Interpersonal interactions in an unequal world

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Doctoral thesis

**INTERPERSONAL INTERACTIONS IN AN UNEQUAL
WORLD: EFFECTS OF INEQUALITY AND
UNFAIRNESS ON SOCIAL AND CONSUMER
DECISION-MAKING**

Leticia R. Micheli

2021

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**INTERPERSONAL INTERACTIONS IN AN UNEQUAL
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DECISION-MAKING**

DISSERTATION

To obtain the degree of Doctor at the Maastricht University,
on the authority of the Rector Magnificus, Prof. Dr. Rianne M. Letschert
in accordance with the decision of the Board of Deans,

to be defended in public
on Friday 19th of November 2021, at 12.00 hours

by

Leticia Rettore Micheli

Supervisors

Prof. Dr. Caroline Goukens

Prof. Dr. Arno Riedl

Co-Supervisor

Dr. Kelly Geyskens

Assessment Committee

Prof. Dr. Elisabeth Brüggem (Chair)

Prof. Dr. Carolyn Declerck, University of Antwerp, Belgium

Prof. Dr. Christian Ruff, University of Zürich, Switzerland

Dr. Matthias Wibrall

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Sincerely,

Letícia

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1

Introduction

The last three decades have been marked by a substantial increase in economic inequality in most of the country members of the Organization for Economic Cooperation and Development (OECD), with some countries like the United States reaching unprecedented high levels. According to a recent report, the average disposable income of the 10% richest is now nine and half times bigger than that of the poorest 10% across all OECD countries. This disparity between the richest and the poorest is seven times bigger than it was three decades ago (OECD, 2018).

Although the poorest are undoubtedly the ones most negatively affected by inequality, as their financial hardships are greatly intensified (Jachimowicz et al., 2020), high levels of inequality tend to make everyone worse off. As nicely described by Davidai (2018), inequality brings negative consequences for individuals, groups and societies as a whole. On an individual level, high inequality has been associated with lower life satisfaction (Oishi & Kesebir, 2015), higher risk taking (Payne, Brown-Iannuzzi, & Hannay, 2017), greater working hours (Bell & Freeman, 2001) and status anxiety (Blake & Brooks, 2019). Inequality has also been reported to influence how individuals interact with each other, decreasing overall cooperation (Nishi, Shirado, Rand, & Christakis, 2015) and enhancing perceived competition (Sommet, Elliot, Jamieson, & Butera, 2019). Finally, at a societal level, inequality is associated with higher rates of violent crime (Fajnzylber, Lederman, & Loayza, 2002), female sexualization (Blake, Bastian, Denson, Grosjean, & Brooks, 2018), increased consumer borrowing and spending (Alvarez-Cuadrado & El-Attar Vilalta, 2018; Christen & Morgan, 2005).

Even though the rise of inequality has been accompanied by an increased interest in understanding its effects on individual behavior, there are still many unknowns regarding the psychological impact of inequality on decisions made in the context of social interactions (Jetten & Peters, 2019). Even if a multitude of factors contribute to the rise of inequality, the way in which individuals interact with each other can definitely play an important role in mitigating or intensifying inequality (Nishi & Christakis, 2015). Hence, inequality may affect our behaviors in various ways, which in turn contribute to the persistence of societal patterns where the richer gets richer and the poorer is kept in poverty. Stopping the cycle of inequality requires a better comprehension of interpersonal relationships in a world surrounded by inequality and unfairness. A better understanding of how individuals react to inequality and to situations deemed as unfair may also be important to inform and shape policies aimed at reducing inequality. In this dissertation, I aim to study the effects of inequality and unfairness on interpersonal decision making. Specifically, I investigate how individuals make social and consumer decisions in light of inequality and unfairness.

In this chapter, I lay the conceptual foundation for the research projects described in this dissertation by providing an overview of how inequality affects behavior. Importantly, following the literature on distributive justice, I differentiate between two

notions of inequality depending on the resource being distributed: inequality of outcomes and opportunity. Subsequently, I discuss how fairness perceptions play a crucial role in the acceptance and legitimization of some types of inequality. In addition, I review how a concept closely related to inequality, namely economic mobility, influences individuals' behaviors. Finally, an outline of the research objectives of this dissertation is provided. Considering that understanding the intricacies of the impact of inequality and unfairness on behavior is a multidisciplinary endeavor, the overview provided in this chapter reunites insights from different disciplines, ranging from Economics and Marketing to Psychology and Neuroscience.

1.1 Inequality of outcomes and opportunities

Research on social and distributive justice is primarily concerned with how resources such as outcomes and opportunities should be allocated between members of a society. While inequality of outcomes generally refers to the final inequality in the distribution of income, inequality of opportunity reflects an unequal distribution of sets of choices that individuals have at their disposal or chances to achieve a desired outcome (Ooghe, Schokkaert, et al., 2007).

Thus far, most studies have focused on inequality of outcomes and its consequences to individual behavior (Lefranc, Pistolesi, & Trannoy, 2008). Research in Economics has consistently showed that - despite the rise of inequality - individuals dislike unequal outcomes and show preferences for equality (Fehr & Fischbacher, 2002; Fehr & Schmidt, 1999). Illustrating this point, experiments have shown that individuals faced with the decision to split a monetary amount between themselves and another person make in general quite fair proposals, whereas the recipient of this monetary transaction often rejects proposals deemed as unfair (Nowak, Page, & Sigmund, 2000). Moreover, individuals are in general willing to alter the income of others at a cost to themselves in order to reduce inequality of outcomes in a group (Dawes, Fowler, Johnson, McElreath, & Smirnov, 2007). The general explanation for such behavior is that individuals do not only act on behalf of their own self-interest, but their actions are also guided by social norms of equity and fairness (Fehr & Fischbacher, 2002).

The literature investigating inequality of opportunity is more recent (Fleurbaey & Peragine, 2013) and considerably less vast. Nevertheless, studying the impact of inequality of opportunity is by no means less relevant. As the disparities in income inequality increase, so does the inequality in opportunity, as economic disadvantages are passed on from parents to their children (Corak, 2013). Children of low-income families often have far less opportunities than children of high-income families, facing lower quality education, poorer diets and precarious health services, which contribute to the permanence of these individuals - when adults - at the bottom of the income distribution.

Given the importance of opportunities in contributing to the perpetuation of inequality of outcomes, it is imperative that inequality of opportunity is taken into consideration in the redistributive debate. In fact, experimental evidence has shown that individuals do not only care about inequality of outcomes, but also have fairness concerns regarding the distribution of opportunities. Experiments in Economics have shown that when faced with opportunities to achieve a monetary outcome, individuals are willing to share these opportunities with others even at a cost of reducing their own chances of getting the monetary prize (Brock, Lange, & Ozbay, 2013; Krawczyk & Le Lec, 2010). In addition, individuals report feeling more positive emotions when opportunities are more equally distributed in a group (Aoki et al., 2014). For these reasons, measurements of equality that focus exclusively on outcomes have been criticized (Roemer & Trannoy, 2016) and recent theories of distributive justice have proposed to focus on opportunities as an appropriate benchmark for distributive decisions (Peragine, 2004).

