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What you give, what you get? A Pilot Study on Reward-Dependent Behaviour in Experiments[1]

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Abstract

Is what you give, what you get? Many recent studies have examined the differences between primary- and secondary rewards in social experiments, however, could the specific choice of primary reward actually determine the outcome of your experiment? In this study, we tried to answer the question if experimental behaviour is, in fact, reward-dependent. To answer this question, our research compared behavioural patterns of two comestible rewards, nuts and Oreos, in two traditional games, the dictator- and ultimatum game. In addition, we examined the importance of two potential determinants of primary reward preferences, subjective values and physiological state. Our study found indications of reward-dependent behaviour patterns for ultimatum game proposers. In addition, we found trends suggesting a positive correlation between dictator game proposals and subjective reward values. We postulate that this pattern illustrates a subjective stakes effect for primary rewards inverse to that of traditional monetary stakes effects. Furthermore, we could not find any indications of a relation between the physiological state and experimental behaviour. The results from our study suggests that we react with different decisions on different aspects of the reward-structure, preference biases might have limited robustness across reward media, and inconsistencies in studies on primary- and secondary reward structures could be caused by the choice of reward or quantity of reward. However, our results predominantly indicate that more research is required on reward-dependent behaviour.

Keywords: dictator game; ultimatum game; reward-dependent behaviour; primary rewards; secondary rewards; non-monetary rewards; social preferences; subjective values.

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[1] The views stated in this thesis are those of the author and not necessarily those of Erasmus School of Economics or Erasmus University Rotterdam.

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Chapter 1 Introduction

Since the beginning of experimental economics, there has been an unwritten rule that participants have to receive compensations corresponding to their performance. For years, economists have argued that real rewards induce active participation and the display of true preferences, while hypothetical stakes enable interpretation and socially desirable behaviour (Veszteg & Funaki, 2008; Vlaev, 2012). In fact, the required implementation of real rewards is often seen as an important aspect separating economical- and psychological experiments (Noussair & Stoop, 2015). Being economists, most studies provide monetary payments in their experiments (Sanfey, Rilling, Aronson, Nystrom & Cohen, 2003; Read, 2005; Engels, 2011; Johnson & Mislin, 2011). However, the issue with real rewards is that the very value, providing tangibility to an experimental situation, inherently indicates the power of the prospective reward on the action selection. To be exact, this implies that subjects react on the minutiae of a reward structure for their choice of action, analogous to classic stimulus-based behaviourism (Kahneman, Knetsch & Thaler, 1986).

Indeed, several studies have provided evidence on the correlation between experimental behaviour and reward-structures. For instance, numerous researchers have illustrated independent axiom violations in experiments, of which a well-known example are stake size effects in dictator games (Carpenter, Verhoogen & Burks, 2005; Engel, 2011; Larney, Rotella & Barclay, 2019). Several studies have also investigated inconsistencies of experimental behaviour under different reward-types (Takahashi, 2007; Wright et al., 2012; Noussair & Stoop, 2015; Story et al., 2015; Kause, Vitouch & Glück, 2018; Häusser et al., 2019). In particular, recent interest has been drawn to potential divergences in prosocial behaviour caused by the differences between primary- and monetary rewards (Wright et al., 2012; Noussair & Stoop, 2015; Story et al., 2015; Kause et al., 2018; Häusser et al., 2019; Leder, Pastukhov & Schütz, 2020; Mahmood, Gore & Kagel, 2021; Sorokowska et al., 2021; Wang, Chen, Krumhuber & Chen, 2021). Although some studies found indications of these dissimilar preferences in their experiments, most of the literature on this topic has been inconsistent and contradicting. However, past researches have used a wide variety of different primary rewards to make the comparison with monetary experiments[1]. Yet, the very thing that they try to

[1] To give some examples, Wright et al. (2012) used water, Noussair & Stoop (2015) used time, Story et al. (2015) used pain, Sorokowski et al. (2017) used cookies, and Häusser et al. (2019) used nuts.

illustrate for monetary rewards could influence the outcome of their own experiments. To be exact, the specific choice of primary reward could also affect the experimental behaviour.

In this paper, we consider potential reward-dependent behaviour by comparing behavioural patterns of two comestible rewards, nuts and Oreos, in two traditional games. These games, the dictator- and ultimatum game, are often used to analyse social preferences in a laboratorial setting. In addition, they have frequently been used in researches examining primary- and monetary rewards. The aim of this study is to explore the differences in experimental behaviour between two primary rewards. Therefore, in order to establish these differences, we performed the experiments in two groups, the first group played the games with nuts and the second group played with Oreos. This paper also aims to uncover two potential factors, subjective values and physiological states, underlying reward-dependent behaviour and social preferences in experiments with primary rewards. These components have been postulated by neuroscientific literature to determine reward-dependent behaviour. All in all, this study tries to answer the question if behaviour illustrated in experiments is reward-dependent.

Numerous studies have already found incentive-dependent behaviour after comparing preferences in experiments with monetary incentives and different incentive-types, e.g. cigarettes (Takahashi, 2007), pain (Story et al., 2015), and water (Wright et al., 2012; Kause et al., 2018). However, as far as we know, none of the previous studies have analysed the robustness of preference models by comparing experiments of multiple non-monetary rewards from the same reward-type. Yet, this comparison between two similar rewards could provide more information on reward-dependent behaviour in experiments. In addition, neuroscientific researches have postulated that subjective values, prior neural information and physiological states control our reward-dependent behaviour (Soltani & Wang, 2008; Wang, 2008; Schultz, 2010; Sescousse, Redouté & Dreher, 2010; Levy & Glimcher, 2011; Wu, Delgado & Maloney, 2011; Delgado, Joe & Phelps, 2011; Yousuf, Heldmann, Göttlich, Münte & Doñamayer, 2018), however, very few studies have provided empirical evidence that these factors influence our decisions.

Our study makes three contributions to the existing literature. First, this paper provides preliminary data on deep-rooted reward-dependent behaviour and therefore information on the cause of conflicting results in experimental literature. Second, this study is one of the first economical researches to examine neuroscientific philosophies underlying our decisions, therefore, contributing to the literature trying to understand the motivations of our preferences.

Third, this study contributes to the ongoing discussion on the external validity of experiments and the ability to generalize discovered phenomena.

The rest of the paper is structured as follows. Chapter 2 elaborated upon the theoretical framework. Chapter 3 discusses the experimental design and procedure. Chapter 4 presents the results. Chapter 5 provides further elaboration and rationalisation of the results. Chapter 6 concludes.

Chapter 2 Theoretical framework

This chapter discusses the theoretical framework and background of reward structures and reward-dependent behaviour in experiments. First, section 2.1 discusses the literature on upsides and downsides of monetary reward structures, the current industry standard. Hereafter, we discuss the literature on similarities and discrepancies between primary- and secondary reinforcers in section 2.2. Furthermore, section 2.3 elaborates upon the concepts underlying potential reward-dependent behaviour. Lastly, we formulate these concepts into our three sets of hypotheses in section 2.4.

2.1 Monetary reward structures

In economical experiments, providing real task-related payments in performance experiments are an unwritten requirement. To be exact, it is common for experimenters to incentivize subjects with an expected monetary return that corresponds to their performance during the experiment (Sanfey et al., 2003; Read, 2005; Engels, 2011; Johnson & Mislin, 2011). Therefore, throughout the years, numerous studies have examined the compatibility of monetary rewards in experiments (Coombs & Komorita, 1958; Vroom, 1964; Smith, 1976; Smith, 1982; Smith & Walker, 1993; Bardley et al., 2010). These studies have often brought forward two distinct strings of arguments in favour for the use of monetary rewards in experiments. First, one of the most common arguments is on the compatibility with utility and transitivity towards other reward media. For instance, in 1958 Coombs & Komorita debated that preferences could be explained and predicted after considering the utility of money. They argued that subjects have a finite range of possible preferences when the expected monetary outcomes are identical for each option (Coombs & Komorita, 1958). In addition, Bardley et al. (2010) discuss that, as monetary rewards are concrete pay-offs, they can be exploited as a proxy for utilities in game-theoretic experiments. Thus, they assume that utility-maximizing preferences are revealed through the monetary decisions. However, they note that this standard payoff-bridging principle does not account for other-regarding motives. Furthermore, Vroom (1964) postulated that money as a financial reward could be used to acquire things that subjects desires, which is often associated with the Tool Theory (Lea & Webley, 2006). The Tool Theory of money argues that money is not an incentive itself, the only incentive that is provided is through the ability to exchange money for goods and services. Therefore, the Tool Theory

asserts that monetary rewards are strong motivators as they capture the incentives of many goods and services.

Second, economists often argue that monetary reward-structures are a necessity in laboratorial settings as they satisfy the four precepts of the induced-value theorem, non-satiation, salience, dominance and privacy (Smith, 1976; Smith, 1982; Smith & Walker, 1993). Nobel Laureate Vernon Smith argued that a reward structure has to satisfy these four principles in order to accurately reveal true preferences. The non-satiation precept contends that obtaining an extra unit should always be preferred over the alternative, given a costless choice, thus, arguing that more is always better. In addition, the salience dictum postulates that the subjects are guaranteed a prospective reward corresponding to their performance during the experiment. To be exact, the salience precept argues that subjects should not be deceived. Moreover, the dominance axiom assumes that the reward structures dominates any potential subjective costs corresponding with actions taken during the experiment. For instance, an experimenter should provide enough incentive for subjects to be willing to think about their decisions. Furthermore, the privacy precept argues that only information on the subject's own pay-off alternatives should be provided. Smith (1982) argued that revealed preferences are potentially inconsistent and erroneous if the reward structure of an experiment is limited in satisfying these four axioms. Most non-monetary rewards, however, are often considered to be limited in some degree on at least one of the four precepts[2].

Although monetary reward systems are often deemed optimal for behavioural experiments, there are a few downsides to be considered. For instance, Amir, Ariely & Carmon (2008) deliberated that monetary assessments measure the transactional utility but fail to account for consumptive pleasure provided by the reward itself. To be exact, subjects do consider the fairness underlying the transaction or trade, however, they don't contemplate the utility that the reward can produce. In addition, Lea & Webley (2006) dissertate that the Tool Theory of money is inadequate, as money also incentivizes as a cognitive drug. They note that money has no biological relevance itself, however, it still generates the same neural and behavioural impact as some biologically significant stimuli. Building upon research from Zink et al. (2004), which found that the simple presence of money already activated specific brain centres, Lea & Webley (2006) argued that money could, as a drug, overstimulate brain centres corresponding with

[2] For instance, perishable edible rewards have a bounded non-satiation.

trading tendency and reciprocal altruism. As a consequence, monetary reward could provide an inadequate impression of trade and reciprocation in experiments. Analogously, recent studies have proven that monetary rewards provide a self-accelerating motivational incentive (Yang et al., 2020). As a consequence, various studies have reported stake size effects in dictator- and ultimatum games. To be exact, empirical evidence has illustrated that, in dictator games, proposers share a smaller endowment with the receiver in experiments with higher stakes (Carpenter et al., 2005; Engel, 2011; Larney et al., 2019). Comparably, studies have illustrated that rejection rates are lower in ultimatum games with higher monetary stakes (Slonim & Roth, 1998; Cameron, 1999; Munier & Zaharia, 2002; Larney et al., 2019).

2.2 Primary- and secondary reinforcers

As money is a secondary reinforcer and has no biological relevance, numerous studies have examined whether the reward-processing, decision making process and the generalized experimental results are similar to primary rewards. On one hand, neuroscientific literature has well established that primary and secondary reinforcers have similarities in brain centre activations (Delgado, Nystrom, Fissell, Noll & Fiez, 2000; Berns, McClure, Pagnoni & Montague, 2001). For instance, both primary and secondary reinforcers evidently activate the striatum, a neural region associated with reward-related processing and the decision making process (Delgado et al., 2000; Berns et al., 2001). On the other hand, Sescousse, Caldú, Segura & Dreher (2013) found that primary rewards had a higher activation rate in the anterior insula. Among other things, the anterior insula processes emotions and social emotions, such as empathy. In addition, Simon et al. (2015) found that the anticipation of food rewards provides a stronger stimulus towards self-control and self-reflection. Furthermore, Batson, Duncan, Ackerman, Buckley & Birch (1981) executed the renounced shock experiment in which subjects observed a young woman receive electrical jolts and were allowed volunteer to take the remaining shocks. By inducing different levels of empathy, they found that the additional levels of empathy linked to primary rewards led to supplementary altruistic behaviour. Analogously, various researches illustrated a higher level of altruistic behaviour in non-monetary contexts compared to monetary contexts (Batson et al., 1981; Batson, Quin, Fultz, Vanderplas & Isen, 1983). However, when it comes to traditional behavioural experiments in laboratorial settings, psychological and economical studies have illustrated contradicting results on the discrepancies between primary and secondary rewards.

