have been overly invested to help me out because of our personal relationship. This can have an effect on the results if they think

that I expect certain behaviour from them. Furthermore, intrinsic motivation can arise in participants by this personal relationship (Bardsley et al., 2009). Intrinsic motivation can lead to biased results. For future research, I would recommend gathering subjects without using your personal network. Another way to gather subjects is to distribute the survey anonymously or by using a company that will distribute the survey anonymously.

Furthermore, the third limitation of this research is the inability to be certain that this experiment is a controlled economic experiment. First of all, it is hard to say whether the dominance principle is satisfied. The provided incentive might not have been able to dominate the subjective costs of thoroughly considering the decisions in the experiment. Only one participant got randomly paid out according to her final gambling balance. The total amount she received was €12.40 (62*0.20). Even though one participant got paid out, subjects might not have believed that they would actually get paid. The small chance to get a monetary incentive might have resulted in a lack of effort among the participants in the gambling task. When this is the case, the dominance principle is not satisfied. Similar to the dominance principle, it is hard to say with certainty that the privacy precept is satisfied. The online experimental design does not make sure that some people did not talk to each other and discussed the decisions they made during the experiment. When the decisions of the participants are revealed to other subjects, the privacy precept is not satisfied (Smith, 1982). Especially in this gambling experiment where every subject got exposed to the same number sequence (see Appendix B), communication would lead to biased results. Therefore, it is possible that this confounded the treatment. For future research, I would recommend to pay out all the participants according to their final gambling budget. This might increase the effort of the participants when making gambling decisions and gives the experimenter more certainty that the dominance principle is satisfied. Additionally, to have more certainty in satisfying the privacy precept, I recommend taking the survey in specific time slots. Each time a new session begins, the experimenter needs to make sure that there is no possibility for communication between subjects. Furthermore, I would recommend to randomly generate the number sequence for each individual.

Another limitation of this study is the survey's environment. In the survey, I tried to re-enact a casino atmosphere by setting up a roulette gambling task. This is different from a real casino where you play in real-life in a different atmosphere. The five motivations to gamble

(Lee et al., 2007) might be less profound in the online environment of the survey than in the real-life environment of a casino. This might mean that gambling behaviour in the experiment is different from real-world gambling behaviour. Additionally, people in this experiment got a gambling budget of 50 tokens assigned to them. Providing a monetary gain before the experiment will alter an individual's decision making. This so-called house money effect might have led to biased results (Thaler & Johnson, 1990). For future research, I would recommend setting up a field experiment and observe gambling behaviour. The participants need to fill in the questionnaire before they engage in the gambling field experiment. In this field experiment, they do not get rewarded for participation, but are required to use their own money.

The final limitation of this study is a theoretical issue regarding resource theories. Prior research indicates that experimenters cannot always replicate the findings of other papers in resource experiments (Lurquin & Miyake, 2017). There is a lack of empirical validation that two consecutively tasks are capable of showing an ego-depletion effect when they are independently tested from one another. This is relevant for this paper since the results show that the scarcity treatment groups did not have the hypothesised effect on gambling activity. The experimental set up to induce a scarcity mindset, might not be as effective in this paper as in the paper of Roux et al. (2015). While their research indicates that the scarcity recall task altered people's giving behaviour, this does not necessarily have to indicate that it works in altering an individual's gambling behaviour. For future research, I recommend using a different experimental design to induce a scarcity mindset. One should consider using a scarcity treatment which is proven to be an effective measure to induce a scarcity mindset. Instead of using a scarcity treatment in every domain, which is the case in this recall task, I would recommend inducing a scarcity mindset that triggers a scarcity mindset in the monetary domain.

References

Aarts, H., Dijksterhuis, A., & De Vries, P. (2001). On the psychology of drinking: Being thirsty and perceptually ready. *British Journal of Psychology, 92*(4), 631-642.

Allard, S. W. (2004). *Access to social services: The changing urban geography of poverty and service provision.* Brookings Institution, Metropolitan Policy Program.