In trying to understand how individuals are affected by inequality (of outcomes and opportunity), the concept of fairness comes to the forefront of the debate about how resources should be distributed in societies. In the next section, I discuss the role of fairness perceptions on inequality.

1.2 Fairness perceptions

Not all inequalities are equally objectionable. Support for redistributive policies as well as the judgment regarding which inequalities merit rectification depend greatly on individuals' perceptions of what is fair (Alesina & La Ferrara, 2005). Fairness is a central consideration in several human decisions, as it is one of the core foundations of our sense of morality (Haidt et al., 2003). Fairness concerns have been shown to start influencing decisions already in early childhood and continue to develop as children grow up (Almås, Cappelen, Sørensen, & Tungodden, 2010; Li, Wang, Yu, & Zhu, 2016). Despite being an universal value, fairness ideals present in society are rather plural, and individuals differ substantially in what they consider to be fair (Cappelen, Hole, Sørensen, & Tungodden, 2007). This variation of fairness ideals in the population explains why policies aimed at taxing the wealthy or at redistributing opportunities are generally met with mixed support, as individuals have different beliefs of what an ideal distribution of resources should look like (Norton & Ariely, 2011).

Illustrating this variability in fairness ideals, some individuals are known to endorse an *ex post* fairness view, while others uphold an *ex ante* fairness view. The focus of the *ex post* fairness view is mainly on inequality of outcomes, as it is considered fair to equalize outcomes regardless of how they were obtained. The focus of the *ex ante* view, on the other hand, is rather on opportunities and inequality of outcomes is often

considered acceptable if opportunities were equally distributed among individuals. In line with the *ex ante* fairness view, empirical studies have shown that support for redistributive policies decrease when opportunities are thought to be equally distributed in society (Alesina & La Ferrara, 2005; McCall, Burk, Laperrière, & Richeson, 2017).

While the *ex post* fairness view is based on the principle of *egalitarianism*, according to which all individuals should have the same resources, an important principle guiding the *ex ante* fairness view is the *principle of individual responsibility*. According to this principle, only inequalities that arise from factors beyond individual control - for which individuals cannot be held accountable - are thought to need rectification (Roemer, 2002). For the principle of individual responsibility to be taken into account, it is necessary to identify what are the factors causing inequality. Research investigating inequality of outcomes has demonstrated that individuals indeed accept more inequality when it stems from individual responsibility (e.g., efforts, knowledge) than when it is due to factors outside one's control (e.g., luck) (Cappelen et al., 2007; Gächter & Riedl, 2005; Schokkaert & Devooght, 2003). What is considerably less understood, however, is how individuals perceive factors which generate inequality of opportunity. In real life, individuals can have access to different chances because of different factors, some more under their control than others. In **chapter 2**, I propose to fill this gap and investigate individuals' perceptions of fairness and individual control for a myriad of factors leading to inequality of opportunity, such as merit, effort, luck, gender, parental income, ethnicity and so on.

While chapter 2 provides important insights into how individuals perceive the reasons that may lead to inequality in opportunity, it provides only limited knowledge concerning how these considerations about opportunity can impact preferences for redistribution. In **chapter 3**, I focus on identifying how inequality of opportunity affects how individuals allocate outcomes (i) between themselves and others and (ii) between two anonymous others. Precisely, I investigate how people perceive the interplay between inequality of opportunity and inequality of outcome and whether redistributing outcomes is considered a legitimate way to compensate for unequal opportunities originating from factors that vary in how fair and under individual control they are.

The fairness perception of individuals' responsibilities and the ensuing legitimization attributed to some types of inequality is closely related to yet another concept, namely economic mobility, which reflects how much one's merits and efforts can ultimately contribute to individuals achieving any economic position they may want in society. In the next section, I discuss how inequality of outcome, inequality of opportunity and economic mobility are related to each other and review the impact of perceptions of economic mobility on behavior.

1.3 Economic mobility

Intergenerational economic mobility is defined by the link between parental economic status and the child's earnings in adulthood (Corak, 2013). In essence, the more individuals can move away from the socioeconomic class in which they were born into, the more mobile a country is considered to be. Nevertheless, as mentioned above, income inequality is thought to bias how opportunities are distributed in society, contributing ultimately to stifle economic mobility by enhancing the role of family background while diminishing the importance of talents and hard work in determining someone's economic success in adult life.

In general, individuals are in agreement with the fact that when income inequality is high, factors outside one's control such as coming from a wealthy family and having well-educated parents play a greater role in moving up the socioeconomic ladder than factors under control such as hard work and ambition (McCall et al., 2017; Piff et al., 2020). Despite this understanding, individuals still greatly overestimate the degree of economic mobility in society (Davidai & Gilovich, 2015; Kraus & Tan, 2015). One of the reasons for such misguided beliefs in economic mobility is the general tendency to underestimate the levels of income inequality in society (Davidai, 2018).

Past research has shown that belief in economic mobility influences attitudes, leading to lower support for redistribution (Alesina, Stantcheva, & Teso, 2018), greater tolerance for income inequality (Shariff, Wiwad, & Aknin, 2016) and higher endorsement of meritocracy (Day & Fiske, 2017). This happens because in a high mobile society, one's socioeconomic status are thought to reflect one's hard work. Hence, perceptions of high economic mobility are generally associated with the fairness of the economic system. When the system is considered fair, every person is supposed to get what they deserve for their own hard work. As such, any inequality in outcomes is deemed as fair and redistribution policies are considered to be no longer necessary.

As perceptions of high economic mobility influence individuals' beliefs about how much their own actions and hard work may affect their future earnings, it is plausible to expect that such perceptions will influence their behavior as well. Evidence for the influence of perceptions of economic mobility on behavior comes from the fields of Consumer Behavior and Finance. Studies have shown that perceptions of low economic mobility lead to compensatory behavior such as gambling (Tabri, Dupuis, Kim, & Wohl, 2015) and increased variety seeking as an attempt to regain some sense of individual control (Yoon & Kim, 2018), while perceptions of high economic mobility lead to impulsive spending on goods considered important for economic success (Yoon & Kim, 2016) and poorer credit management (Szendrey & Fiala, 2018).

Status consumption is also a form of compensatory behavior in which consumers engage when they feel a sense of self-discrepancy (i.e., between what they have or are

and what they would like to have or be) (Mandel, Rucker, Levav, & Galinsky, 2017). Although such compensatory behavior may not appear to directly contribute to improve one's status and position in the socioeconomic ladder, it may help individuals gain status in their local communities and within their social group (Norton, 2013) and receive favorable treatment in social interactions (Lee, Ko, & Megehee, 2015). Yet, from a consumer behavior perspective, the influence of perceptions of economic mobility on consumption of goods that signal status is not yet known (Yoon & Kim, 2016).

In **chapter 4**, I investigate the influence of perceptions of economic mobility on consumption of status-enhancing goods. In particular, I focus on the behavior of individuals belonging to the bottom of the economic pyramid, that is, those with the lowest income. Importantly, even though consumption can be understood as an individual behavior, I investigate how economic mobility influences the use of consumption to signal status to others. Thus, chapter 4 also contributes to the understanding of how individuals make consumer decisions in the context of broad social interactions in society.