On one hand, numerous studies found that subjects were more willing to share parts of their endowment in experiments with primary rewards (Story et al., 2015; Kause et al., 2018; Häusser et al., 2019; Leder et al., 2020). For instance, Kause et al. (2018) found in their pilot study that thirsty participants were more willing to share water than money in dictator games. In addition, Story et al. (2015) found that subjects had a higher propensity towards fairness in experimental games distributing pain rather than money. Story et al. (2015) argued that the supplementary altruistic motivation arose from the fundamental principle of diminishing marginal utility. Moreover, Häusser et al. (2019) dissected the differences in nuts- and monetary allocations among numerous experimental paradigms and found that participants were far more willing to share nuts. Furthermore, Wright et al. (2012) found that thirsty participants illustrated lower rejection rates in ultimatum games. Lastly, Leder et al. (2020) found discrepancies in dictator game proposals between experiments with time- and monetary rewards. To be exact, they examined the time offered by proposers to help increase the payoff of the responder and found that participants were far more generous with their time than their money.

However, on the other hand, many other studies could not find any discrepancies in allocations between primary and secondary rewards (Noussair & Stoop, 2015; Sorokowski et al., 2017; Sorokowska et al., 2021). For instance, Noussair & Stoop (2015) found evidence that monetary rewards and time-related rewards produced similar behavioural patterns in dictator games, ultimatum games and trust games. In addition, Sorokowski et al. (2017) compared the behavioural patterns of dictator games with monetary, food and daily object rewards among cultures and could not find any evidence of discrepancies. Moreover, Sorokowska et al. (2021) provided evidence of a heightened other-regarding behaviour in empathy-induced food contexts, however, this effect disappeared in the laboratorial setting.

2.3 Reward-dependent behaviour

These prior studies on reward related behaviour in experiments have focussed upon differences in reward type, however, there is a lack of consistency among on the specifics of the reward. To be exact, prior studies used different rewards within the same reward-type to analyse similar hypotheses and found dissimilar results. As a consequence, failing to account for potential reward-dependent behaviour beyond the reward-type. Although literature on this topic is sparse, neuroscientific studies provide a preliminary basis on deep-rooted reward-dependent behaviour.

Numerous neuroscientific studies place the subjective reward value at the foundation of the decision-making process (Schultz, 2010; Sescousse et al., 2010; Levy & Glimcher, 2011; Wu et al., 2011; Dreher, 2013). In addition, various researches link prior neural information and physiological state to reward adaptive choice behaviour (Hikosaka, Bromberg-Martin, Hong & Matsumoto, 2008; Soltani & Wang, 2008; Wang, 2008; Wallis & Kennerley, 2010; Yousuf et al., 2018). For instance, Dreher (2013) argues that the subjective value of the reward at the time of the decision works as a neural currency, individuals use this neural currency to assess their choices and make a decision in experimental games (Surgue, Corrado & Newsome, 2005). As a consequence, people use subjective- rather than objective values to assess the reward incentives and choices (Wright et al., 2012). However, on average, rewards will vary in their subjective values, which inherently suggests reward-dependent behaviour and subjective stakes effects during experiments.

As mentioned, prior neural information is often linked to subjective values and the decision-making process (Soltani & Wang, 2008; Wang, 2008). Soltani & Wang (2008) argued that prior neural reward information influences cognitive systems associated with action selection and execution. For instance, past sense experiences are involved in the decision-making process through reward-dependent synaptic plasticity (Soltani & Wang, 2008; Wang, 2008). To give an example, sensorial characteristics associated with a food reward, e.g. smell or taste, could influence the subjective value assigned to the reward and therefore the choice of behaviour. In addition, prior emotions or social contexts associated with an incentive could influence the decision-making process (Hikosaka et al., 2008; Wallis & Kennerley, 2010). For example, take the study from Murnighan & Saxon (1998), which illustrated lower rejection rates in ultimatum games using M&M's, simply because it made the subjects smile.

Furthermore, the study of Wright et al. (2012) indicates that changes in the physiological state could potentially influence the subjective value assigned to a primary reward. To be exact, being thirsty increases the subjective value of water. Analogously, Yousuf et al. (2018) found a link between neural processing of food reward related centres and metabolic states. They argue that individuals in a hungry metabolic state have shown higher activations in motor- and sensory-related centres when confronted with a food reward. In addition, they illustrate that interactions between the physiological state and reward-type alters the activity in reward-processing centres. Thus, the physiological state could influence the subjective value assigned to the reward at the time of the experiment. Furthermore, the physiological state could stimulate the subjective value through cognitive connections between the reward and the physiological

state (Yousuf et al., 2018). To give an example, being hungry could potentially have a stronger impact on the subjective value of a sandwich compared to candy.

2.4 Hypotheses

The literature on subjective values, prior neural information and physiological states suggest reward-dependent behaviour rather than universal preferences or reward-type dependent behaviour. Following this reasoning, we construct three sets of hypotheses.

In the first set of hypotheses, we hypothesize that the behaviour patterns are different for two rewards of the same reward type. The set of hypotheses can be split in three ways. First, we postulate that the mean proposed allocation in the dictator game will be different between the nuts- and Oreos reward conditions. Second, we hypothesize that the mean proposed allocations in the ultimatum game will not be equal between the two reward conditions. Third, we postulate that the mean rejection threshold in the ultimatum game will differ between the two reward conditions.

The nuts reward condition has already been used by Häusser et al. (2019), and they found a disparity in altruistic behaviour in comparison with monetary reward conditions. Contrarily, Sorokowski et al. (2017) used cookies to examine the same hypothesis and found no dissimilarities. Hence, we expect that the comparison of these two conditions under the same laboratorial setting will illuminate the discrepancies of reward-dependent behaviour.

In the second set of hypotheses, we hypothesize that participants with a high subjective reward value would behave differently from participants with a low subjective reward value. Once again, the set of hypotheses can be split in three ways. First, we postulate that the distribution of comparatively fair dictator game allocations is not equal between subjects with high- or low subjective reward values. Second, we hypothesize that the distribution of comparatively fair ultimatum game proposals is different between subjects of high- or low subjective reward values. Third, we postulate that the distribution of comparatively high inequity averse rejection thresholds differs between subjects with high- or low subjective reward values.

The neuroscientific literature on subjective reward values illuminate the strong involvement in our decision-making process. Although no prior studies have examined the influence of subjective values on proposals in dictator- and ultimatum games, Wright et al.

(2012) found that physiologically inducing the subjective value of water led to lower rejection thresholds. Therefore, indicating the similarities between subjective values and stakes effects. Analogous to the non-laboratorial study of Sorokowska et al. (2021), willingness-to-pay measurements are used as a proxy for the subjective reward values.

In the third set of hypotheses, we postulate that that, in experiments with primary rewards, subjects with a higher subjective hunger will make different decisions than subjects with a lower subjective hunger. As before, the third set of hypotheses can bet split into three separate hypotheses. First, we hypothesize that, in the dictator game, the distribution of comparatively fair allocations is not equal between subjects with a high- or low subjective hunger. Second, we hypothesize that the distribution of comparatively high offers in the ultimatum game is different between subjects with a high- or low subjective hunger. Third, we hypothesize that the distribution of comparatively high rejection thresholds in the ultimatum game differs between subjects with a high- or low subjective hunger.

A few studies have already found laboratorial indications that physiological states can influence our decisions in dictator- and ultimatum games. For instance, subjectively thirstier individuals were more likely to accept unfair offers in ultimatum games (Wright et al., 2012). Furthermore, Kause et al. (2018) provided preliminary results on physiological “hot” states inducing the propensity to share in dictator games. Therefore, we expect that the distributions will not be equal between the subjective hunger groups.

Chapter 3 Methodology

This chapter elaborates on the methodology used in this study to examine reward-dependent behaviour. First, section 3.1 provides a detailed description of the experimental design followed by a clarification of the sample selection procedure in section 3.2. Hereafter, we discuss the experimental procedure in section 3.3 and match the hypotheses to the statistical tests in section 3.4.

3.1 Experimental design

The experiment consists of two behavioural games, a dictator game (DG) and an ultimatum game (UG). These games are frequently used in social studies to examine altruism and sensitivity to fairness respectively (Brañas-Garzia, 2006; Wittig, Jensen & Tomasello, 2013). This experiment executed both these behavioural games in an online interactive laboratorial setting under two different reward conditions. Under the first condition, subjects had to allocate 10 bags of 10-gram nuts between themselves and the other player, while under the second condition, subjects played the same games for the endowment of 10 Oreo cookies. Each subject played first the dictator game and then the ultimatum games, and was randomly assigned to either one of the conditions. This structure therefore enabled us to compare, on a between-subjects level, the behavioural patterns under two reward conditions.

Congruous to the traditional dictator- and ultimatum games, each subject was matched with another subject before the experiment starts. Homologous to Häuser et al. (2019), each session was held preceding a meal and participants were requested to sustain from eating prior to the experiment. Furthermore, this study applied a single-blind construct to establish anonymity, thus, limiting the influence of social cues and social pressure on the decisions made in the games (Rigdon, Ishii, Watabe, & Kitayama, 2009). Although subjects played both the dictator- and the ultimatum games in one session, each agent only executed a role once. Hence, a subject that fulfilled the role of proposer in the dictator game subsequently played the responder in the ultimatum game. Contrariwise, the proposer in the ultimatum game was priorly the receiver in the dictator game.

Minutes before and after playing the experimental games, subjects had to fill out a few relevant questions. To be exact, prior to the games, subjects had to answer demographic

questions on age, gender and current educational status. In addition, they had to indicate the hours since their last meal and subjective hunger on a ten-point Likert scale (Appendix C). Directly after the behavioural games, subjects were requested to fill out a post-experimental survey containing questions on their fondness of the reward, willingness-to-pay, and the option to donate a monetary equivalent of the reward to donate the monetary equivalent of the real reward to charity (Appendix B).

Each pair of subjects played first the dictator game and subsequentially the ultimatum game, however, the outcome of the dictator game was not revealed until the matched pair completed the ultimatum game. This was to avert the influence of unsolicited reciprocity from the dictator game onto ultimatum game decisions. To be specific, being uninformed about the dictator game allocations induced the subjects to make augmented unprejudiced decisions in the ultimatum game.

The subjects received their condition corresponding task-related payment through the medium of a random-lottery incentive system (Cubitt, Starmer & Sugden, 1998). To be specific, subjects were paid either the established distribution of the dictator- or the ultimatum game. The reward structure was communicated to the subjects prior to the sessions (Appendix A), therefore, providing a real reward incentive analogous to the experimental decisions. However, upon completion of the experiment, subjects were given a choice to receive either the real reward or donate the monetary equivalent to a food-related charity, "Voedselbanken"[3]. The experiment was executed online and therefore subjects were required to provide their address to receive the real reward, thus, the option to donate the monetary equivalent to a charity allowed participants to preserve their anonymity.

By applying the random-lottery incentive system, we limited the predisposition of the dictator game proposals upon the ultimatum game rejection thresholds. To be exact, the random-lottery incentive system averted that self-compensation in the dictator games lead to lower rejection thresholds in the ultimatum games. In addition, the reward structure provided tangibility to the potential outcome of both parties leaving without compensation after an offer rejection. As a consequence, the random lottery incentive system capacitates true behavior by making action-related consequences more tangible.

[3] The "Voedselbanken" is a Dutch charity that provides food to low income households on a national scope.

3.1.1 The dictator game

The dictator game comprised two positions, proposer and receiver. The proposer submitted a proposition for the allocation of the commodities. For instance, the proposer could decide to allocate three bags of nuts to the other agent and keep seven bags of nuts for himself. In the dictator game the receiver is obliged to accept the allocation proposition made by the proposer. Consequently, the proposer decided which extent of the endowment would be included in his random lottery and how much would be given to the other agent. The subjects were randomly assigned to either the role of proposer or the role of receiver. The information and instructions on the dictator game that was provided to the subjects can be found in Appendix B and C.