Angioni, G. (2019, January 23). *How to win at roulette: Bets and strategy tips to beat roulette.* Retrieved from https://www.pokernews.com/casino/win-at-roulette.htm

Angrist, J. D., & Pischke, J. S. (2009). Instrumental variables in action: sometimes you get what you need. *Mostly harmless econometrics: an empiricist's companion*, 113-220.

Ayton, P., & Fischer, I. (2004). The hot hand fallacy and the gambler's fallacy: Two faces of subjective randomness?. *Memory & cognition, 32*(8), 1369-1378.

Bardsley, N., Cubitt, R., Loomes, G., Moffat, P., Starmer, C., & Sugden, R. (2009). *Experimental economics: Rethinking the rules*. Princeton University Press. Ch.6.

Barr, M. S. (2012). *No slack: The financial lives of low-income Americans*. Brookings Institution Press.

Benjamin, D. J., Brown, S. A., & Shapiro, J. M. (2013). Who is 'behavioral'? Cognitive ability and anomalous preferences. *Journal of the European Economic Association, 11*(6), 1231-1255.

Bertrand, M., Mullainathan, S., & Shafir, E. (2004). A behavioral-economics view of poverty. *American Economic Review, 94*(2), 419-423.

Bircan Z, Bowling AC and Grant LD (2016). How to make better gambling decisions: avoid heuristics and biases! *Conference Abstract: Southern Cross University 13th Annual Honours Psychology Research Conference*. doi: 10.3389/conf.FPUBH.2016.02.00001

Burns, B. D. (2004). Heuristics as beliefs and as behaviors: The adaptiveness of the "hot hand". *Cognitive psychology, 48*(3), 295-331.

Carvalho, L. S., Meier, S., & Wang, S. W. (2016). Poverty and economic decision-making: Evidence from changes in financial resources at payday. *American Economic Review, 106*(2), 260-84.

Clotfelter, C. T., & Cook, P. J. (1991). *Selling hope: State lotteries in America.* Harvard University Press.

Croson, R., & Sundali, J. (2005). The gambler's fallacy and the hot hand: Empirical data from casinos. *Journal of risk and uncertainty, 30*(3), 195-209.

Deck, C., & Jahedi, S. (2015). The effect of cognitive load on economic decision making: A survey and new experiments. *European Economic Review, 78*, 97-119.

Dickerson, M. G., Baron, E., Hong, S. M., & Cottrell, D. (1996). Estimating the extent and degree of gambling related problems in the Australian population: A national survey. *Journal of gambling studies*, *12*(2), 161-178.

Ellis, H.S. (1950). The Economic Way of Thinking. *The American Economic Review, 40(1), 1-12.*

Gerhardt, H. (2013). *Essays in experimental and neuroeconomics* (Doctoral dissertation). Retrieved from https://edoc.hu-berlin.de/bitstream/handle/18452/17374/gerhardt.pdf

Gilovich, T., Vallone, R., & Tversky, A. (1985). The hot hand in basketball: On the misperception of random sequences. *Cognitive psychology, 17*(3), 295-314.

Haisley, E., Mostafa, R., & Loewenstein, G. (2008a). Subjective relative income and lottery ticket purchases. *Journal of Behavioral Decision Making, 21(3),* 283-295.

Haisley, E., Mostafa, R., & Loewenstein, G. (2008b). Myopic risk-seeking: The impact of narrow decision bracketing on lottery play. *Journal of Risk and Uncertainty, 37*(1), 57-75.

Haushofer, J., & Fehr, E. (2014). On the psychology of poverty. *Science, 344*(6186), 862-867.

Hollander, E., Buchalter, A. J., & DeCaria, C. M. (2000). Pathological gambling. *Psychiatric Clinics of North America, 23*(3), 629-642.

Holtgraves, T. (2008). Evaluating the problem gambling severity index. *Journal of gambling studies, 25*(1), 105.