The relationship between perceptions of economic mobility and status consumption is of relevance due to the fact that poor consumption behaviors such as investing on goods not for their functionality, but for their signaling characteristics can intensify poverty and inequality. Moreover, most of the literature linking status consumption to macroeconomic variables has focused on income inequality as an explanatory variable (Paskov, Gërxhani, & van de Werfhorst, 2017; Walasek, Bhatia, & Brown, 2018; Walasek & Brown, 2015). Thus, in chapter 4, I try to disentangle the effects of perceived economic mobility and perceived inequality on status consumption.

1.4 Neural basis of inequality and fairness

Following evidence (discussed above) that humans do not always behave selfishly with the intent to maximize their own payoff - as expected in classic economical models - but are also guided by fairness concerns in their reactions to inequality, neuroscientific methods started to be incorporated in social justice research to help elucidate some of the underlying psychological and emotional processes that could be involved in reacting to inequality and unfairness.

In this context, the Ultimatum game (UG) (Güth, Schmittberger, & Schwarze, 1982) has been often used to study the behavioral and neural mechanisms of reactions to inequality and unfairness. In this two-person game, one person acts as the proposer and has to decide how to split a monetary amount between themselves and another person - the receiver. After receiving the proposer's offer, the receiver can accept the proposal, in which case the money is split as suggested by the proposer. However, the

receiver can also reject the proposal and both players receive no money. In sum, this game is an important tool to measure preferences for fairness because of the clear trade off between economic selfishness and fairness preferences, since to be able to communicate that an offer was unfair and unacceptable, the receiver has to forego the monetary incentives.

In a seminal study using functional magnetic resonance (fMRI) to identify individuals' reactions to an unequal and unfair split of money in the UG, it was found that the dorsolateral prefrontal cortex (dlPFC) was more activated when participants received unfair monetary offers (Sanfey, Rilling, Aronson, Nystrom, & Cohen, 2003). Follow up studies have then established that the right dlPFC is crucial to put in place cognitive control mechanisms that inhibit predominant responses to behave selfishly (and maximize one's own economic resources by accepting unfair offers in the UG). This inhibition of selfish impulses is crucial for people to behave accordingly to what they think is fair, rejecting unfair offers even if this means they would receive no money at all (Knoch, Pascual-Leone, Meyer, Treyer, & Fehr, 2006; Van't Wout, Kahn, Sanfey, & Aleman, 2005).

While this explanation is based on a cognitive component of our reaction to unfairness, emotions also play a role in our decisions. As shown by Civai, Corradi-Dell'Acqua, Gamer, and Rumiati (2010), emotional responses are more prevalent when we are ourselves the target of unfairness and in contexts of disadvantaged inequality (i.e., when we are worse off than others) (Civai, 2013). This is also evidenced by the involvement of the medial prefrontal cortex - an area often associated with processing self-relevant stimuli, when we react to unfairness directed at us, but not directed to someone else (Civai, Miniussi, & Rumiati, 2015; Corradi-Dell'Acqua, Civai, Rumiati, & Fink, 2013). Importantly, because individuals also react to unfairness when it is directed at others, emotional components cannot be the sole drivers of our reaction to unfairness.

Altogether, these findings suggest that our reaction to inequality and unfairness is context dependent, presumably relying more strongly in the process of self-relevant stimuli in occasions when oneself is the target of unfairness while depending more on cognitive process when monetary stakes are involved. Nevertheless, other explanations that do not rely on the constraints of the UG, have pointed to a more general (as opposed to context specific) reaction to unfairness. For example, Buckholz and Marois (2012) have claimed that whenever our idea of what is fair in a situation is violated by others' actions, the right dlPFC is important to integrate input coming from different regions of the brain and select an appropriate reaction to unfairness. This explanation implies a more general role of the dlPFC in dealing with unfairness, which seems to extend beyond its involvement in suppressing monetary self-interest, as previously suggested.

In **chapter 5**, I use transcranial magnetic stimulation (TMS) to study whether involvement of the right dlPFC and mPFC in responses to (in)equality is context-dependent, varying according to monetary stakes and personal involvement. Moreover, by exposing participants to unfair monetary allocations that create disadvantageous inequality (i.e., they were worse off than the other participant) as well as to hyper-fair allocations that lead to advantageous inequality (i.e., they were better off than the other participant), I investigate whether the psychological processes underlying the involvement of the right dlPFC and mPFC in reaction to disadvantageous inequality are the same in situations of advantageous inequality.

1.5 Approach to the study of inequality and unfairness

In this dissertation, I study the impact of inequality and unfairness on individuals' interpersonal decision-making by employing a neuroeconomic approach. Neuroeconomics is a relatively recent field which has interdisciplinarity as its defining characteristic. Since inequality is a multifaceted social issue, its investigation from multiple angles and perspectives can only contribute to a broader and more comprehensive understanding of the topic.

The goal of Neuroeconomics is to bridge efforts and tools from Psychology, Economics and Neuroscience as to enrich the understanding of human decision-making. It originated in the late 1990s, when the emergence of Cognitive Neuroscience as a field coincided with a movement initiated by behavioral economists in search of data that could explain inconsistencies in neoclassical models of economic behavior (Glimcher, Camerer, Fehr, & Poldrack, 2009). Since then, Neuroeconomics has gained space by (i) taking into account that humans do not always behave in a rational and consistent way, but that psychological processes (i.e., emotions, motivations, self-interest, cognitive biases) influence behavior and (ii) attempting to integrate descriptions of neurological processing with normative choice theory derived from Economics. In addition, stemming from Neuroeconomics, a more applied field of research termed Consumer Neuroscience aims to bring insights from Psychology, Economics and Neuroscience to consumer and other marketing relevant behaviors (Lee, Broderick, & Chamberlain, 2007).

In this thesis, I use a variety of methods to investigate interpersonal decision-making under (un)fairness. Specifically, I use online survey (chapter 2), laboratory and online experimentation (chapter 3 and 4) and TMS (chapter 5). As each of these methods have its advantages and shortcomings, it is ultimately their combination that strengthens the investigation of the issue at hand.

By employing surveys and questionnaires, researchers can assess (via self-reports) latent psychological constructs which cannot be directly observed (e.g., attitudes) (Kros-

nick, Judd, & Wittenbrink, 2005). Moreover, surveys are also an important method to obtain inter-relations between different constructs. Although surveys can be subject to response biases (e.g., social desirability and insufficient effort), proper questionnaire design can often minimize these issues (Krosnick & Presser, 2010). Laboratory experimentation is usually recognized for its high internal validity due to the random assignment of participants to experimental conditions and increased control of extraneous variables - which make it possible to establish a causal relationship between the experimental conditions and the observed behavior (Loewenstein, 1999). However, it often has low external validity due to the artificiality of the laboratory setting (Schram, 2005).

Finally, neuroscientific methods are powerful tools when used in combination with laboratory experimentation in order to establish the relationship between brain and behavior. In specific, TMS is a non-invasive technique that enables stimulation of the human brain. A magnetic coil with passing electric current is placed over individuals' heads. A magnetic field is then generated, which can interfere temporarily with the area of the brain placed under the coil (Hallett, 2007). Protocols with high-frequency stimulation lead to an increase in the strength of the synapses in the region of the brain being stimulated, while low-frequency stimulation results in decreasing the strength of these synapses (Dayan, Censor, Buch, Sandrini, & Cohen, 2013). This temporary synaptic interference is of value to research aiming to understand the functionality of specific brain regions in certain behavioral tasks. By demonstrating the impact of disrupting neural activity of the stimulated brain region on individuals' performance and behavior, TMS has been consolidated as an unique neuroscientific method in the investigation of causal structure-function relationships in the brain and how they connect with observed behavior (Camerer, Loewenstein, & Prelec, 2005; Sack, 2006).