3.1.2 The ultimatum game

This study used a strategy method in the ultimatum game. This ultimatum game, analogous to the dictator game, encompassed two functions, the proposing- and responding role. Analogous to the dictator game, the proposer submitted a proposition for the allocation of commodities. Coetaneous, the responder decided upon their rejection threshold. Offers below the threshold were automatically rejected and offers at or above the threshold were automatically accepted. The rejection of the proposition meant that neither of the agents would receive rewards for the ultimatum game in the random lottery. Adversely, an accepted proposal meant that the established distribution of the endowment would be included in the random lottery. Moreover, the roles in the ultimatum game were antitheses to that in the dictator game.

3.2 Sample selection

The subjects were recruited for our experiment viva voce and by snowball sampling. As a consequence, most subjects originated from the Dutch cities of Amsterdam, Gorinchem, Rotterdam and Zoetermeer. All subjects were contacted in the months January and February of 2021 to solicit their participation in the experiment. In addition, participants that already completed the experiment were requested to provide new candidates (Appendix B).

This study has used various exclusion criteria to avert biases and complications. First, people with allergenic genes corresponding to either of the rewards were precluded from partaking in the experiment to avert medical consequences. Second, subjects that did not

complete the entire experiment were omitted from the sample pool. Third, during the experiment, subjects had to indicate their fondness of the reward corresponding to their session on a five-point Likert scale. Analogous to Häusser et al. (2019), participants that noted a zero on the fondness Likert scale were excluded from the sample pool to avert biased results caused by complete reward aversion. Eventually zero subjects were excluded from the sample, as none of the participants failed to meet these criteria.

This paper is a pilot study, therefore, our sample size can be relatively small. We determined that a minimum sample size of sixty subjects was, at least, necessary to enable us to provide preliminary data on reward-dependent behaviour. To be exact, a sample of sixty subjects would mean thirty under each condition, thus, fifteen under each subsample. Therefore, a smaller sample would make the probability of spurious postulations, caused by biased results, too big.

Nonetheless, we also performed an a priori power analysis to obtain an estimate of the sample size that would have been required to get powerful and significant results. However, as far as we know, this is the first study comparing experimental behaviour of two primary rewards from the same type. Hence, we used parameters of the study from Häusser et al. (2019), which compares dictator game behaviour with nuts and money, to get a robust estimate of the required sample size for analysing reward-dependent behaviour[4]. We executed the power test for two-sided Wilcoxon-Mann-Whitney tests with G*Power 3.1. (Faul, Erdfelder, Buchner & Lang, 2009), using a 95% power interval, an α error probability of 0.05 and an effect size of 0.44. The outcome of the power test illustrated that an estimate of 280 subjects would be required to obtain powerful and significant results.

3.3 Procedure

Subjects were predominantly conscripted through viva voce and snowball sampling. Individuals with interest in participating in the study received an email with further information. Among other information, this email clarified further proceedings, the reward structure and potential allergic hazards involved (Appendix A). Moreover, subjects received a calendar to

[4] As mentioned in chapter 2, Sorokowski et al. (2017) used cookies to examine discrepancies between primary- and secondary rewards, analogous to us. However, unfortunately, they did not provide enough parameters to perform an a priori power test.

note in which sessions they would be able to partake. By randomly assigning subjects to the sessions, possibilities of self-matching were limited[5]. Furthermore, subjects received an email 24 hours prior to the session as a reminder and to provide the links to the experimental platform (Appendix A).

As mentioned, the experiment took place in an online laboratorial setting[6]. Both subjects received two distinctive links. The first link brought them to a Google Spreadsheets file and the second connected them to a Google Slides document. During the experiment, subjects were requested to insert their answers and decisions into the designated Google Spreadsheets cells. Furthermore, subjects were informed that the experimental explanation and the decisions made during the session would appear on the Google Slides document. As these four digital documents stood in communication, decisions were communicated to both players. To be exact, after confirmation, each game decision was automatically communicated from the Google Spreadsheets document to both Google Slides files. The digital platforms were programmed to routinely refresh the data, therefore, limiting the information delay to mere seconds. At each part of the experiment, before moving on, subjects were required to wait for visual confirmation of completion from both agents. Subsequentially, the players and data moved through the experiment at the same time[7]. In addition, the visual confirmation provided the perception of playing against another person, and therefore stimulating subjects to reveal their true preferences. The structure of the digital platform also limited communications between the two agents to the predesigned format. Analogous to neuroscientific studies (Delgado et al., 2000; Berns et al., 2001; Sescousse et al., 2013), pictures of the rewards were provided throughout the experiment to provide a visual stimulus and incentivize reward-dependent behaviour.

When arriving on the digital platform, subjects were requested to answer the pre-experimental questionnaire (Appendix B & C). To be specific, subjects were asked to provide some typical demographic characteristics, age, gender and educational status. Moreover, analogous to Häusser et al. (2019), subjects had to indicate their subjective hunger and time since their last meal. In addition, general information on the experiment was repeated

[5] As the experiment occurred online, a session usually existed out of one or two groups. Hence, allowing subjects to choose their own session would enable them to self-match.

[6] The experiments were executed during the Covid-19 health crisis, therefore, physical experiments were not possible due to contamination risks.

[7] Visual confirmation was automatically provided through the data from Google Spreadsheets files. Therefore, visual confirmation also meant that the decisions were communicated to the Google Slides documents.

(Appendix B). The information on the dictator game was provided after both agents confirmed that they understood the information and filled out the pre-experimental questionnaire (Appendix B). The dictator game proposer was allowed to submit his decision once both agents confirmed that they understood the new material. Hereafter, the information on the ultimatum game was provided (Appendix B). Once again, after confirmation, both players were able to lock in their decisions on the ultimatum game. Subsequentially, both the results from the dictator- as the ultimatum game were communicated towards the subjects. In addition, the subjects received a link to a post-experimental questionnaire (Appendix B). This questionnaire contained on their fondness of the reward, willingness-to-pay, and the option to donate a monetary equivalent of the reward to charity. Upon completion of the experiment, the subjects received an email on which of the games would be paid out and received their rewards within 24 hours after providing their address (Appendix B)[8].

3.4 Hypotheses and statistical tests

This study has three sets of hypotheses to answer our research question. In the first set of hypotheses, we postulate that the behavioural patterns are different between the two conditions. To test the first set of hypotheses, we use the three decision variables, dictator game proposals, ultimatum game proposals, and ultimatum game rejection threshold of each condition. To be specific, we compare the means of the three decision variables from the nuts condition with the three means of the decision variables from the Oreos condition, using a distinct Mann-Whitney U test for each of the decision variables respectively. The dictator game proposals variable measures the proportion of the endowment allocated towards the other player by the proposer in the dictator game, while the ultimatum game proposals variable measures the portion of the endowment offered by the proposer to the responder in the ultimatum game, and the ultimatum game rejection threshold variable measures the level of rejection thresholds from the responders in the ultimatum game.

Furthermore, in the second set of hypotheses, we postulate that participants with a high subjective reward value would behave differently from participants with a low subjective reward value. To test our second set of hypotheses, we combine each of the three distinct

[8] The experiment was executed online, therefore the rewards had to be delivered to an address. As a consequence, the delivery of rewards was delayed rather than direct.

decision variables from the two conditions and create three new high-low binarized decision variables. These three high-low binarized decision variables take a value of 1 for comparatively high allocations and rejection thresholds, and a value of 0 for comparatively low allocations and rejection thresholds. Therefore, creating new high-low binary variables for dictator game proposals, ultimatum game proposals, and ultimatum game rejection thresholds respectively. In addition, we use a high-low binarized willingness-to-pay variable, which takes a value of 1 for comparatively high willingness-to-pay and a value of 0 for comparatively low willingness-to-pay, to proxy subjective values. This provide us a separation between the subjects with high subjective values and the subjects with low subjective values. The equal distribution of comparatively high allocations, and rejection thresholds from the binarized decision variables is tested for the high- and low subjective value groups using three 2x2 Fisher exact tests and three 2x2x2 Cochran-Mantel-Haenszel tests.

Moreover, in our third set of hypotheses, we postulate that, in experiments with primary rewards, subjects with a higher subjective hunger will make different decisions than subjects with a lower subjective hunger. To test the third set of hypotheses, we utilize the same binarized high-low decision variables as in the previous analyses. In addition, we use a high-low binarized subjective hunger variable, which took the value of 1 for comparatively high subjective hunger ratings and the value of 0 for comparatively low subjective hunger ratings, as a proxy for the physiological state. This allows us to have a separation between subjects which noted that they were relatively hungry and subjects which noted that they weren't relatively hungry. Similar as before, the equal distribution of comparatively high allocations and rejection thresholds from the binarized decision variables is tested for the high- and low subjective hunger groups using three 2x2 Fisher exact tests. We do not apply the 2x2x2 Cochran-Mantel-Haenszel tests for the third set of hypotheses, because the questions on the subjective hunger were asked at the start of the experiment. As a consequence, there is no requirement to stratify for the reward incentive used during the session.

All three of the hypotheses sets are also tested upon robustness in regression analyses of Appendix F. To be exact, we applied a robustness ordinary least squares regression (Hereafter: OLS) for each of the three decision variables as dependent variables. Furthermore, we used a binary variable for reward as explanatory variable. This binary variable took the value of 1 for the Oreos condition and the value of 0 for the nuts condition. In addition, we used continuous variables for willingness-to-pay and subjective hunger as explanatory variables. Furthermore, we use the following control variables, male, student, age, fondness of incentive, and donation.

In addition, we used an extra control variable, for the dictator game proposals, in the ultimatum game rejection threshold robustness analysis to test for a possible anchor effect. The control variables, male, student and donation were binary variables, which took the value of 1 for males, students/recent graduates and donated to charity respectively, and the value of 0 otherwise. The control variables age and fondness of incentive were continuous.

Chapter 4 Results

This chapter reports the results of our experiments and statistics. We will start by discussing the distribution of the sample in section 4.1. Hereafter, we will compare the proposals made during the dictator- and ultimatum game in section 4.2, and the ultimatum game rejection thresholds in section 4.3. Lastly, section 4.4 and 4.5 will examine the relevance of subjective values and subjective values respectively.

4.1 Participants

The total sample of our study consisted of 60 participants, half of the participants executed the experiments under the nuts condition and the other half under the Oreos condition. In addition, the subjects in these condition subsamples were further divided over the types of players. The first type of player contain the dictator game proposer- and ultimatum game responder position, while the second type of player contain the dictator game responder- and ultimatum game proposer position. Therefore, in this section, we abbreviated the first set of roles to DG and the second set of roles to UG. Table 1 provides more information on the demographic characteristics of the sample and subsamples.

Table 1. Decriptive statistics of the sample per subsample

	Total sample			*Nuts subsample*			*Oreos subsample*		
	Total	DG	UG	Total	DG	UG	Total	DG	UG
N	60	30	30	30	15	15	30	15	15
Male (%)	58.4	56.7	60.0	63.4	66.7	60.0	53.4	46.7	60.0
Student (%)	66.7	46.7	86.7	63.3	40.0	86.7	70.0	53.3	86.7
Age[1]	32.1	36.7	27.5	32.5	37.7	27.3	31.8	35.8	27.7
Fondness of incentive[1]	3.5	3.7	3.3	3.9	4.1	3.6	3.1	3.3	3.0

[1] The age and fondness for incentive numbers illustrate the means.

As can be seen from the demographic statistics, more than half of the subjects partaking in the experiment were male, 58.4% to be exact. In addition, the distributions of male participants was equal among the nuts- and Oreos subsamples (p = 0.998, Kolmogorov-Smirnov test), and the DG- and UG subsamples (p = 1.000, Kolmogorov-Smirnov test).

Furthermore, although the DG Oreos subsample has a notably lower percentage of male participants (46.7%), statistical tests illustrate that the distribution is not significantly different with the DG nuts subsample (p = 0.925, Kolmogorov-Smirnov test). Therefore, this will not provide any complications in the statistical analyses.

Another interesting aspect of the demographic characteristics is the high participation of students and recent graduates (66.7%). In particular, the fact that the percentage of students and recent graduates in the UG subsample were 86.7%, and therefore significantly lower than the DG subsample (p = 0.016, Kolmogorov-Smirnov test). However, the subsamples of the nuts- and Oreos conditions contain similar proportions and therefore corresponding biases are likely limited (p = 1.000, Kolmogorov-Smirnov test).