Kane, T. J. (1987). Giving back control: Long-term poverty and motivation. *Social Service Review, 61*(3), 405-419.

Katz, S. J., & Hofer, T. P. (1994). Socioeconomic disparities in preventive care persist despite universal coverage: breast and cervical cancer screening in Ontario and the United States. *Jama, 272*(7), 530-534.

Kelly JR, K. S. (1992). The effects of time scarcity and abundance on group performance quality and interaction processes. *J Exp Soc Psychol, 28*(6), 542-71.

Ladouceur, R., Boisvert, J. M., Pépin, M., Loranger, M., & Sylvain, C. (1994). Social cost of pathological gambling. *Journal of gambling studies*, *10*(4), 399-409.

Langer, E. J. (1975). The illusion of control. *Journal of personality and social psychology*, *32*(2), 311.

Lawrance, E. C. (1991). Poverty and the rate of time preference: evidence from panel data. *Journal of Political economy*, *99*(1), 54-77.

Lee, H. P., Chae, P. K., Lee, H. S., & Kim, Y. K. (2007). The five-factor gambling motivation model. *Psychiatry research*, *150*(1), 21-32.

Lesieur, H. R., & Heineman, M. (1988). Pathological gambling among youthful multiple substance abusers in a therapeutic community. *British journal of addiction*, *83*(7), 765-771.

Lighthall, N. R., Mather, M., & Gorlick, M. A. (2009). Acute stress increases sex differences in risk seeking in the balloon analogue risk task. *PLoS One, 4*(7), e6002.

Lurquin, J. H., & Miyake, A. (2017). Challenges to ego-depletion research go beyond the replication crisis: a need for tackling the conceptual crisis. *Frontiers in Psychology*, *8*, 568.

MacFie, H. J., Bratchell, N., GREENHOFF, K., & Vallis, L. V. (1989). Designs to balance the effect of order of presentation and first-order carry-over effects in hall tests. *Journal of sensory studies*, *4*(2), 129-148.

Mani, A., Mullainathan, S., Shafir, E., & Zhao, J. (2013). Poverty impedes cognitive function. *science*, *341*(6149), 976-980.

Mather, M., Gorlick, M. A., & Lighthall, N. R. (2009). To brake or accelerate when the light turns yellow? Stress reduces older adults' risk taking in a driving game. *Psychological science*, *20*(2), 174-176.

McCormick, B., & Stone, I. (2007). Corporate Analytical Team. *Economic costs of obesity and the case for government intervention. Obesity Reviews, 8*, 161-164.

McDaniel, S. R., & Zuckerman, M. (2003). The relationship of impulsive sensation seeking and gender to interest and participation in gambling activities. *Personality and Individual differences*, *35*(6), 1385-1400.

Mok, W. P., & Hraba, J. (1991). Age and gambling behavior: A declining and shifting pattern of participation. *Journal of Gambling Studies*, *7*(4), 313-335.

Mullainathan, S., & Shafir, E. (2013). *Scarcity: Why having too little means so much*. Macmillan.

Pietrzak, R. H., & Petry, N. M. (2005). Antisocial personality disorder is associated with increased severity of gambling, medical, drug and psychiatric problems among treatment-seeking pathological gamblers. *Addiction*, *100*(8), 1183-1193.

Porcelli, A. J., & Delgado, M. R. (2009). Acute stress modulates risk taking in financial decision making. *Psychological Science*, *20*(3), 278-283.

Rabin, M. (2002). Inference by believers in the law of small numbers. *The Quarterly Journal of Economics, 117(*3), 775-816.

Roux, C., Goldsmith, K., & Bonezzi, A. (2015). On the psychology of scarcity: When reminders of resource scarcity promote selfish (and generous) behavior. *Journal of consumer research, 42*(4), 615-631.

Sacks, D. W., Stevenson, B., & Wolfers, J. (2012). The new stylized facts about income and subjective well-being. *Emotion*, *12*(6), 1181.