1.6 Aims and outline of this thesis

While the rise of inequality has captured the interest of many researchers of different fields in the past decade, the psychological mechanisms underlying how inequality affects our decisions in a social context are still poorly understood (Jetten & Peters, 2019). The main goal of this dissertation is to contribute to this research gap and examine how decisions made in the context of social interactions are impacted by inequality and unfairness. This dissertation's aim is explored in four empirical chapters (chapters 2-5).

Chapter 2 provides an initial perspective of individuals' perceptions of inequality of opportunity. In contrast to previous research which focuses on the effect of different sources of inequality of outcomes, chapter 2 explores the effect of different sources of inequality of opportunity on individuals' perceptions of fairness and control. Opportu-

nities are operationalized as chances to achieve a monetary prize. In an online survey, participants are asked to evaluate different factors that contribute to generate an unequal distribution of chances between two other individuals. These factors resemble several real world situations that generate unequal chances, ranging from merit (e.g., effort, knowledge) to biological (e.g., gender, ethnicity) and socioeconomic factors (e.g., parental income). For each of these factors, participants evaluate how fair they are and how much control they enable individuals to have over the chances received. This allows the investigation of the differences and similarities in how varied sources of inequality of opportunity are perceived. Moreover, it enables the examination of the relationship between perceptions of fairness and individual control in an *ex ante* context, that is, before chances realize into different outcomes. Finally, by changing which individual would be favored by higher chances (e.g., male or female; individual with higher or lower parental income), it is possible to test whether it is considered fairer to provide higher chances to often disadvantaged groups, which is the main guiding principle of Affirmative action. Results are discussed in terms of its contributions to policy-making and to future investigations of inequality of opportunity.

Chapter 3 adds to chapter 2 by providing an investigation of how different sources of inequality of opportunity influence individuals' preferences for redistribution. The main goal of this chapter is to examine whether individuals perceive outcome redistribution as a legitimate compensation for inequality in opportunity. In addition, it investigates whether compensation for inequality in opportunity depends on the source of the inequality and whether having more or less opportunities influences how one thinks of compensation. Specifically, it is examined whether having more opportunities influences how entitled one feels, resulting in less redistribution. In a behavioral experiment, individuals receive either high or low chances to get a lottery prize. Before revealing whether the participant with higher or lower chances was the winner of the lottery, participants are asked to report how they would share the prize with the other participant in case they were the winner. Based on the results of chapter 2, the source of inequality is varied, such that unequal distributions of chances are based on factors that lack on fairness and individual control (e.g., height), that lack on individual control but not on fairness (e.g., luck) or that are both fair and under individuals' control (e.g., merit). Finally, it is taken into consideration that redistributive decisions can be biased by self-interest. In this case, regardless of the inequality in opportunity, participants can report that they would like to share a small percentage of the lottery prize with the other participant, so they could maximize their payoff in the experiment. To control for this, the behavior of both involved (i.e., stakeholders) and non-involved individuals (e.g., spectators) is examined. While stakeholders receive chances in the experiment and make decisions that affect their own payoff, spectators do not receive chances to get the monetary prize and are asked to make decisions regarding how outcomes should be distributed between two other individuals. In that sense, spectators' decisions do not influence their payoff in the experiment and should therefore provide a more normative perspective of which level of outcome

redistribution is fair to offset unequal opportunities. Results of this chapter provide insights into how individuals think inequality in opportunity should be compensated. Importantly, the investigation here is in the *ex ante* domain, that is, before chances realize in different outcomes. Thus, results can provide relevant knowledge for real life situations and Affirmative action policies aimed at offsetting unequal opportunities before they translate into unequal outcomes.

Chapter 4 continues the study of the effects of (in)equality of opportunity, but in the domain of consumer behavior. The notion that societies offer equal opportunities to its members contributes to beliefs on economic mobility, the view that with hard work and determination anyone can achieve a higher socioeconomic position. Beliefs in economic mobility and the desire to achieve a higher socioeconomic status are naturally linked to the pursuit of status in interpersonal relationships. Nevertheless, the link between perceptions of economic mobility and the willingness to consume goods that display status to others has not yet been empirically investigated. Instead, most of research dedicated to understand societal consumer patterns has focused on the relationship between income inequality and status consumption. The main goal of chapter 4 is to examine how perceptions of economic mobility influence status consumption. In specific, the focus is on bottom tier consumers, given that status consumption can have more impactful consequences to this socioeconomic class, potentially intensifying their financial constraints. In light of previous literature, a second goal of chapter 4 is to disentangle the effects of perceptions of economic mobility and perceptions of income inequality on status consumption. To this end, four different studies are conducted to investigate the role of perceptions of economic mobility (and income inequality) on status consumption and to understand what are the psychological motivations underlying such relationship. Results are discussed in terms of their implications to marketers and policy-makers.

Chapter 5 investigates the neural mechanisms of reactions to (in)equality of outcomes and (un)fairness. The neuroscientific literature has consistently reported the involvement of prefrontal regions of the brain in reciprocating unfairness. Nevertheless, the differences in the study designs employed in this literature make it challenging to draw comprehensive conclusions about the involvement of the prefrontal cortex on the decision to reciprocate unfairness in different contexts (e.g., when monetary incentives are at stake or when we are ourselves the target of unfairness or not). Using a methodological framework that independently varies personal involvement and monetary costs in combination with TMS to inhibit the functionality of the right dlPFC and mPFC, this chapter aims to provide evidence of the involvement of these brain regions in reacting to unfairness. In doing so, it is possible to test different psychological motivations that have been put forward to explain the roles of these prefrontal regions in dealing with unfairness, ultimately providing evidence of whether the roles of the right dlPFC and mPFC in face of unfairness are context-dependent or not. Lastly, this chapter also aims to test whether the right dlPFC and mPFC are involved to the

same extent in reciprocating fairness as they are in reciprocating unfairness. Insights from this chapter contribute to the neuroeconomics literature by providing a comprehensive test of previous psychological mechanisms proposed to explain reciprocal fairness. Moreover, it extends this literature by providing a much needed behavioral and neurobiological comparison between reciprocating fairness and unfairness.

Finally, **chapter 6** provides a summary of the main findings of this dissertation together with a discussion of its contributions to the field of social justice and to the design of policies aimed at reducing inequality.

2

Unequal chances: Fairness and Individual control

This paper was co-authored by Nickolas Gagnon. This chapter is based on: Micheli, L. & Gagnon, N. (2020). Unequal chances: Ex ante fairness and individual control. *Scientific Reports*, 10:21862.