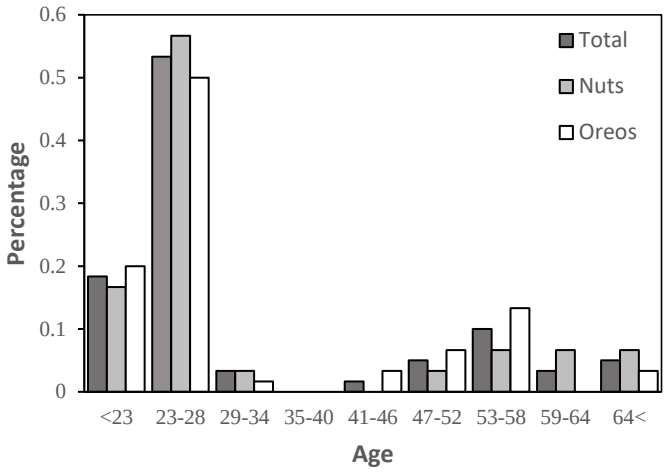

Figure 1. Distribution of age among the samples

Furthermore, as can be seen in Fig. 1, most of the participants were between the age of 23 and 28. The sample is dominated by a younger population, therefore, the sample is skewed toward the right. As a consequence, the average age of the sample is 32.1. Moreover, on average, the histogram in Fig. 1 and the demographic statistics illustrate an equal distribution of age between the two reward conditions (p = 0.799, Kolmogorov-Smirnov test). Though, analogous to the earlier observation on the subsample student distributions, the average age of the DG subsamples are remarkably higher (p = 0.035, Kolmogorov-Smirnov test). However, once again, these occurrences are similar between the two conditions. Therefore, we can assume that the deviations in age distribution will not affect our analyses.

Moreover the statistics illustrates that, on average, participants had a higher self-indicated fondness for the nuts condition in both position subsamples. Furthermore, in general, subjects indicated a larger affection for their corresponding reward incentive in the DG subsamples. A potential explanation is that subjects in DG subsamples had to use more cognitive attention to make decision involving the reward. Therefore, as a consequence, indicating a higher fondness for the incentive afterwards.

4.2 Proposals in the dictator- and ultimatum games

A summary of the proposed allocations exhibited during the two games is provided in Table 2. Furthermore, Fig. 2 and Fig. 3 illustrate the distribution of proposals in the dictator- and ultimatum games respectively. The percentages provided in the tables and figures throughout the paper indicate the proportion of the total endowment that the proposer was willing to offer to the other player.

Table 2. Descriptive statistics of the proposal decision variables per sample and subsample

	Total sample		*Nuts subsample*		*Oreos subsample*	
	DG	UG	DG	UG	DG	UG
N	30	30	15	15	15	15
Mean (%)	35.3	42.3	32.7	38.0	38.0	46.6
Median (%)	30.0	40.0	30.0	40.0	30.0	50.0
Std. dev (%)	19.1	13.0	15.3	10.8	22.4	14.0

The descriptive statistics exhibit that, for both the dictator- and ultimatum game, the mean proposed allocation was higher under the Oreos condition. In addition, the median proposals in the ultimatum game is ten percentage points higher under the Oreos condition comparatively to the nuts condition. However, although the mean allocated volume is higher under the Oreos condition in the dictator game, the median is 30% for both conditions. Furthermore, the standard deviation of the Oreos condition is repeatedly higher than the nuts condition, indicating that the illuminated discrepancies could be the consequence of the extremes discernible in Fig. 2. Nonetheless, Fig. 3 still illustrates a distinct difference in the proposed allocation for the two conditions during the ultimatum game. Particularly, the distinguished weight on the inequity distribution of Oreos in Fig. 3 exhibits either a larger

propensity towards fairness or a larger anticipated rejection threshold. Furthermore, although the difference is statistically insignificant, it is notable that the proposals during the ultimatum game are higher than those during the dictator game (p = 0.134, Kolmogorov-Smirnov test). This is homologous to the study of Rand, Tarnita, Ohtsuki and Nowak (2013), which found subjects to be more inequality aware due to the possibility of an offer being rejected.

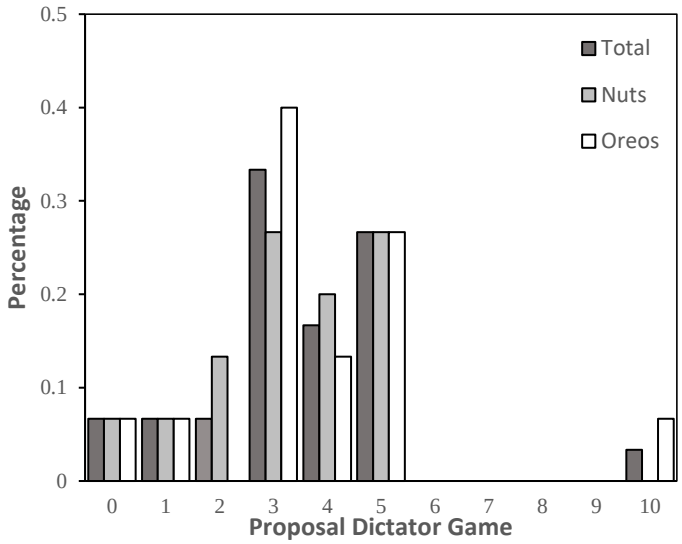

Figure 2. Distribution of proposals in the dictator game

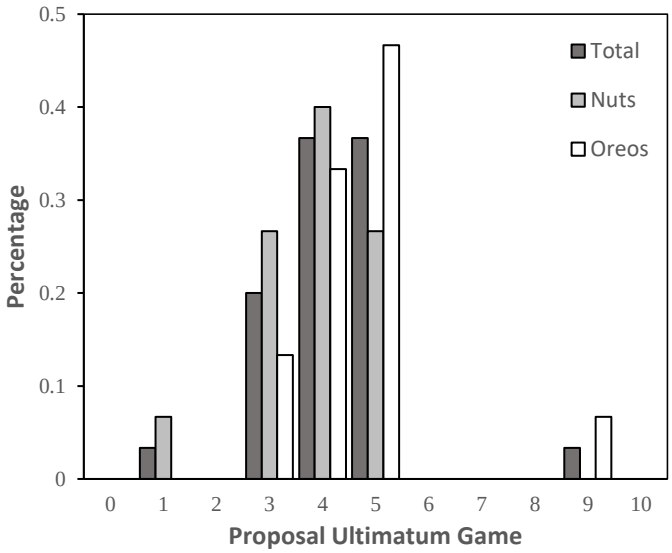

Figure 3. Distribution of proposals in the ultimatum game

As earlier mentioned, the incongruities illustrated in the descriptive statistics could be the consequence of extremes providing a distorted perception. Hence, Mann-Whitney U tests were used to examine the discrepancies between the two conditions. Mann-Whitney U tests are

quintessential to analyse small and poorly distributed samples, therefore a strong alternative for the independent t-test (Nachar, 2008). As the Mann-Whitney U test is a ranked test, the extremes are smoothened in the statistics.

Each distinctive proposal made in the dictator- and ultimatum game was taken as an independent observation. The test was repeated for both the dictator- as the ultimatum games independently. Comparing the nuts and Oreos condition in the dictator game, we found no significant divergence between the endowment offered by the proposers (p = 0.62, Mann-Whitney U test). In addition, comparing the nuts and Oreos condition in the ultimatum game, we found a weak significant difference, at a 10% significance level, between the proposals made by the proposers under the two conditions (p = 0.08, Mann-Whitney U test). Thus, although no conclusive statistically significant evidence, the results provide modest trends indicating for a potential reward-dependent behavioural pattern.

4.3 Rejection thresholds in the ultimatum game

This study also examined the reward-dependent behaviour of the responders in the ultimatum game. The strategy method has been used to provide independent and quantifiable datapoints, therefore responders were asked to fill out their rejection thresholds. The descriptive statistics of rejection threshold behaviour is illustrated in Table 3. The distribution of rejection thresholds is displayed in Fig 4.

Table 3. Descriptive statistics on the rejection threshold variable per sample and subsample

	Total sample	*Nuts subsample*	*Oreos subsample*
N	30	15	15
Mean (%)	32.3	30.0	34.7
Median (%)	30.0	30.0	30.0
Std. dev (%)	17.7	12.0	22.3

Similar as with the proposals of the dictator- and ultimatum game, there is a divergence in the mean rejection threshold between nuts and Oreos, being 30.0 and 34.7 respectively. In addition, the median and standard deviation illustrate a pattern analogous to that of the dictator game. Once again, the medians are identical and the standard deviation of the Oreos condition is larger than that of the nuts condition, being 12.0% and 22.3% respectively. This illuminates

a potential anchor effect in the decisions, which also becomes apparent in the robustness regressions of Appendix F. Fig 4 exhibits a notable similarity between the two conditions for the lower half of the rejection thresholds. However, the higher bound rejection thresholds were more prominent in experiments using Oreos as rewards. Thus, explaining the larger mean rejection threshold and standard deviation under the Oreos condition.

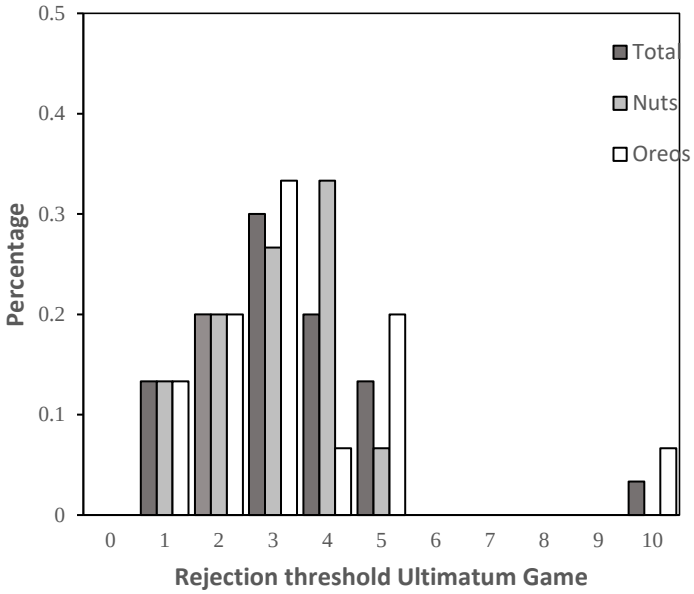

Figure 4. Distribution of rejection thresholds in the Ultimatum game

Similar to the proposal analyses, Mann-Whitney U tests were used to examine whether the rejection thresholds diverged under the two conditions. Each distinctive decision on the height of the rejection threshold was taken as an independent observation. Comparing the ultimatum games of the nuts and Oreos conditions, we found no significant difference between the rejection thresholds (p = 0.83, Mann-Whitney U test). Thus, providing no significant evidence of reward-dependent behaviour for responders in the ultimatum game.

4.4 Subjective values

Neuroscientific studies have illustrated that subjective values are fundamental in our decision-making process. Hence, in the second set of hypotheses, we postulate that participants with a high subjective reward value would behave differently from participants with a low subjective reward value. the set of hypotheses can be split in three ways. First, we postulate that the

distribution of comparatively fair dictator game allocations is not equal between subjects with high- or low subjective reward values. Second, we hypothesize that the distribution of comparatively fair ultimatum game proposals is different between subjects of high- or low subjective reward values. Third, we postulate that the distribution of comparatively high inequity averse rejection thresholds differs between subjects with high- or low subjective reward values.

The subjective value has been proxied using a direct willingness-to-pay measurement (Hereafter: WTP), analogous to Sorokowska et al. (2021). Fisher exact tests and Cochran-Mantel-Haenszel tests (Hereafter: CMH) were used to test our hypotheses on the relationship between subjective values and experimental behaviour. To be exact, a two-sided 2x2 Fisher exact test and 2x2x2 CMH tests were instigated for each decision variable. The Fisher exact tests examine the distribution of behaviour between high- or low subjective values, disregarding the reward incentive used during the experiment. This while, the CMH tests does take the different reward systems into account by stratifying on the incentive[9].

The decision variables had to be transmuted towards binary variables, as both tests use binary categories. The variables were partitioned at the median to create a high-low disparity. As seen before, the medians of the dictator game proposal variable and ultimatum game rejection threshold variable were equal under the two conditions. Analogously, a high-low binary variable had to be created for the WTP[10]. Once again, the variable was separated at the median, 1.50 euro, to create a binary variable. Thus, producing a new high-low binary WTP variable, where high $\approx \geq$ 1.50 euro and low $\approx <$ 1.50 euro.