Salling, M., & Harvey, M. E. (1981). Poverty, personality, and sensitivity to residential stressors. *Environment and behavior*, *13*(2), 131-163.

Shah, A. K., Mullainathan, S., & Shafir, E. (2012). Some consequences of having too little. *Science, 338*(6107), 682-685.

Shah, A. K., Shafir, E., & Mullainathan, S. (2015). Scarcity frames value. *Psychological Science*, *26*(4), 402-412.

Shurtleff, D. (2009). Improving savings incentives for the poor. *National Center for Policy Analysis Brief Analysis*, (672).

Smith, V. L. (1982). Microeconomic systems as an experimental science. *The American Economic Review*, *72*(5), 923-955.

Spears, D. (2011). Economic decision-making in poverty depletes behavioral control. *The BE Journal of Economic Analysis & Policy*, *11*(1).

Spilerman, S., & Elesh, D. (1971). Alternative conceptions of poverty and their implications for income maintenance. *Social Problems*, *18*(3), 358-373.

State Gaming Control Board (2012). *Gaming revenue report.* Retrieved from https://gaming.nv.gov/modules/showdocument.aspx?documentid=7618

Stoop, J.T.R. (2019). *Causal Inference, week 1, lecture 1* [Lecture Slides]. Retrieved from https://canvas.eur.nl/courses/25358/files/10145361?module_item_id=305547

Thaler, R. H., & Johnson, E. J. (1990). Gambling with the house money and trying to break even: The effects of prior outcomes on risky choice. *Management science*, *36*(6), 643-660.

Tversky, A., & Kahneman, D. (1971). Belief in the law of small numbers. *Psychological bulletin*, *76*(2), 105.

Vu, C. M., & Austin, M. J. (2007). The Explosive Nature of the Culture of Poverty: A Teaching Case Based on an Agency-Based Training Program. *Journal of Human Behavior in the Social Environment*, *16*(1-2), 167-182.

Whitney, P., Rinehart, C. A., & Hinson, J. M. (2008). Framing effects under cognitive load: The role of working memory in risky decisions. *Psychonomic bulletin & review*, *15*(6), 1179-1184.

Appendix

Appendix A: Questionnaire

Thank you for participating in this experiment. The answers giving in this experiment will be anonymous to the experimenter. The experiment will be divided into two parts. The first part will contain a task where you have to recall events from the past. The second part will be a gambling game where you have a chance to win real money.

Appendix A1: Demographics

Age

Gender
- ○ Male
- ○ Female
- ○ Other

Education level
- ○ No schooling completed
- ○ High school graduate
- ○ Bachelor's degree
- ○ Master's degree
- ○ Doctorate degree

Occupation
- ○ Employed full time
- ○ Employed part-time
- ○ Unemployed looking for work
- ○ Unemployed not looking for work
- ○ Retired
- ○ Student
- ○ Unable to work
- ○ Other, namely:

Appendix A2: Scarcity treatment

Note that the participants are placed in the scarcity treatment or the control treatment.

Recall at least three events in the past where you felt that "you did not have enough of something" or "that resources where scarce". This can be about anything: money, time, caloric intake or friends etc.

Event 1

Event 2

Event 3

Further, explain event one and event two in more detail and how you felt during this event

Can you explain event one in more detail? What was lacking? How did you feel?

Can you explain event two in more detail? What was lacking? How did you feel?

Appendix A3: Control treatment

Note that the participant is placed in the scarcity treatment or the control treatment.

Recall three events in the past week that you did in the past week. E.g.: Cinema, Diner with a friend or played a ball sport with your friends

Event 1

Event 2

Event 3

Further, explain event one and event two in more detail and how you felt during this event.

Can you explain event one in more detail? How did you feel?

Can you explain event two in more detail? How did you feel?

Appendix A4: Roulette game information

Thank you for completing the first part of the experiment you received **50** tokens for this part. With these tokens, you can play the roulette game in part 2 of the experiment.