Abstract

Unequal financial outcomes often originate from unequal chances. Yet, compared to outcomes, little is known about how individuals perceive unequal distributions of chances. We investigate empirically the role of different sources of unequal chances in shaping inequality perceptions. Importantly, we do so from an *ex ante* perspective—i.e., before the chances are realized—which has rarely been explored. In an online survey, we asked uninvolved respondents to evaluate *ex ante* the fairness of unequal allocations of chances. We varied the source of inequality of chances, using a comprehensive range of factors which resemble several real world situations. Respondents also evaluated how much control individuals hold over the distribution of chances. Results show that different sources generate different *ex ante* perception of fairness. That is, unequal chances based on socioeconomic and biological factors, such as gender, family income and ethnicity, are evaluated to be unfair relative to the same chances based on effort, knowledge, and benevolence. Results also show that, for most individuals, there is a positive correlation between perceived control of a factor and fairness of unequal chances based on that factor. Luck appears to be an exception to this correlation, ranking as high in fairness as effort, knowledge, and benevolence, but similarly low in individual control as ethnicity, family income, and gender.

2.1 Introduction

Unequal chances abound in the pursuit of financial rewards; erecting the landscape of the financial outcomes likely to be achieved by different groups of individuals. A striking recent study (Chetty, Hendren, Jones, & Porter, 2020) reports that in the United States “controlling for parental income, black boys have lower incomes in adulthood than white boys in 99% of Census tracts.” Policies such as additional investments for low-income children, diversity quotas in firms, and Affirmative Action in university admissions strive to redress these uneven chances before they translate into unequal outcomes. They attempt to “level the playing field” as the saying goes. Such policies can be observed across the globe. Brazil invests additional funds in the education of low-income children, through its Bolsa Família cash-transfer program. Norway as well as other European countries require a gender quota on corporate boards. Universities in India, South Africa, and the United States increase the admission chances of disadvantaged groups through Affirmative Action. Nevertheless, our understanding of how individuals perceive the unequal chances that these policies address is minimal. In fact, there is a noticeable empirical gap in the existing literature on distributive fairness ideals: we have limited knowledge about which types of unequal chances are considered to be fair from the *ex ante* standpoint—i.e., before chances are realized and incomes are known. We employ ourselves to bridge this gap.

Using a survey, we investigate the fairness perceptions of different factors used to distribute unequal chances, from the *ex ante* perspective. As many studies before (Cappelen et al., 2007; Cettolin & Riedl, 2016; Konow, 2000, 2009; Schokkaert & Devooght, 2003), we examine the fairness perceptions of an impartial or uninvolved spectator. While non-monetarily incentivized, the perspective of the spectator is of value because it is expected to be devoid of self-interest (Konow, 2009). That is, the spectator’s judgment should be impartial, providing us with a normative account of what is considered fair in the *ex ante* domain.

We use a large set of factors, which include factors often serving as bases for unequal chances in society such as effort, knowledge, luck, gender, ethnicity, and family income. Those factors are more comprehensive than those that the literature on fairness has employed, enabling a more fine-grained exploration of differences among a range of situations that can generate unequal chances. The motivation for employing this wider range is twofold. First, our primary motivation is empirical, as whether differences exist in fairness perceptions is unknown for almost all chance factors studied here, and several of those unstudied factors such as ethnicity and gender are valuable for public policy. The only study investigating chance factors from an *ex ante* viewpoint also makes conclusions about “sheer luck” and “performance” by studying height and a mix of effort and knowledge, but those are proxies of unknown quality (Krawczyk, 2010). Moreover, we add identification numbers (ID) to our factors because experimenters sometimes allocate students to treatments based on IDs in lab-

oratory experiments to mimic random assignment, so that it is practical to understand the fairness of such a chance assignment. Second, from a theoretical viewpoint, liberal egalitarianism, which we discuss below, as well as a few other concepts could affect fairness perceptions of some of our factors. Those include repugnance (Roth, 2007), psychological cost (Pascoe & Smart Richman, 2009), and indirect reciprocity (Nowak & Sigmund, 2005), which we discuss in the Methods section.

Moreover, we examine the perception of individual control over these factors and the relationship between control and ex ante fairness. This is important because economic and philosophy research on the liberal egalitarian fairness ideal has emphasized the positive relationship between factors perceived as within one's control and fairness perception of different types of outcome inequality and the lasting theoretical difficulties in pinpointing exactly which factors are under one's control (Arneson, 1989; Cappelen, Sørensen, & Tungodden, 2010; Cohen, 1989; Dworkin, 1981; Roemer, 1998). Furthermore, whether this relationship extends empirically to chance inequality and ex-ante fairness judgements has not been explored. Lastly, we touch upon Affirmative Action, which raises the odds for disadvantaged groups over advantaged groups. We do this by testing whether it is fairer to provide higher chances to groups that are generally disadvantaged than to groups that are generally advantaged. Our hope is that understanding how individuals perceive unequal chances originating from different factors can provide insights to policymakers in terms of which unequal chances are perceived as justifiable and which may call for rectification.

The economic literature investigating inequality and redistribution decisions draws a line between ex post and ex ante fairness. While *ex post fairness* concerns the distribution of incomes between individuals once these incomes are known (Harsanyi, 1955), *ex ante fairness* applies to the distribution of chances that are to generate incomes (Diamond, 1967). The literature in psychology and management (Cohen-Charash & Spector, 2001; Leventhal, Karuza, & Fry, 1980; Thibaut & Walker, 1975; Tyler, 2000) also studies the factor generating outcomes separately from the outcomes themselves and uncovers crucial elements that influence individuals' appraisal of factors, such as respect, an opportunity to be involved or voice their concerns, and the absence of biases.

The empirical literature on redistribution focuses mostly on ex post fairness, once incomes are already known. Studies show that a substantial proportion of individuals display concern for equality of incomes, exhibiting a willingness to decrease their own income to improve the conditions of others through redistribution (Bolton & Ockenfels, 2000; Cappelen et al., 2007; Charness & Rabin, 2002; Dawes et al., 2007; Fehr & Schmidt, 1999; Forsythe, Horowitz, Savin, & Sefton, 1994; Konow, 2000). Studies have also examined ex-post fairness from the non-monetarily incentivized spectator viewpoint, showing that many individuals also prefer to equalize earnings of equally-deserving participants (Almås, Cappelen, & Tungodden, 2020; Cappelen et

al., 2007; Konow, 2000) and judge such unequal situations to be unfair when asked in a hypothetical manner (Konow, 2009; Schokkaert & Devooght, 2003).

There is also empirical evidence that individuals care about *ex ante* inequality, although the topic is less studied. For instance, recent economic experiments (Brock et al., 2013; Krawczyk & Le Lec, 2010) presented participants with unequal chances to win at a lottery, and the opportunity to redistribute chances before the realization of that lottery (also see Miao and Zhong (2018) for another type of experiment in the same vein). In those experiments, many individuals indeed show concern for equality when redistributing chances, even if it reduces their own chances of winning. Similarly, experiments show that individuals do consider the distribution of initial chances in their redistribution decisions even after the realization of these chances, both when they are themselves involved (Bolton, Brandts, & Ockenfels, 2005; Cappelen, Konow, Sørensen, & Tungodden, 2013a; Grimalda, Kar, & Proto, 2016) or when spectators (Cappelen et al., 2013a; Cettolin & Riedl, 2016). Finally, theoretical work on social preferences for obtaining a fair chance has been the focus of a number of papers in the past twenty years (Bolton et al., 2005; Karni & Safra, 2002; Krawczyk, 2011; Saito, 2013; Trautmann, 2009).