As mentioned, the dictator game proposal variable was separated at the median of 30% allocation. Thus, creating a new high-low binary variable for dictator games where high $\approx >$30% and low $\approx \leq$30%. Each distinctive dictator game proposal and corresponding WTP level was taken as an independent observation. The Fisher exact test indicates that in the dictator game, subjects illustrated comparatively high allocations in 36% of the low subjective value group and 56% of the high subjective value group, a difference that was not statistically significant (p = 0.299, Fisher exact test). Supplementary, the CMH test confirmed that the difference of high allocations between low subjective value groups and high subjective value groups was not

[9] By applying both the Fisher-exact test and CMH test, we take into account the potential limits of monetary assessments as a proxy for the neural currency (Surgue et al., 2005).

[10] The descriptive statistics of the WTP can be found in Appendix E.

statistically significant ($\chi^2 = 1.27$, 1 d.f., $p = 0.261$, Cochran-Mantel-Haenszel test). Thus, both the Fisher exact test as the CMH test do not provide evidence that subjective value and comparatively fair allocations are related in dictator games.

Analogously, the ultimatum game proposal variable was separated at the median of 40% allocation. Therefore, transmuting the ultimatum game proposal variable into a new high-low binary variable where high ≈ >40% and low ≈ ≤ 40%. Furthermore, each individual ultimatum game proposal and corresponding WTP level was taken as an independent observation. The Fisher exact test illustrated that in the ultimatum game, subjects displayed comparatively high allocations in 38% of the low subjective value group and 41% of the high subjective value group, a difference that was not statistically significant ($p = 1.000$, Fisher exact test). In addition, the CMH test substantiated that the disparity of high allocations between low subjective value groups and high subjective value groups was not statistically significant ($\chi^2 = 0.02$, 1 d.f., $p = 0.880$, Cochran-Mantel-Haenszel test). Therefore, both the Fisher exact test as the CMH test cannot provide any evidence of subjective values being connected to fair allocations in ultimatum games.

Furthermore, the ultimatum game rejection threshold variable was separated at the median of 30% allocation. Thus, creating a new high-low binary variable for the ultimatum game responders, where high ≈ >30% and low ≈ ≤30%. Again, each distinctive ultimatum game rejection threshold and corresponding WTP level was taken as an independent observation. The Fisher exact test indicates that in the ultimatum game, subjects illustrated comparatively high rejection thresholds in 29% of the low subjective value group and 44% of the high subjective value group, a difference that was not statistically significant ($p = 0.466$, Fisher exact test). Supplementary, the CMH test confirmed that the difference between high rejection thresholds of low subjective value groups and high subjective value groups was not statistically significant (($\chi^2 = 0.74$, 1 d.f., $p = 0.389$, Cochran-Mantel-Haenszel test). Thus, both the Fisher exact test as the CMH test cannot conclude that subjective values and high rejection thresholds are related.

4.5 Physiological state

Prior studies indicated that the variations in the physiological state potentially affect the subjective value that we assign to a primary reward (Wright et al., 2012; Yousuf, 2018). As a consequence, affecting the behaviour that we illustrate in experiments. Therefore, in the third set of hypotheses, we postulate that that, in experiments with primary rewards, subjects with a

higher subjective hunger will make different decisions than subjects with a lower subjective hunger. As before, the third set of hypotheses can bet split into three separate hypotheses. First, we hypothesize that, in the dictator game, the distribution of comparatively fair allocations is not equal between subjects with a high- or low subjective hunger. Second, we hypothesize that the distribution of comparatively high offers in the ultimatum game is different between subjects with a high- or low subjective hunger. Third, we hypothesize that the distribution of comparatively high rejection thresholds in the ultimatum game differs between subjects with a high- or low subjective hunger.

The physiological state is measured by the self-reported subjective hunger[11]. Analogous to the previous analyses, we will use Fisher-exact tests to analyse our hypotheses. However, CMH tests are not required as the subjective hunger was measured prior to incentivisation with reward conditions. Once again, we will need to transmute the subjective hunger variable into a high-low binary variable. To be exact, the subjective hunger variable will be separated at the median of 6. Therefore, creating a new high-low binary variable for subjective hunger, where high ≈ >6 and low ≈ ≤6.

First, we analyse the distribution of comparatively high allocations in high- and low subjective hunger groups. Each individual dictator game proposal and corresponding subjective hunger was taken as an independent observation. The first Fisher exact test illustrates that in the dictator game, subjects choose comparatively high allocations in 47% of the low subjective hunger group and 55% of the high subjective hunger group, a difference that was not statistically significant (p = 0.707, Fisher exact test). Hence, the Fisher exact test does not provide any evidence that proposals in the dictator games and the metabolic state are related.

Second, we execute a similar procedure for the ultimatum game. Again, each distinctive ultimatum game proposal and corresponding subjective hunger was taken as an independent observation. The second Fisher exact test indicates that in the ultimatum game, subjects offered comparatively high allocations in 44% of the low subjective hunger group and 36% of the high subjective hunger group, a difference that was not statistically significant (p = 0.722, Fisher exact test). Thus, our analyses cannot conclude that comparatively fair allocations in ultimatum games are linked to the state of subjective hunger.

[11] The descriptive statistics of the subjective hunger variable can be found in Appendix E.

Third, we examine the distribution of comparatively high inequity averse rejection thresholds in high- and low subjective hunger groups. Each individual ultimatum game rejection threshold and corresponding subjective hunger was taken as an independent observation. The Fisher exact test illuminates that in the ultimatum game, subjects illustrated comparatively high rejection thresholds in 37% of the low subjective hunger group and 36% of the high subjective hunger group, a difference that was not statistically significant ($p = 1.000$, Fisher exact test). Therefore, providing no indications that subjective hunger is related to inequity averseness.

Chapter 5 Discussion

In this chapter, section 5.1 discusses the results in regards to the research question and hypotheses. Hereafter, we will elaborate upon the limitations of our study in section 5.2. Lastly, section 5.3 provides suggestions for future research.

5.1 Discussion

In general, most economical researches assume that the characteristics of money allows monetary rewards to reveal our true preferences. Hence, the exposed phenomena in monetary experiments are often generalized and expected to apply to other rewards and contexts. However, numerous studies have already tried to illuminate discrepancies between experiments performed with monetary rewards and experiments performed with primary rewards (Wright et al., 2012; Noussair & Stoop, 2015; Story et al., 2015; Kause et al., 2018; Häusser et al., 2019; Leder et al., 2020; Mahmood et al., 2021; Sorokowska et al., 2021; Wang et al., 2021). Although some studies found disparities between the two reward-types, literature upon this topic has illustrated inconsistent and contradictory outcomes. We postulate that one of the reasons for these discrepancies between studies is that behaviour is reward-dependent. Hence, this study has analysed reward-dependent behaviour between two rewards of the same reward-type. To be exact, we examined reward-dependent behaviour in dictator- and ultimatum games by comparing experimental outcomes under a nuts condition and an Oreos condition. Neuroscientific studies have illustrated that reward processing and the decision-making process are influenced by reward-specific subjective values, prior neural information and physiological states ((Soltani & Wang, 2008; Wang, 2008; Schultz, 2010; Secousse et al., 2010; Levy & Glimcher, 2011; Wu et al., 2011; Yousuf et al., 2018). Therefore, we had three sets of hypotheses to answer our research question. First, we hypothesized that the behavioural patterns would be different between the two conditions. Second, we postulated that participants with a high subjective reward value would behave differently from participants with a low subjective reward value. Third, we also theorized that subjects with a higher subjective hunger would make different decisions than subjects with a lower subjective hunger.

Although this study was unable to produce statistical evidence of reward-dependent behaviour, trends illustrated during our experiments provided some interesting insights. The

descriptive statistics of experimental decisions displayed a consistently stronger propensity towards fairness in the Oreos condition. However, the distributions and Mann-Whitney U tests revealed that this was merely due to extreme outliers for the dictator game proposals and ultimatum game rejection thresholds. Nonetheless, although insignificant, the outcome of the ultimatum game proposals still indicated discrepancies between the two conditions and therefore reward-dependent behaviour. To be exact, in contrast with the high probabilities of the other two positions, the Mann-Whitney U tests revealed that there is only an eight percent chance that the disparities between the two reward conditions were coincidental. In addition, the distribution of proposals in the ultimatum game reinforced that there was a distinct difference in allocations between the two reward conditions. This while, although insignificant, trends displayed in the subjective reward value analyses illuminated a potential correlation between subjective values and decisions made by dictator game proposers and ultimatum game responders. To be specific, the distribution of relatively fair allocations in the dictator game was twenty percentage points higher for the group of subjects with a high subjective reward value compared to the group of subjects with a low subjective reward value. Analogously, the dispersal of relatively inequity averse rejection threshold was fifteen percentage points higher for the group of participants with a high subjective reward value[12]. Thus, indicating that, for dictator game proposers and ultimatum game responders, higher subjective values might lead to a stronger propensity towards fairness. These trends did not become apparent for the ultimatum game proposals. Moreover, this study could not find any indications of correlations between the self-reported physiological state and preferences revealed during the experiment.

As mentioned, our study found unique preliminary indications of reward-dependent behaviour in ultimatum game proposals. For years, ultimatum game proposals have been a controversial topic in behaviour literature. Although many biological, economical and psychological researches have analysed factors influencing dictator- and ultimatum game behaviour in monetary experiments, very few were found to affect ultimatum game proposals. For instance, numerous studies on monetary stake size effects could only find empirical evidence for dictator game proposers and ultimatum game responders (Slonim & Roth, 1998; Cameron, 1999; Munier & Zaharia, 2002; Carpenter et al., 2005; Engel, 2011; Larney et al., 2019). The sparsity of empirical evidence is often attributed by economists to the complexity

[12] Do keep in mind, however, that the potential trend from the ultimatum game responder position could be because of an anchoring effect (Appendix F).

of motivations underlying the decisions for ultimatum game proposers. To be specific, in the ultimatum game, fair endowment allocations could have an altruistic- or a strategic motivation[13]. This while, economists regard offers in the dictator games to be motived by altruism and rejection rates in ultimatum games by reciprocity. Therefore, the fact that our study only indicated trends of reward-dependent behaviour for proposers in the ultimatum game is unorthodox and unanticipated. However, dissimilarities of the processes involved in proposal behaviour of dictator games and ultimatum games provide a potential explanation for this phenomenon.

It is well-established that proposals in the dictator games and ultimatum games activate different brain centres (Zheng & Zhu, 2013; Cutler & Campbell-Meiklejohn, 2019). In particular, Zheng and Zhu (2013) found that proposers in dictator games had higher activations in centres that were related to cognitive control and conflicting-information processing. This while, proposal decisions in ultimatum games had a stronger influence on centres associated with threat-related information processing (Zheng & Zhu, 2013). This distinction between dictator games and ultimatum games might explain the differences in reward-related behaviour. To be exact, on one hand, the activation of cognitive control centres in the dictator game indicates the ability to focus upon information that is relevant for a particular decision, while suppressing information that is irrelevant (Morton, Ezekiel & Wilk, 2011). As a consequence, proposers might be less affected by reward-related information that is not directly connected to the decision. On the other hand, the stronger activation of centres that are associated with threat-related information processing can increase the use of reward-related information and reward-dependent synaptic plasticity. Subsequently, ultimatum game proposal decisions are more affected by the choice of reward. Therefore, the different empathises of the mental processes from the dictator- and ultimatum games might explain why we only found trends of reward-dependent behaviour for the ultimatum game proposers.

The stronger activation of centres involved with cognitive control and conflicting-information processing for dictator games might also explain monetary stake size effects in experimental games. Eventually, the theoretical foundation of stake size effects is built upon the trade-off between propensities towards fairness and self-interest motivations (Munier & Zaharia; Engel, 2011; Larney et al., 2019). Previous studies have already found negative

[13] To clarify, ultimatum game proposers could offer a larger portion of the endowment because they value fairness. However, they could also be offering a larger percentage as they anticipate that lower proposals would be rejected.

correlations between monetary stakes and propensities to fairness (Slonim & Roth, 1998; Cameron, 1999; Munier & Zaharia, 2002; Carpenter et al., 2005; Engel, 2011; Larney et al., 2019). To be exact, Larney et al. (2019) found that in dictator games, proposers shared a lower percentage of the endowment in experiments with higher stakes. Analogously, Munier & Zaharia (2002) found that rejection thresholds were lower when stakes increased. Therefore, as they are assumed to work as a universal neural currency (Surgue et al., 2005; Dreher, 2013), one would anticipate similar stakes effects for subjective values. On the contrary, our study provided preliminary indications of a positive correlation between subjective reward values of primary rewards and propensity towards fairness. To be specific, the group of participants with high subjective reward values had a remarkably larger proportion of fair allocations and inequity averse rejection thresholds in the dictator- and ultimatum game respectively. Therefore, in fact, illustrating an inverse subjective stakes effect. However, the divergence in stakes effects is not as strange as it might look on first sight.