The second part of the experiment will be a roulette game. In this gambling game, you get an amount of 50 tokens each token represents €0,20. You play for real money and make real gambling decisions as you would make in the casino. You can cash out in any round if you do not want to deplete your money further or you are happy with your gain. You can play up to a maximum of 50 rounds. One participant will be randomly paid out by the experimenter for the full amount of their budget.

**You can pick from the following bets:**

Red/Black *"all the red or black numbers"* (+1)

1st12-2nd12-3rd12 *"1st 12 means nr 1-12 etc."* (+2)

Trio (00/0/1) *"Put a bet on the three lowest numbers"* (+11)

Single number *"Pick any number you like between 00-36"* (+35)

You can place up to 5 euros on each bet, by checking the boxes to your willing amount. Down here you see an example of someone placing three euro on the gamble "red".

☑ Red

☑ Red
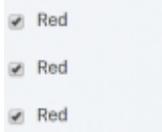
☑ Red

When you want to play a single gamble. Place your amount of bets on the assigned box. Afterwards, you will get forwarded to a page that allows you to choose the gamble.

☑ Single

☑ Single

Do you need more information on how to play roulette?

○ Yes!

○ No, I know the rules of the game!

Note that this is only shown when the participant wants more information on how to play roulette.

"In the roulette table, you use a roulette wheel that contains the number 1-36. These numbers are either red or black. Additionally, there are two green numbers in play. These numbers are 0 and 00. At the start of the round, the players put money on the table. The croupier announces that you are not eligible to bet anymore and spins a ball on the wheel. After some, the wheel stops spinning and the ball drops in one of the 38 numbers.

The wheel counts in total 18 numbers of a single colour, as much red numbers as black numbers. The two remaining numbers, 0 and 00, are green. There are three columns that indicate if the number is in the 1st 12, 2nd 12 or 3rd 12. One can bet on a colour, dozen, trio or single number. Before the round starts an individual has to place money on the single number they think will win. A trio is the combination of 00-0-1 which pays out if one of the three falls on the wheel. The participants will be paid out according to their gambles placed. Gambles with a lower chance of winning will pay out more than gamblers with a higher chance of winning.
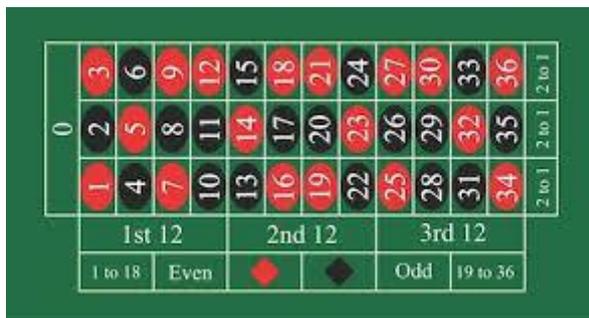
Appendix A5: Heuristic treatment
Note that the statistical sheet is only showed when the participants are allocated in the heuristic group.

Additional to the bets you will get a sheet that shows you statistics on the numbers that have appeared on the roulette table. There is a sheet that keeps track of **hot numbers** and a sheet that keep track of **the last 10 rounds.**

The hot numbers which are showed in the graph are the numbers that occurred the most in the last 25 rounds. There are already statistics provided on the previous 25 rounds that occurred at the roulette in advance of this survey. The hottest numbers of the previous rounds are number 6,19,22 and 32. These numbers occurred the most out of all the possible roulette numbers.

The last 10 rounds show statistics of the last 10 numbers that fell on the roulette board. This shows the colours of the numbers as well. Underneath the hot numbers, you see the last 10 rounds. 17 fell the previous round while number 9 fell 10 rounds ago.