Studies investigate the fairness perception and the distribution decisions of incomes that have been generated through different factors, but they do so almost exclusively from an *ex post* perspective. For example, they examine whether the patterns of fairness perceptions and income distribution decisions differ if income inequality is caused by different factors, such as effort, knowledge, and luck (Almås et al., 2020; Cappelen et al., 2007; Gächter & Riedl, 2005; Konow, 2000; Schokkaert & Devooght, 2003). Typically, a sizeable proportion of individuals are more accepting of inequality caused by effort and knowledge than luck, both when involved (Almås et al., 2020; Cappelen et al., 2007; Gächter & Riedl, 2005; Konow, 2000) and when spectators (Almås et al., 2020; Cappelen et al., 2007; Konow, 2000). The prominent explanation for this type of behavior is the view that individuals should be held accountable for factors under their control, such as effort and knowledge, but not for others which they cannot influence, such as luck. This is the position taken by the liberal egalitarian fairness ideal (Roemer, 1998) and the accountability principle (Konow, 2000). Several earlier equality concepts in philosophy also hold individuals responsible for their choices, the difference often being to which extent one is responsible for certain factors and not for others, a notoriously difficult matter to determine theoretically (Arneson, 1989; Cohen, 1989; Dworkin, 1981).

In contrast, how different factors behind the distribution of chances affect the *ex ante* fairness perception of these chances has scarcely been explored by empirical studies. We believe that this missing step is socially valuable because many policies—such as the Affirmative Action described in the first paragraph—intend not to correct incomes once unequal chances have been realized, but to correct different types of unequal

chances before they are realized. Furthermore, whether the positive relationship between perceived control and fairness of inequality documented ex post is typical from an ex ante perspective has not been researched much. Studying ex ante perceptions is essential because our knowledge regarding ex post fairness views does not necessarily inform us about ex ante fairness views. For instance, theoretically, a society's fairness evaluation of a factor based on luck may differ ex ante and ex post: providing equal chances of obtaining either a high or low income to everyone might be judged as fair at the outset, only to be considered unfair once unequal incomes have been randomly allocated (Myerson, 1981).

The only study that has empirically investigated the role of different factors in ex ante fairness views aims to compare how distributions of chances based on "sheer luck" vs. "performance" impact individuals' ex ante choice of future redistribution by employing chances based on height vs. a combination of effort and knowledge in a quiz (Krawczyk, 2010). Using those measures of luck and performance, the study finds that, ex ante, individuals are more prone to support future redistribution when luck influences chances than when performance does, which provides some evidence that liberal egalitarianism is present ex ante. We add to this research by investigating fairness perceptions of a wide range of factors underlying unequal distribution of chances, which are mostly chosen to resemble real-world situations of inequality. Interestingly, we measure fairness perceptions of height and luck, and find large differences in fairness ratings between the two, whereas luck rates similarly in fairness as effort and knowledge. Moreover, we measure individuals' perceptions of control over the different factors. We note that the previous study also included questions regarding fairness perceptions of factors, but did not find significant differences between the reported fairness of the height and the effort and knowledge factors. However, as the author reports, its use of a between-subject design might generate too much noise to distinguish fairness differences between the factors. Our within-subject design is likely to alleviate this issue.

Finally, we note the following point about our measures of fairness. In economic studies of distributive moral ideals, it is theoretically assumed that individuals hold fairness preferences or ideals that translate into income redistribution decisions, and the common empirical way of studying fairness is then through revealed preferences: we measure redistribution decisions and then infer preferences from those decisions (Cappelen et al., 2007; Konow, 2000; Krawczyk, 2010). We instead use survey questions about fairness perceptions in a hypothetical scenario, as others have done (Gaertner, Jungeilges, & Neck, 2001; Konow, 2009; Schokkaert & Devoght, 2003). Note that economic experiments in other domains also sometimes employ non incentivized measures of fairness perceptions, e.g., in labor experiments (Cohn, Fehr, & Goette, 2015; Gagnon & Noussair, 2020).

2.2 Methods

We recruited 82 undergraduate students from the online recruitment system for economic experiments (ORSEE) (Greiner, 2015) of the Behavioral and Experimental Economics Laboratory (BEElab) at the School of Business and Economics of Maastricht University (The Netherlands) to take part in an online Qualtrics survey. We obtained informed consent from participants to take part in the study. They completed the survey in April and May 2017 and received 5 EUR for their participation. In terms of demographic characteristics, 41% are men and the mean age is 21.5 years. The study was conducted following the peer-approved factors established by Maastricht University's Behavioral and Experimental Economics Laboratory (BEElab). Our study was approved by the Maastricht University's Behavioral and Experimental Economics Laboratory at a public ethics review and project proposal meeting that is mandatory for all scholars who wish to use the BEElab facilities. All methods were performed in accordance with the relevant guidelines and regulations of the BEElab and Maastricht University for studies with human participants.

Participants considered a hypothetical scenario in which unequal chances to win a prize of 10 EUR are allocated between two other individuals. Participants could not win the prize themselves, and, for simplicity, we framed chances as lottery tickets. Chances are always allocated in the following manner: one individual has a 90% chance, and the other has a 10% chance. Only one of the two individuals wins the prize. Participants were asked questions concerning different factors determining who receives which chance. The scenario was described to participants in the following manner:

Consider a situation in which lottery tickets are distributed between two persons. Generally we ask you to assume that these two persons have a similar social, economic and educational background. In some cases this will not be so and you will be explicitly informed about it. Each ticket gives a 10% chance to win the lottery. There can be only one winner in the lottery, who receives 10 EUR as a prize. The ticket allocation is as follows: one person gets 9 tickets and thus has a 90% chance of winning the lottery prize, whereas the other person gets 1 ticket and thus has a 10% chance of winning the lottery prize. The allocation of tickets is based on various factors.

We then presented procedures varying 11 different factors in random order. Although all procedures presented led to the same consequences (i.e., one person receiving a 10% chance to win a single lottery prize and the other receiving a 90% chance of winning that same prize), these procedures differed with respect to the factor that determines who receives which chances. The factor presented was one of the following: benevolence, knowledge, effort, luck, student identification number (ID), height, weight, nationality, gender, ethnicity (skin color), and family (parental) income. We set a highly unequal distribution of chance 90% vs. 10%) to make chance unequal-

ity more salient than outcome inequality. This distribution is similar to that used in (Bolton et al., 2005).

All factors were presented once in our “Regular” Block, where the higher chance was allocated to individuals who were benevolent, more knowledgeable, exerted more effort, lucky, with a higher ID, tall, heavy, man, German, light-skinned, or from a high-income family. We also presented participants with the same factors in our “Reverse” Block, this time allocating higher chances to the opposite individuals (e.g., individuals who are non-benevolent, dark-skinned, women or from a low-income family). The order of blocks was randomized. Except for a few pre-selected factors, we are solely interested in the “Regular” Block because the factors in this block described cases that generally occur more often in real life, such as advantaging men, light-skinned individuals, or individuals from a high-income family. All factors are presented in the “Reverse” block simply to avoid disclosing the factors we wanted to focus on in this block. Those pre-selected factors of interest in the “Reverse” block are chosen to evaluate whether asymmetries in fairness might exist for them, which we explain below.