Unlike most primary rewards, monetary rewards provide a continuous stimulation towards survival and self-interest (Lea & Webley, 2006; Zhao, Vohs & Baumeister, 2009; Wright, Symmonds, Fleming & Dolan, 2011; Zhao, Wang, Rao, Yang & Li, 2014; Yang et al., 2020; Lee, Chen, Wu & Chiou, 2021). The stimulation towards survival and self-interest is often attributed to our biological instinct to acquire resources (Lee, Chen, Wu & Chiou, 2021), however, as a secondary reinforcer money provides this incentive incessantly. In fact, Yang et al. (2020) found that money provides a self-enhancing motivational incentive to accumulate more, conform with the money as a drug theorem (Lea & Webley, 2006). This is often attributed to the negative correlation between monetary stakes and the anterior insula, which means that monetary reinforcers acceleratively downplay our emotions (Zhao et al., 2009; Wright et al., 2011). As a consequence, higher monetary stakes often lead to lower propensities towards fairness (Zhao et al., 2014).

Primary rewards, on the other hand, are frequently associated with antithetical systems (Sescousse et al., 2013; Yang et al., 2020). For instance, Yang et al. (2020) noted that obtaining a primary good led to decreasing motivational incentives to acquire more. Thus, unlike money, a larger quantity of primary rewards lead to less self-interested motivations. In addition, primary rewards are known to have a stronger activation of the anterior insula, therefore, put a larger emphasis on social emotions, such as empathy (Sescousse et al., 2013). Subsequently, in games as the dictator game, which rely on cognitive control and conflicting-information processing (Zheng & Zhu, 2013), other-regarding motivations often carry a larger weight in decisions.

However, keep in mind that individuals do not know the exact subjective value that the other person assigns to the reward, and so, it is coherent that they extrapolate their own. As a consequence, people with a higher subjective reward value anticipate similar appreciations from the other person, and therefore reveal a stronger propensity towards fairness[14]. This concept of inverse subjective stakes effects for primary rewards, however, contradicts the findings of study from Wright et al. (2012).

Wright et al. (2012) found subjective stakes effects for primary rewards by inducing different levels of thirst and therefore manipulating the subjective value of water. As a consequence, they also provided evidence that physiological states affect our decisions, a phenomenon that was absent in our study. The heterogeneity on the relation between physiological states and decisions, however, might provide a partial explanation on different patterns in subjective stakes effects. To be exact, on this topic, there is a clear distinction between the methodology used by studies that found significant effects (Wright et al., 2012; Kause et al., 2018; Yousuf et al., 2018) and studies that were inconclusive (Rantapuska, Freese, Jääskeläinen & Hytönen, 2017; Fraser & Nettle, 2019; Häusser et al., 2019). On one hand, studies that found significant results manipulated the physiological state in a controlled environment. For instance, Wright et al. (2012) used an intravenous saline infusion to either provide isotonic- or hypertonic saline to manipulate the subjective thirst levels, while Kause et al. (2018) stimulated severe thirst through physical exercise. On the other hand, studies that found inconclusive results, like ours, allowed the manipulation of physiological states to occur in an uncontrolled environment (Rantapuska et al., 2017; Fraser & Nettle, 2019; Häusser et al., 2019). To be specific, these studies requested subjects to refrain from eating prior to the experiment, however, this enabled participants to satiate when the body provided strong signals of necessity. As a consequence, the severity of the physiological "hot" states in these experiments, and thus the stimulus towards survival and self-interest, was diminished. However, unlike monetary rewards, primary rewards don't naturally provide continuous stimulations towards survival and self-interest (Lea & Webley, 2006; Yang et al., 2020; Lee et al., 2021). Therefore, the manipulation of subjective values, from Wright et al. (2012), by inducing thirst might have caused a different subjective stakes effect than we found in our study.

[14] This is a phenomenon that does not seem to occur for subjective values of monetary rewards (Sorokowski et al., 2017).

The potential disparity between (subjective) stakes effects of primary- and secondary reinforcers would explain the inconsistency in the literature. For instance, most studies on this topic have used for their comparison cash payments equal to the monetary value of the primary reward, and hereafter assumed that this would provide generalisable outcomes. However, the data in our study has indicated that subjective values are important and subjective stakes effects are inverse. Analogously, prior literature has suggested that propensity towards fairness decreases with higher monetary rewards and increases with higher primary rewards. As a consequence, the choice of reward and corresponding quantity could be determining for the outcome of the experiment.

5.2 Limitations

This study has several limitations that influenced the outcome and representativeness of the experiment. One of the most apparent constraints coinciding with the design of the experiment is the online execution. Although an uncontrollable and unsolicited consequence of the Covid-19 crisis, the online application of this study contains some notable implications. First, this study examines reward-dependent behaviour through the comparison of two consumable primary rewards. However, the online presentation of the rewards limited the sensorial stimuli and delayed the reward-deliverance. The online experiment provided sensorial stimuli through digital visuals. Although digital visuals are often used as sensorial incentives in neuroscience (Delgado, 2007; Yousuf et al., 2018), they are plausibly not as strong in decisional settings as offline incentives would have been. In particular as we are comparing two rewards of the same reward-type. This could have led to remarkably lower statistical significance of reward-dependent behaviour.

In addition, the online setting forced us to have a delayed reward deliverance. The delayed reward deliverance might have led to a disassociation between the decisions and the reward compensation. Therefore, illustrating results more similar to experiments with hypothetical rewards. Furthermore, as far as we know, this is one of the first experiments executing dictator- and ultimatum games in a complete interactive online setting. Prior studies have examined online experiments, however, they used questionnaires (Bekkers, 2007; Raihani, Mace & Lamba, 2013). Hence, no implications on the results are known for online interactive experimental designs.

In this pilot study, we used binarized variables to examine the importance of subjective values and physiological states for our decision-making process. We binarized the results by separating the variables at the median, however, this most likely decreased the accuracy of our statistics. We decided to use this method to provide preliminary data as our sample size was remarkably small and the variation in the explanatory variables large. As a consequence, although a strong effect might be present, it was implausible that our statistics would provide any significant results in regression analyses. Subsequently, regression analyses would not provide any information on possible trends that could provide preliminary data for future researches. Therefore, we decided to nonparametric tests as our main statistics and use OLS regressions in Appendix F to illustrate robustness.

Furthermore, as mentioned, the decisions of the ultimatum game rejection thresholds might suffer from an anchoring bias[15]. The anchoring bias states that people have a propensity to rely too heavily on prior information to make new and independent decisions (Tversky & Kahneman, 1974). In this experiment, there is a possibility that the subjects used their decisions in the dictator games to formulate their rejection thresholds. To be specific, subjects played the role of proposer in the dictator game prior to setting their level of rejection threshold in the ultimatum game. As a consequence, participants could have unconsciously used their decision in the dictator game to anchor their rejection thresholds. However, the other player was unaware of the dictator game outcome and therefore the two games were coherently independent[16]. There was also a possibility of conscious anchoring. Although irrational, high allocators could perceive their proposals in the dictator game as reciprocity altruism, and therefore feel entitled to receive similar allocations from the other player in the ultimatum game.

The impact of a potential anchoring effect could have led to biased results for the ultimatum game responders. However, likewise, randomizing the order of the games could have lead to biased outcomes as the sample size was small. To be exact, in experiments with small samples, trends illustrated in the experiment could be the consequence of incidental order assignment

[15] The robustness regressions of Appendix F illustrate a strong correlation between proposals made in the dictator game and rejection thresholds in the ultimatum game. This could either be because of propensities towards fairness or an anchor effect.

[16] Note that the results from the dictator game were not announced before the ultimatum game was finished. Therefore, the proposers in the ultimatum games could not have known whether a fair allocation was made in the dictator games. In addition, although one player tried, none of the subjects were able to prematurely communicate their results early.

rather than the behavioural phenomenon in question. This while, biases caused by incidental order assignment are mitigated in larger samples.

Another limitation of the experiment comes from the available measurements of subjective values. As discussed, monetary assessments are able to measure the transactional utility, however, they are limited in measuring utility obtained from consumption (Amir et al., 2008). This study used primary rewards to examine reward-dependent behaviour and therein the involvement of subjective values. Hence, our hypotheses relied upon the deep-rooted factors impacting our subjective reward values. Although transactional utilities primarily includes the fairness of transaction, there is a plausibility that our willingness-to-pay measurements were not able to capture the full range of subjective values underlying the decisions. Therefore, there is still a possibility that subjective values determine our decisions as a neural currency, but this was not illustrated in our analyses. Unfortunately currently, to our knowledge, there is no available method that can accurately measure subjective values. However, we propose in section 5.3 an alternative strategy that can be used to determine the involvement of subjective values in reward-dependent behaviour.

The stakes used during this experiment had a monetary value of €1 euro. Furthermore, participants only received compensation corresponding to their reward-related actions. We can therefore assume that partaking in the experiment was motivated from an altruistic point of view. As a consequence, this study potentially has a self-selection bias towards subjects with stronger altruistic tendencies. Although the self-selection bias does not impact the comparative analyses within this study, it does limit the representativeness.

In addition, the sample includes a disproportional fraction of students or recent graduates, 66.7% to be exact. However, studies have shown that students are less generous than the average population (Falk, Meier & Zehnder, 2013). Furthermore, the demographic statistics of our sample illustrates a disproportional distribution of students among the subsamples. The discrepancies in the distribution of students could have led to lower and varying representativeness of our (sub)samples.

Furthermore, a strong constraint of our experiments is the sample size. Although the complete sample consists of sixty subjects, the experiment contains two conditions and two positions. Hence, in the statistical analyses we often had to rely on comparisons between groups of fifteen or thirty participants. Yet, small sample sizes are incongruous to provide conclusive evidence of relevant effects. In particular as the variances of smaller samples are remarkably

higher compared to larger samples. To be exact, as is noticeable in the descriptive statistics of paragraph 4.2, a single extreme outlier could already produce a significantly higher variance. Consequently, only phenomena with an exceptional magnitude will provide significant statistics. However, the magnitude of reward-dependent behaviour between two comestible rewards is most likely of a smaller proportion. Therefore, statistical conclusive evidence could be sparse while trends still indicate reward-dependent behaviour.

5.3 Suggestions for future research

Without success, many previous studies have tried to find potential factors influencing proposals in the ultimatum game. Predominantly, economists have analysed whether raising the stakes would alters the proposing behaviour, a phenomenon well-established in the dictator game. Therefore, although this study could not produce statistical evidence, our preliminary signs of reward-dependent behaviour in proposals of the ultimatum game indicate that further research is necessary and could provide essential information. In particular, additional research into the external factors and internal processes causing reward-dependent behaviour could illuminate the motivations and incentives determining strategic decisions in laboratorial settings and the real world.

Many reward-related characteristics could potentially influence our strategic decisions and provide an interesting source of information. For instance, due to the online execution, this study was unable to completely control the sensorial influences on reward-dependent behaviour. This while, Bonini et al. (2011) already illustrated that disgusting smells increased the acceptance rates in ultimatum games. Hence, the question remains whether sensorial factors impact strategic proposals. Furthermore, additional research on reward-dependent behaviour in ultimatum games could illuminate factors that influence strategic decisions on the work-floor. To give an example, could prior positive associations with company-related products influence the fairness of private equity offerings?

This study also found trends illustrating that more knowledge is required upon the mechanisms underlying our decisions. To be exact, this study founds trends of subjective stakes effects that were inverse to prior monetary studies. Yet, these findings contradict the theorem of an universal neural currency. The absence of a neural currency would indicate that economical experiments have a limited power of generalization and rationalization towards situations that include other reward-types. Therefore, additional research towards subjective

stake effects in primary rewards and monetary rewards would be crucial in determining the universality of prosocial behaviour.