Appendix A6: Example round

Your Balance: 50 tokens

Please pick the following bets:
Two tokens on red
One token on 2nd 12

☑ Red	☐ Black	☐ 1st 12	☐ 3rd 12	☐ Trio
☑ Red	☐ Black	☑ 2nd 12	☐ 3rd 12	☐ Trio
☐ Red	☐ Black	☐ 2nd 12	☐ 3rd 12	☐ Single
☐ Red	☐ 1st 12	☐ 2nd 12	☐ 3rd 12	☐ Single
☐ Red	☐ 1st 12	☐ 2nd 12	☐ Trio	☐ Single
☐ Black	☐ 1st 12	☐ 2nd 12	☐ Trio	☐ Single
☐ Black	☐ 1st 12	☐ 3rd 12	☐ Trio	☐ Single

The number that appeared on the board was!
17

Your non-single bets from the previous rounds were:
☑ Red ☑ Red ☑ 2nd 12
This round you Won/Lost:
On the non-single number bets:
-1, -1, 2
On the single number bets:

Your New Balance: 50 tokens

Good luck, go to the next round!
○ I am ready!
○ I want more information on the rules of roulette

Appendix A7: Round 1

Your Balance: 50 tokens
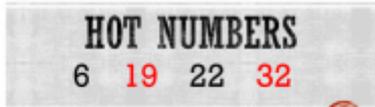
Choose from the following:

☑ Red	☐ Black	☐ 1st 12	☐ 3rd 12	☐ Trio
☑ Red	☐ Black	☐ 2nd 12	☐ 3rd 12	☐ Trio
☐ Red	☐ Black	☐ 2nd 12	☐ 3rd 12	☐ Single
☐ Red	☑ 1st 12	☐ 2nd 12	☐ 3rd 12	☐ Single
☐ Red	☑ 1st 12	☐ 2nd 12	☑ Trio	☐ Single
☐ Black	☐ 1st 12	☐ 2nd 12	☐ Trio	☐ Single
☐ Black	☐ 1st 12	☐ 3rd 12	☐ Trio	☐ Single

The number that appeared on the board was!

6

Your non-single bets from the previous round were:

☑ Red   ☑ 1st 12   ☑ Trio

☑ Red   ☑   1st 12

This round you Won/Lost:

On the non-single number bets:

-1, -1, 2, 2, -1

On the single number bets:

Your New Balance: 51 tokens

Show me the rules!

○ I understand the game, go to the next round!

○ I want more information on the rules of roulette

I would like to cash out

○ Yes, cash out!

○ No, keep playing!

Appendix A8: Cash out

Are you sure? (Enter your email if you want to be randomly selected to change your tokens into real money, leave the text entry open otherwise)

○ No, Keep playing!

○ Yes, Cash out! Enter email if interested: [   ]

Appendix B: Statistical sheet

6
4
28
18
9
4
8
22
30
9
25
7
0
17
6
22
34
15
24
16
32
7
18
11
23
21
19
27
6
34
36
0
6
11
4
19
14
35
33
29
8
18
6
8
20
14
15
7
30

HOT NUMBERS
6 19 22 32

| 17 | 9 | 30 | 4 | 19 | 0 | 26 | 16 | 6 | 9 |

Statistical Sheet provided before round one started.

HOT NUMBERS
6 9 22

| 30 | 22 | 8 | 4 | 9 | 18 | 28 | 4 | 6 | 17 |

Statistical Sheet provided before round ten started.

HOT NUMBERS
4 9 0

| 24 | 15 | 34 | 22 | 6 | 17 | 0 | 7 | 25 | 9 |

Statistical Sheet provided before round 20 started.

HOT NUMBERS
4 18

| 6 | 27 | 19 | 21 | 23 | 11 | 18 | 7 | 32 | 16 |

Statistical Sheet provided before round 30 started.

HOT NUMBERS
6 0

| 33 | 35 | 14 | 19 | 4 | 11 | 6 | 0 | 36 | 34 |

Statistical Sheet provided before round 40 started.

HOT NUMBERS
6 18

| 30 | 7 | 15 | 14 | 20 | 8 | 6 | 18 | 8 | 29 |

Statistical Sheet provided before round 50 started.