Table 2.1 summarizes the criteria for receiving higher chances, for each factor of each block. For benevolence, we presented the case of an individual who decided to help a person in need and another individual who decided to *not* help a person in need. In this specific case, higher chances are allocated to the benevolent person in the “Regular” Block, while higher chances are allocated to the non-benevolent person in the “Reverse” Block. For knowledge, we used a general knowledge quiz, where the person with a higher number of correct answers would receive higher chances in the “Regular” Block and lower chances in the “Reverse” Block. For effort we employed a slider task (Gill & Prowse, 2012), a common effort task in experimental economics, which is explained in the example below. Again, the person exerting more effort would receive higher chances in the “Regular” Block and lower chances in the “Reverse” Block.¹

Then, for luck we adopted a 6-side die roll where one person would roll a number equal or smaller than 3 and receive higher chances, whereas the other would receive lower chances. For the ID factor, we used greater and smaller student ID numbers (which are generally allocated by order of enrolment, although this might be un-

¹We make a few observations about this effort task. First, we think that the effort scenario that we present makes it clear that the two individuals in the scenario are aware that their effort determines their chances of winning the prize, although it does not explicitly specify the beliefs of individuals in the scenario. Control ratings by respondents in the Results section are in line with this, suggesting participants understand that chances depend on individuals’ effort. Second, we cannot rule out that performance in the slider task is fully unrelated to ability, but it is a gruesome manual task that relies on the willingness to put in effort. Third, since it is one of the most common tasks used in economic experiments, participants in our laboratory pool are likely to be familiar with this task by having experienced it themselves. Even for those who have not, the task and its mechanical nature are relatively easy to comprehend in the description that we provide.

known to students). For height we contrasted taller and shorter individuals, while for weight we contrasted heavy and light persons and for gender we employed women versus men. For nationality, we made use of Germans versus non-Germans (German is the most common nationality in the participants pool). For ethnicity, we contrasted light-skinned to dark-skinned individuals. Finally, for family income we considered individuals coming from higher or lower income families.

Participants first rated the fairness of all factors for both the Regular and Reverse Blocks. After that, participants were exposed a second time to both blocks, again in random order, and rated the same factors in terms of how much individual control one has over chances received. Responses were given on a 7-point Likert scale ranging from *Very Unfair* to *Very Fair* and from *No Control* to *Full Control*. At the end of the study, participants provided demographic information, such as age, gender and parental income as well as other characteristics of themselves such as height and weight. The full instructions are provided in Appendix A. As in many studies on moral ideals before us (Almås et al., 2020; Cappelen et al., 2007; Cettolin & Riedl, 2016; Konow, 2000, 2009; Schokkaert & Devooght, 2003), our participants' answers do not affect their own financial welfare. We rely on participants' intrinsic motivation to pay attention. Still, we made sure that our study provides adequate conditions for them to pay attention: all instructions are carefully explained, the study is designed to be short (<20 minutes) and participants are provided with messages warning them prior to a change in blocks or a change in ratings (i.e., fairness to control). The following two examples regarding effort and gender describe how the factors were presented to participants. Both examples belong to the Regular Block.

Effort Example: Chances are allocated based on the results of a task that depends on effort. In the task, people see dots appearing randomly on horizontal bars on their computer screen. Their task is to position as many dots as possible in the middle of the horizontal bars. The person who places more dots in the correct position in a given time receives a 90% chance to win, and the person who places less dots in the correct position receives a 10% chance to win.

Gender Example: Chances are allocated based on gender. The two persons have different genders. The man receives a 90% chance to win, and the woman receives a 10% chance to win.

2.2.1 Hypotheses

We test whether there are differences in fairness among factors, and whether fairness is a correlate of the perception of control. Our first hypothesis is that there are differences in fairness perceptions of chance factors. If the liberal egalitarian ideal previously documented in environments without chances (Cappelen et al., 2007; Gächter & Riedl, 2005; Konow, 2000; Schokkaert & Devooght, 2003) translate to chance fac-

tors, effort and perhaps knowledge will be evaluated as fairer than other factors. In addition, several other concepts could be at play. For instance, low chances based on morally hard-to-justify factors such as ethnicity, gender, and income could create strong repugnance (Roth, 2007), which would lower fairness perceptions. Understanding the extent of the psychological cost of ethnic and gender discrimination on those receiving them (Pascoe & Smart Richman, 2009) could also decrease the perceived fairness of chance based on those factors, and indirect reciprocity (Nowak & Sigmund, 2005) could increase the fairness of high chances based on benevolence or good deeds.

Our second hypothesis is that factors with low individual control are perceived as more unfair, in line with liberal egalitarianism (Roemer, 1998). Furthermore, we test for asymmetries in fairness ratings when chances favor one group over the other for the following factors: benevolence, knowledge, effort, gender, ethnicity, and family income. We expect that asymmetries in these cases will arise for two reasons. First, previous research shows that individuals reward “merit” in the case of effort (Almås et al., 2020; Cappelen et al., 2007; Cappelen et al., 2010; Konow, 2000) and knowledge (Gächter & Riedl, 2005), and this might extend to benevolence. This can lead to individuals finding it fairer to allocate higher chances to those who were benevolent, who provided more correct answers in the knowledge quiz and who exerted more effort than to those with opposite characteristics. Second, we conjecture that one might find it fairer to favor generally disadvantaged groups because this compensates existing inequality. Hence, our third hypothesis is that participants rate factors as fairer when women, individuals with dark skin and low parental income receive higher chances than men and individuals with white skin and high parental income.

Table 2.1: Criteria for receiving higher chances in the Regular and Reverse Blocks.

Procedure	Regular Block	Reverse Block
Benevolence	Choosing to <i>help</i> someone in need	Choosing <i>not to help</i> someone in need
Knowledge	<i>Higher</i> results in a knowledge quiz	<i>Lower</i> results in a knowledge quiz
Effort	Correctly position <i>more</i> dots in the task	Correctly position <i>less</i> dots in the task
Luck	Roll of 6-faced die gives 3 or <i>less</i>	-
ID	<i>Higher</i> student ID number	<i>Lower</i> student ID number
Height	<i>Taller</i> person	<i>Shorter</i> person
Weight	<i>Heavier</i> person	<i>Lighter</i> person
Gender	<i>Male</i>	<i>Female</i>
Nationality	<i>German</i>	<i>Non-German</i>
Ethnicity	<i>Lighter</i> skin color	<i>Darker</i> skin color
Family Income	<i>Higher</i> parental income	<i>Lower</i> parental income

Notes: We did not reverse Luck because this would simply mean changing the winning numbers of the die roll, which should have no effect on its fairness and control ratings.

2.3 Results

2.3.1 Ex Ante Fairness Ratings

Result 1: Regular-block factors advantaging individuals who are benevolent, knowledgeable, exert effort and are lucky, score high on fairness, whereas factors advantaging individuals based on socioeconomic or biological factors (e.g., gender, height, skin color or parental income) score low on fairness.