However, as mentioned, monetary assessments of subjective values only measure transactional utilities. Hence, monetary assessments could fail to capture essential factors that determine the subjective values and a potential neural currency. Therefore, we suggest for future research an adjusted method of utility measurements to capture potential subjective stake effects in primary rewards. To be exact, we recommend an between-subject design that compares two primary rewards of the same type. Supplementary, we propose that a traditional choice-list design, which provides the repeated option between the two primary rewards of interest, could provide a comparatively accurate estimation of the subjective value disparities.

Chapter 6 Conclusion

Recent biological, economical and psychological interest has been drawn towards behavioural differences in experiments with primary- and monetary rewards (Wright et al., 2012; Noussair & Stoop, 2015; Story et al., 2015; Kause, Vitouch & Glück, 2018; Häusser et al., 2019; Leder, Pastukhov & Schütz, 2020; Mahmood, Gore & Kagel, 2021; Sorokowska et al., 2021; Wang, Chen, Krumhuber & Chen, 2021). However, the literature on this topic has been proven to be inconsistent and contradictory. We postulated that the wide variety of primary rewards used in the literature might cause the contradictory results. Therefore, in this study, we tried to answer the question whether behaviour illustrated in experiments is reward-dependent. To investigate reward-dependent behaviour, we compared behavioural patterns of dictator- and ultimatum games under two comestible reward conditions, nuts and Oreos. In addition, we examined whether differences in subjective values and physiological states could be explanatory for variations in propensities towards fairness of experiments with primary rewards. These factors are often associated in neuroscientific literature with reward-dependent behaviour. Although we could not provide statistical evidence of reward-dependent behaviour, trends in our experiments provide some interesting insights.

First, we found indications of reward-dependent behavioural patterns for the ultimatum game proposers. To be exact, in the ultimatum game, offers were consistently higher under the Oreos condition. These trends, however, were not observable for the dictator game proposers and ultimatum game responders. Second, our results suggested a potential positive correlation between subjective values of primary rewards and propensity towards fairness for dictator game proposers and ultimatum game responders. These trends illustrate a potential subjective stakes effect for primary rewards inverse to that of traditional monetary theorems (Slonim & Roth, 1998; Cameron, 1999; Munier & Zaharia, 2002; Carpenter et al., 2005; Engel, 2011; Larney et al., 2019). However, in contrary to the reward-dependent behavioural patterns, these trends were not observable for the ultimatum game proposers. Third, our results could not provide any consistent indication that physiological states were explanatory for the variations in prosocial behaviour. However, we postulate that only severe physiological “hot” states significantly influence our social preferences.

Overall, our results illuminate that the concept of reward-dependent behaviour in experiments is not straight forward. In particular, the trends in our study suggests that we react

with different decisions on different aspects of the reward-structure, which is most likely due to variations in the neural process. In addition, our results indicate that the robustness of preference biases might be limited across reward media. The complexity of reward-dependent behaviour and limited transitivity of preference biases most likely explains the contradicting results in the literature on primary- and secondary reinforcers. To be exact, the potential disparities, between primary- and secondary rewards, in (subjective) stakes effects would allow for different outcomes caused by the choice of reward. Therefore, the results of our study provide additional indications that the outcome of experiments have a limited ability to be generalized. However, most of all, the preliminary data of our paper suggests that more research is required on reward-dependent behaviour to understand the implications of experimental studies.

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Appendix

Appendix A Pre-experiment briefings

Appendix A1 pre-experiment information letter

Dear Participant,

Thank you for showing interest in participating in our experiment, this email will further elaborate upon the process and procedures. The whole experiment will take between 10-15 minutes. The experiment is conducted with either nuts or Oreos and therefore, unfortunately, interested parties with nut and/or milk allergies cannot participate in the experiment. As this experiment considers a hunger aspect, we would like to request all participants to restrain from eating in the hours prior to the experiment to ensure clean data. The rewards obtained during the experiment determine the compensation rewarded after the experiment. To be exact, the experiment consists of two experimental games and at the end of the experiment, one of these two games is randomly chosen and paid. Thus, if you obtained 80-gram nuts in the first game and 20-gram nuts in the second game, you have a 50% chance to obtain 80-gram nuts and 50% chance to obtain 20-gram nuts. The games are played separately and the results of the first game does not influence the results from the second game. As the experiments will be conducted online, the food rewards can only be paid out in the following cities: Amsterdam, Gorinchem, Rotterdam and Zoetermeer. The participants that do not live in the earlier mentioned cities will receive an equivalent alternative. After you fully completed the experiment, you will receive an email stating which reward will be paid out within 24 hours after the experiment by delivery. Thus, you will have to provide your address in order to receive the reward.

Prior to the experiment, you will be matched to another participant that will be the opposing player during the game. Do keep in mind that there will be an opposing player, and therefore don’t be late to the experiment as the other participant will have to wait. The experiment is conducted through the communications between Google Spreadsheets documents and Google Slides documents. You can write down the data in the Google Spreadsheets document and the game relevant information will then be communicated from the Google Spreadsheets document towards the Google Slides document. In addition, the Google Slides document will contain light symbols illustrating whether the other player is ready to move

towards the next step. We would like to request that you patiently wait until both players are ready to move towards the next part of the experiment, otherwise miscommunication will occur and the data will be inadmissible. The data will be communicated from the Google Spreadsheets document to the Google Slides document once every few seconds, hence there might be a slight delay.

Each player has specific roles during the experiment, these roles are listed at the end of the document and will also be listed upon the provided documents at the time. Only fully completed experiments will be valid datapoints for the analyses and therefore only fully completed experiments will be rewarded at the end. You will receive the links to the Google Spreadsheets document and google Slides documents utmost 3 hours in advance. If you are unable to access the files or if there are any questions prior or during the experiment, please call or text me at +31 6 ** ** ** **.

Appendix A2 pre-experiment email

Dear …,

This email contains the roles and links of the experiment. You will have to use both links for the experiment, the information will be shown on the Google Slides document and you can fill in your data on the Google Spreadsheets document. The choices of the other player will be displayed on the Google Slides document as well. Please read the information carefully during the experiment, but if you have any more questions don't hesitate to ask me through +31 6 ** ** ** **.

You are Player: *A/B*

Your role in the dictator game is: *Proposer/Receiver*

Your role in the ultimatum game is: *Responder/Proposer*

You will play for: *100-gram nuts/ 10 Oreos*

Your subjectnumber is: …

Google Sheets: ……..

Google Spreadsheets: ……

Yours sincerely,

Dion van Kessel

Appendix B General information and questions experiment.

Appendix B1 General information pre-games

Welcome to the experiment!

This document will provide you the necessary information on the games and it will display the choices made by the other player. The data can be filled out on the google spreadsheet document, which communicates your decisions back to this document automatically. Please read all the instructions carefully to avoid confusion during the experiment.

~second page~

Once again, welcome to the experiment, we would like to thank you in advance for participating. Before continuing with the experiment, we would like to first repeat some details about the experiment. The experiment will be executed in anonymity, the other player will not know your identity. The experiment consists of a pre-game survey, 2 experimental games and a post-game survey. All parts have to be completed for the session to be included in the data and for rewards to be paid out. The decisions in the games have real consequences for your potential rewards. Do keep in mind that you will play against another player that will be active at the same time. You'll have to fill out your decisions in the Google Spreadsheets document. Hereafter the information will be transferred towards this document, however, this could take up to a minute. You will have a 50% chance to win either the rewards from the Dictator Game or the Ultimatum Game, which game will be paid out is randomly decided after the experiment process has been completed.

Throughout the experiment, you will see a red dot on the page. This dot will become green after you have confirmed that you and the other player understand, or made your decision in, that part of the experiment. This is to ensure that both players are at the same part of the experiment at the same time. Please wait until confirmation that both players are ready to continue before continuing. This is to ensure that the experiment will run smoothly.

You are: ***Player A/B*** You will play for: ***100-gram nuts/10 Oreos***

Please answer the question on the Google Spreadsheets document and confirm that you are ready to continue.

Appendix B2 General information dictator game

The Dictator Game contains two roles, proposer and receiver. The proposer, Player A, has to decide how many of the *10 sacks of nuts (which contains 10-gram nuts each)/10 Oreos* he will transfer to the receiver, Player B. Player B cannot make any decisions in this game. The outcome of the Dictator Game will count for the compensation prospects at the end of the experiment. The results of the Dictator Game will be provided after the Ultimatum Game is finished. The proposed allocation will be locked in after it has been confirmed.

Example 1: Player A, the proposer, decided not to transfer any *nuts/Oreos* towards Player B, the receiver. This means that Player A will obtain a 50% chance to earn *100-gram nuts/10 Oreos* at the end of the experiment and Player B will have a 50% chance to earn nothing at the end of the experiment.

Example 2: Player A, the proposer, decided to transfer X *nuts/Oreos* towards Player B, the receiver. This means that Player A will obtain a 50% chance to earn *100 - X gram nuts/ 10- X Oreos* at the end of the experiment and Player B will have a 50% chance to earn X *nuts*/Oreos at the end of the experiment.

Please confirm on the google sheets that you fully understand the rules.

Appendix B3 General information ultimatum game

The Ultimatum Game contains two roles, proposer and responder. The proposer, Player B, has to decide how many of the *10 sacks of nuts (which contains 10-gram nuts each)/ 10 Oreos* he will offer to the other player. The responder, Player A, has to decide what he thinks the minimum acceptable offer is. The offer of Player B is accepted if it is higher than the minimum acceptable offer from Player A. The offer of Player B is rejected if it is lower than the minimum acceptable offer from Player A. If the offer is rejected, both of the participants will earn nothing for this part of the experiment. If the offer is accepted, the proposed distribution will be included in the compensation prospects at the end of the experiment. The outcome of the Ultimatum

Game will count for the compensation prospects at the end of the experiment. The decisions will be locked in after they are confirmed.

Example 1: Player B, the proposer, decided to offer *X nuts/Oreos* to Player A. However, Player A, the responder, decided that the minimum acceptable offer is higher than X and therefore rejected the offer. This means that both players will obtain a 50% chance to earn nothing at the end of the experiment.

Example 2: Player B, the proposer, decided to offer X *nuts/Oreos* to Player A. Player A, the responder, decided that the minimum acceptable offer is lower than X and therefore accepted the offer. This means that Player B will obtain a 50% chance to earn *100 - X nuts/ 10 – X Oreos* at the end of the experiment and Player A will obtain a 50% chance to earn X *nuts/Oreos* at the end of the experiment.

Please confirm on Google Sheets that you fully understand the rules

Appendix B4 General post-experiment questionnaire

Welcome to the last part of the experiment. You just completed the experimental games and now we would like to get to know more about your preferences. Please fill in your assigned subject number below and continue to the questions. Your assigned subject number is required to ensure that we match the data we obtain here with the data from the games.

Please indicate how much you like or dislike *nuts/Oreos* on a scale from 0 (Dislike a great deal) to 5 (Like a great deal).

Imagine that you are in a store and you have to buy *nuts/Oreos*, how much would you be willing to pay for the *100-gram nuts/Oreos* illustrated below. If you use a different valuta than Euros, please include which one.

You have finished the final part of the experiment! thank you for participating. The part below are a few final questions regarding the reward. You will receive an email within 24 hours to follow up on the payment of the rewards and to let you know which of the games has randomly been selected to be paid out. As mentioned before, the physical reward can only be distributed in Amsterdam, Gorinchem, Rotterdam and Zoetermeer.

However, during these troubled times, we would also like to offer a second option. Because of Covid-19 many families are now reliant on food support for the first time, this has put a heavy weight upon organisations such as the Food Banks. Hence, we would like to provide the option to donate the monetary value of your compensation to www.voedselbanken.nl (the Food Banks), for which we assume that *100-gram nuts/10 Oreos* is worth 1 euro. The total amount of donated rewards will be transferred to the Food Banks after all experiments have been conducted.