Appendix C: Descriptive statistics of measured variables

Appendix C1: Descriptive statistics of the demographical variables

Age	Mean	Standard Deviation	Frequency
Control	36.88372	16.17642	43
Only Scarcity	35.43478	13.57078	23
Only Gambling Bias	37.8566	14.60918	41
Scarcity*Gambling bias	37.72973	16.86490	37
Total	**37.14583**	**16.86490**	**144**

Table 11: Descriptive statistics of age by group.

Gender	Male	Female	Other
Control	22	21	0
Only Scarcity	14	9	0
Only Gambling Bias	28	13	0
Scarcity*Gambling bias	19	17	1
Total	**83**	**60**	**1**

Table 12: Frequency table of gender by group

Education level	No schooling completed	High school graduate	Bachelor's degree	Master's degree	Doctorate degree
Control	3	16	14	9	1
Only Scarcity	0	8	9	6	0
Only Gambling Bias	2	13	17	9	0
Scarcity*Gambling bias	3	10	16	8	0
Total	**8**	**47**	**56**	**32**	**1**

Table 13: Frequency table of education level by group

Occupation	Employed full time	Employed part-time	Unemployed not looking for work	Unemployed looking for work	Retired	Student	Unable to work	Other
Control	14	9	0	0	1	15	1	3
Only Scarcity	10	6	0	1	1	5	0	0
Only Gambling Bias	19	9	0	2	1	9	0	1
Scarcity*Gambling bias	9	10	0	1	2	10	1	4
Total	**52**	**34**	**0**	**4**	**5**	**39**	**2**	**8**

Table 14: Frequency table of occupation status by group

Appendix C2: Descriptive statistics of GFB, HHFB, GAR and GAB.

Gambler's fallacy behaviour	Mean	Standard deviation	Frequency
Control	1.51163	4.04953	43
Scarcity	0.91304	1.44326	23
Gambling Bias	0.58537	1.84358	41
Scarcity*Gambling bias	1.13514	2.23808	37
Total	1.05556	2.73485	144

Table 15: Descriptive statistics of gambler's fallacy behaviour

Hot hand fallacy behaviour	Mean	Standard deviation	Frequency
Control	-0.79496	1.49065	21
Scarcity	1.13789	2.86331	9
Gambling Bias	-0.51141	1.97915	22
Scarcity*Gambling bias	-0.13903	0.91132	17
Total	-0.29083	1.84210	69

Table 16: Descriptive statistics of hot hand fallacy behaviour

Rounds played (GAR)	Mean	Standard deviation	Frequency
Control	10.90698	13.58538	43
Scarcity	5.17391	4.97861	23
Gambling Bias	8.560976	8.14263	41
Scarcity*Gambling bias	8.216216	11.63838	37
Total	8.631944	10.68608	144

Table 17: Descriptive statistics of rounds played

Final bets placed (GAB)	Mean	Standard deviation	Frequency
Control	46.53488	56.86758	43
Scarcity	30	31.95025	23
Gambling Bias	35.70731	38.64533	41
Scarcity*Gambling bias	31.94595	49.63027	37
Total	37.0625	46.76563	144

Table 18: Descriptive statistics of final bets placed

Appendix D: Correlation matrix

	Rounds played	Final bets placed	Only scarcity group	Only gambling bias group	Scarcity* Gambling bias group	Age	Gender	Education	Occupation
Rounds played	1.000								
Final bets placed	0.889	1.000							
Only scarcity group	-0.142	-0.066	1.000						
Only gambling bias group	-0.004	-0.018	-0.275	1.000					
Scarcity*Gambling bias group	-0.023	-0.065	-0.256	-0.371	1.000				
Age	0.166	0.077	-0.049	0.029	0.022	1.000			
Gender	-0.126	-0.168	-0.034	-0.141	0.096	0.165	1.000		
Education	0.042	0.073	0.057	0.005	-0.010	-0.310	-0.102	1.000	
Occupation	0.155	0.134	-0.114	-0.145	0.135	-0.245	-0.009	0.057	1.000

Table 19: Correlation analysis of the dependent and control variables.