Please select which form of compensation you would like to receive:

- ○ The Nuts (when living in Amsterdam, Gorinchem, Rotterdam and Zoetermeer)
- ○ I would like to donate the monetary equivalent to the Food Banks

Once again we would like to thank you for participating in the experiment. You will receive an email within 24 hours to follow up on the payments of the rewards. If you still have any questions or would like to recommend new participants to us, please don't hesitate to contact us at:

431325dk@gmail.com

Appendix B5 Debriefing

Dear …,

I would like to thank you for your participation, I hope you found it interesting. As you might remember, a …/… distribution came from the dictator game and a …/… distribution from the ultimatum game, for you and the other player respectively. The random lottery has decided that the *dictator game/ultimatum game* will be paid out. You decided that you would like to *receive the nuts/Oreos / donate the monetary equivalent to the foodbanks*, thus, … *nuts/Oreos* will be *delivered at your doorstep within 24 hours after letting us know the address / donated to the foodbanks*. Furthermore, I was hoping that you perhaps knew some people that would be interested in participating in our experiments, as we heavily need more participants to make this study relevant. If you have any more question about the experiment don't hesitate to let me know.

Yours sincerely,

Dion

Appendix C Specific questions and interfaces

Appendix C1 Pre-experimental survey and Google Spreadsheet interface Type-DG Player

Please fill out the questions below before continuing with the experiment		
Please fill in your assigned subject number		
What is your age		
What is your gender	-	
Are you currently a student at / have you recently graduated from an institute of higher learning? (< 1 year ago)	-	
How hungry are you right now, on a scale of 1 (not at all hungry) to 10 (very hungry)	-	
How long ago was your last meal?		
Are you finished with the questions above? if so select yes and go back to the google slides to wait until the other player is ready	Not yet	
The part below is to provide your answers for the experimental game. Please follow the steps on the google slides and patiently wait until the other player is ready, as otherwise the experiment will not be able to illustrate accurate results.		
Dictator Game		
Did you fully read and understand the rules of the Dictator Game?	Not yet	
I would like to transfer the following amount of Nuts towards the other player	-	g Nuts
This means that for the Dictator Game my possible prize is	-	g Nuts
Would you like to confirm?	Not yet	
After confirming, please go back to the google slides and wait until the green light appears		
Ultimatum Game		
Did you fully read and understand the rules of the Ultimatum Game?	Not yet	
What is the minimum amount that the other player has to offer for you to accept?	-	g Nuts
This means that the maximum amount that the other player will get for the Ultimatum Game as possible prize is	-	g Nuts
Would you like to confirm?	Not yet	
The other player has offered me the following amount of Nuts	-	g Nuts
This means that the other player will get for the Ultimatum Game as possible prize	-	g Nuts
Is the distribution proposed by the other player filled out above?	Not yet	
The proposal is	-	

Appendix C2 Pre-experimental survey and Google Spreadsheet interface Type-UG Player

Please fill out the questions below before continuing with the experiment		
Please fill in your assigned subject number		
What is your age		
What is your gender	-	
Are you currently a student at / have you recently graduated from an institute of higher learning? (< 1 year ago)	-	
How hungry are you right now, on a scale of 1 (not at all hungry) to 10 (very hungry)	-	
How long ago was your last meal?		
Are you finished with the questions above? if so select yes and go back to the google slides to wait until the other player is ready	Not yet	
The part below is to provide your answers for the experimental game. Please follow the steps on the google slides and patiently wait until the other player is ready, as otherwise the experiment will not be able to illustrate accurate results.		
Dictator Game		
Did you fully read and understand the rules of the Dictator Game?	Not yet	
After confirming, please go back to the google slides and wait until the green light appears. The other player is making the decisions in the Dictator Game.		
Ultimatum Game		
Did you fully read and understand the rules of the Ultimatum Game?	Not yet	
I would like to offer the following amount of Oreos towards the other player	-	Oreos
This means that I will get for the Ultimatum Game as maximum possible prize	-	Oreos
Would you like to confirm?	Not yet	

Appendix C3 Questions specific for Type-DG Player

Your role: Proposer

Please fill in how many nuts you would like to transfer to the other player in the Google Spreadsheets document under the heading “Dictator Game”. After you confirmed your decision, wait until the light turns green before continuing.

Your role: Responder

Player A

Player B

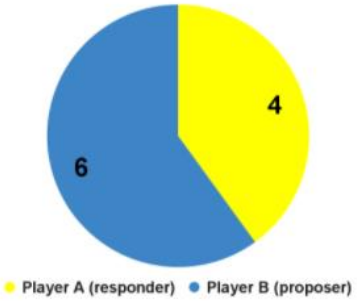
Please fill in on the google sheets document under the heading “Ultimatum Game” the minimum amount of nuts the other player has to offer for you to accept. After you confirmed your decision, wait until both the lights turn green before continuing.

Appendix C4 Questions specific for Type-UG Player

Your role: Receiver

The other player is currently filling in his decision on the dictator game, please wait until the green dot appears before continuing to the next slide.

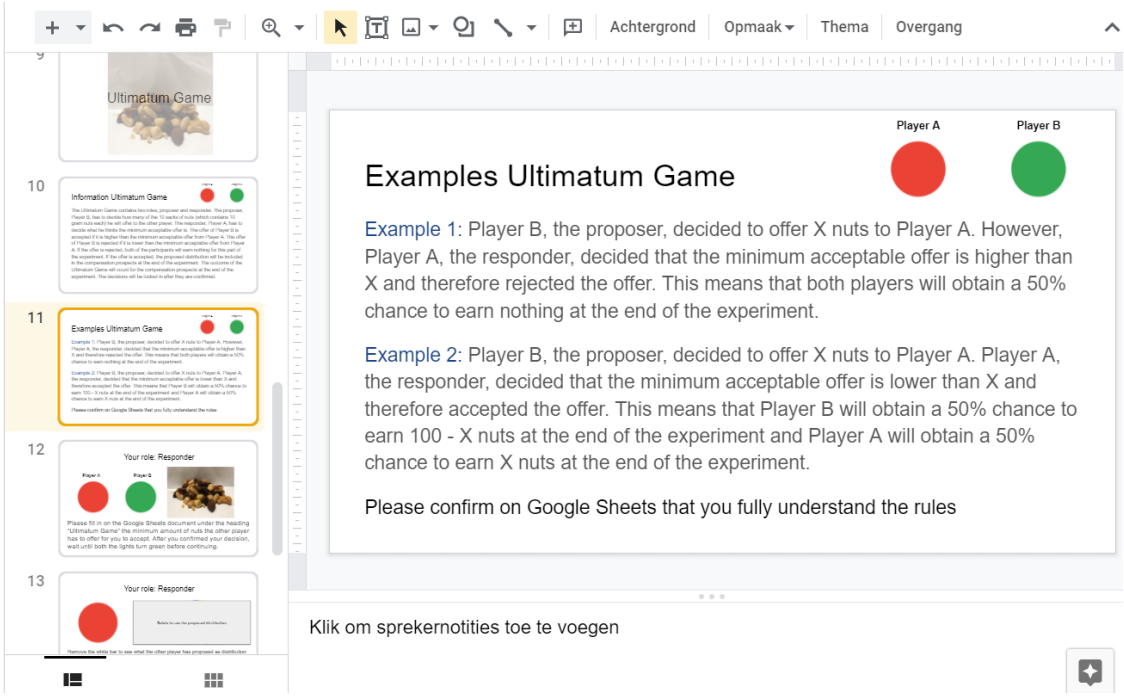
Your role: Proposer



Please fill in how many Oreos you would like to offer to the other player in the google sheets document under the heading “Ultimatum Game”. After you confirmed your decision, wait until the distribution appears before continuing (max 1 minute).

Appendix D Experimental Interface

Appendix D1 Example of interface information



Appendix D2 Links to online example

Our study has been executed in an online setting, therefore links to an example platform are included this appendix. However, the systems have been put on read-only to ensure their quality, and therefore the interaction between the two documents does not work.

Google Spreadsheets: **https://docs.google.com/spreadsheets/d/16eVOOMcG_9W-QJcgEoe4QgYkKfHbKa9UjiJCP4mAOos/edit?usp=sharing**

Google Slides: **https://docs.google.com/presentation/d/1LRij250xxYOAg-YKga87tKm5VCXkZmsyRAP0L1SzO-c/edit?usp=sharing**

Appendix E Supplementary descriptive statistics

Appendix E1 Descriptive statistics WTP

Table 4. Discriptive statistics WTP per sample and subsample

	Total sample			*Nuts subsample*			*Oreos subsample*		
	Total	DG	UG	Total	DG	UG	Total	DG	UG
N	60	30	30	30	15	15	30	15	15
Mean	1.57	1.76	1.39	1.65	1.72	1.58	1.49	1.80	1.19
Median	1.03	1.50	1.50	1.60	1.50	1.70	1.35	1.50	1.00
Std. dev (%)	1.50	1.30	0.62	0.92	1.13	0.69	1.14	1.50	0.49

Appendix E2 Descriptive statistics subjective hunger

Table 5. Distinctive statistics subjective hunger per sample per subsample

	Total sample			*Nuts subsample*			*Oreos subsample*		
	Total	DG	UG	Total	DG	UG	Total	DG	UG
N	60	30	30	30	15	15	30	15	15
Mean	5.95	5.80	6.10	6.10	5.93	6.27	5.80	5.67	5.93
Median	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	7.00
Std. dev (%)	1.93	1.95	1.92	1.90	1.87	1.98	1.97	2.09	1.91

Appendix F Robustness analyses

This section of the Appendix examines the robustness of our results using three OLS regressions. We regress the continuous explanatory WTP and subjective hunger variables upon the three decision variables, Dictator proposals, Ultimatum proposals and Ultimatum rejection thresholds. These OLS regressions have the purpose to test the robustness of our analyses, therefore, we use numerous control variables. The regressions are shown in Table 6.

Table 6. Robustness regressions for dictator game proposals, ultimatum game proposals, and ultimatum game rejection thresholds

	Dictator proposals	P-value	*Ultimatum proposals*	P-value	*Ultimatum rejection thresholds*	P-value
Reward	-1.95 (8.02)	0.810	8.17 (5.25)	0.134	3.69 (6.75)	0.591
WTP	3.42 (2.85)	0.243	1.69 (4.63)	0.719	1.96 (3.14)	0.538
Subjective hunger	-0.79 (2.05)	0.702	-1.22 (1.39)	0.389	-1.70 (1.73)	0.339
Male	-17.30 (8.30)	0.049	-2.31 (5.83)	0.696	16.71 (7.91)	0.047
Student	5.66 (7.13)	0.436	1.02 (16.1)	0.950	-1.94 (8.66)	0.825
Age	0.22 (0.36)	0.539	0.19 (0.41)	0.642	0.07 (0.30)	0.809
Fondness of incentive	-2.67 (4.17)	0.528	-1.70 (2.95)	0.571	-0.54 (3.57)	0.880
Donation	4.37 (11.97)	0.719	0.59 (5.41)	0.915	5.37 (10.36)	0.610
Proposals dictator game					6.49 (1.80)	0.002
Constant	49.96 (28.95)	0.098	36.31 (24.40)	0.152	0.44 (30.39)	0.989

The standard errors are denoted within the parentheses.

As can be seen in Table 6, the significance of the variables, for which we indicated trends of interest in the nonparametric tests, does not differ much in the regression with additional control variables. For instance, in the Mann-Whitney U tests, we found indications that ultimatum game proposers have different behavioural patterns between the two reward-conditions ($p = 0.08$, Mann-Whitney U test). In the robustness regression of the ultimatum game proposals, we can see that the incentive variable has a p-value of 0.134, thus, only a slight decrease of probability in the robustness analysis. This indicates that it is unlikely that the trends, which we saw in section 4.2, were the cause by the other variables.

If we compare the statistics on the subjective values, section 4.4, with those of the robustness analysis, we can see that the WTP variable for the dictator game analysis has a lower p-value than in the Fisher-exact test and CMH test. Therefore, once again, providing no indications that the trends were caused by biased statistics.

The ultimatum game rejection thresholds, however, illustrate a remarkably worse p-value in the robustness analysis compared to the CMH test in the subjective value analysis, 0.538 and 0.389 respectively. This might indicate that the trends in section 4.4 are the consequence of biased results, in particular, when we examine the potential anchor effect. To be exact, we noted that there was a potential anchor effect or transitivity of preferences from the dictator game proposal role to the ultimatum game responder role. In the robustness analysis, we can see that the control variable Proposals dictator game is significant, at a 5% significance level, and with a magnitude of 6.49 percentage points. Therefore, confirming our suspicions on a potential anchoring effect.

Furthermore, it is noteworthy to point out that the male variable is significant, at a 5% significance level, in both the dictator game proposal- as ultimatum game rejection threshold robustness analyses with a magnitude of -17.30 and 16.71 respectively. Thus, providing opposing effects.