Table 2.2 presents the mean fairness ratings of Regular-block factors. We use non-parametric Wilcoxon signed-rank tests to analyze pairwise differences between factors in their distribution of fairness ratings (N=82). We employ such a non-parametric rank-based technique because the fairness data that we have is measured on an ordered (non-metric) scale and heavily censored below (49.6% of answers indicate the minimum fairness level). Stars in a cell indicate that the factor in the column is fairer than the corresponding row. *P*-values are corrected for multiple comparisons using the Holm-Bonferroni method (Holm, 1979) and are indicated by the number of stars. For completeness, fairness ratings of the factors in the Reverse Block can be found in Appendix A.

Table 2.2: Mean Fairness and Wilcoxon Signed-Rank Test Comparisons

Procedure	Benev.	Effort	Luck	Know.	ID	Height	Weight	Nat.	Inc.	Gender	Ethn.
Benevolence (Benev.)	5.38 (1.47)										
Effort		5.04 (1.53)									
Luck	*		4.63 (1.77)								
Knowledge (Know.)	***	**		4.38 (1.88)							
ID	***	***	***	***	2.17 (1.67)						
Height	***	***	***	***	**	.37 (.75)					
Weight	***	***	***	***	**		.35 (.60)				
Nationality (Nat.)	***	***	***	***	***			.33 (.85)			
Family Income (Inc.)	***	***	***	***	***				.29 (.60)		
Gender	***	***	***	***	***					.21 (.46)	
Ethnicity (Ethn.)	***	***	***	***	***	**	**				.13 (.34)

Note: Standard deviations are indicated in parentheses. Stars in a cell indicate that the factor in the column is fairer than the factor in the corresponding row. Holm-Bonferroni-corrected *p*-values: * $p < .05$; ** $p < .01$; *** $p < .001$.

This result indicates that not all chance inequalities are considered equally fair from the ex ante viewpoint, which is in line with what other studies have found for the ex post perspective. Indeed, despite the fact that all factors led to an unequal distribution

of chances between individuals, some factors were considered fairer than others. Unlike for the ex post perspective, however, factors giving higher chances to those who exert effort or are knowledgeable are not significantly fairer than luck, which simply randomly allocates chances. Factors based on socioeconomic and biological criteria are the ones which really differ from luck, by being substantially less fair.

Although we do not aim to formalize groups in terms of fairness, we can assay their presence by conducting a Principal Component Analysis (PCA). It detects three main components (eigenvalues ≥ 1), which we interpret as groups, in terms of fairness: (1) height, weight, gender, nationality, ethnicity, and family income (all biological and sociological factors that we use; 33.9% of variance), (2) effort, knowledge, and benevolent action (19.0% of variance), and (3) luck and ID (9.5% of variance). Given that the last group is only marginally detected (eigenvalue = 1.04) and explains little of the variation, the picture arising from this analysis is generally similar to what we obtained by engaging in pairwise comparisons of factors.

We also examine whether a participant's characteristic could influence their fairness ratings when facing a situation that allocates chances based on that specific characteristic, e.g., whether a man rates unequal chances advantaging a man any differently than a woman does. To do this, we conduct a non-parametric Wilcoxon-Mann-Whitney test (or Wilcoxon rank-sum test) to test whether this is the case for each of the following 7 self-reported characteristics: gender, height (below or above median sample value), weight (below or above median sample value), skin color, general knowledge (below or above median sample value), laziness (below or above median sample value), and parental income. We find no statistically significant effect for each of the 7 tests on fairness ratings (p -values $> .159$). This is line with the advantage of using spectator participants: their judgement is as impartial as possible as they have no stake in the situation.

Overall, our first result suggests that individuals may be prone to accept, ex ante, certain inequality of chances, e.g., when they come through effort, knowledge, or even luck, while endorsing policies that rectify others, e.g., when they rest on biological and socioeconomic factors. Next, we test whether individuals' judgments of ex ante fairness differ depending on who is advantaged by the unequal distribution of chances.

2.3.2 Asymmetries in Ex Ante Fairness Ratings

Result 2: *It is fairer to advantage individuals who are benevolent, dark-skinned, knowledgeable, and exert more effort, compared to advantaging individuals with the opposite characteristics. It is not fairer to advantage women over men.*

In five of the six cases of interest (benevolence, effort, knowledge, family income,

gender, skin color), as hypothesized, the ex ante fairness rating differs depending on the individual who is favored with higher chances. The exception is gender, for which, unlike what we hypothesized, we did not find a significant asymmetry. Table 2.3 reports the mean fairness for the factors advantaging one group (Regular Block) versus the other group (Reverse Block). Non-parametric Wilcoxon signed-rank tests (N=82) are used to compare fairness ratings of a factor in the Regular Block vs. the Reverse Block, separately for each of the six factors (e.g., favoring someone who was benevolent vs. someone who was not benevolent, then favoring a man vs. favoring a woman). Stars in the table indicate whether favoring one type of individuals was significantly fairer than favoring the other type for each factor separately. The asymmetries that we identify can occur for different reasons. First, asymmetries in fairness in factors that involve some sort of merit (benevolence, effort, knowledge) can occur because individuals find it fair to distribute chances in a meritocratic manner. Second, individuals may consider it fairer to give higher chances to disadvantaged groups similar to what Affirmative Action policies often do.

Table 2.3: Asymmetries and Wilcoxon Signed-Rank Test Comparisons

Higher Chance to:	Mean Fairness	Difference
Benevolent	5.38 (1.47)	***
Non-Benevolent	1.93 (1.44)	
More Effort	5.04 (1.53)	***
Less Effort	2.52 (1.65)	
More Knowledgeable	4.38 (1.88)	***
Less Knowledgeable	2.17 (1.39)	
High Family Income	1.29 (.60)	***
Low Family Income	2.74 (1.79)	
Man	1.21 (.46)	
Woman	1.32 (.83)	
Ethnicity—Light Skin	1.13 (.34)	**
Ethnicity—Dark Skin	1.44 (.98)	

Note: Standard deviations are indicated in parentheses. Stars in a cell indicate a significant difference in fairness depending on who is advantaged. Holm-Bonferroni-corrected p -values: * $p < .05$; ** $p < .01$; *** $p < .001$.

We make two observations. First, finding no asymmetries in the case of gender might be due to the specific setting that we study—a Dutch business school with a large share of women among its student body, which for students is likely not highly unequal in terms of gender. Second, although we do find asymmetries in fairness, factors that favor disadvantaged groups are still generally considered unfair compared to factors that advantage those who are benevolent, exert effort, or are knowledgeable. This result reflects to some extent the mixed support affirmative action can receive. Even though individuals recognize that giving more chances to the disadvantaged is fairer, such factors are still considered relatively unfair. Alternatively, the low relative fairness of the affirmative action factors that we use might be due to the somewhat egalitarian environment of the students. Another reason for this result is that these factors create a large amount of inequality by distributing very unequal chances in-

stead of slightly advantaging the generally-disadvantaged group.

2.3.3 Control and Fairness

Result 3: *A majority of individuals consider factors that one has control over to be fairer. Interestingly, luck stands out as the exception: it ranks high in fairness but low in control.*

Table 2.4 details the mean control ratings of the Regular factors. Since our fairness and control data are both measured on an ordered scale, we calculate the non-parametric Spearman correlation between fairness and control for each individual ($N=79$), for the 11 factors contained in the Regular Block. Note that we cannot calculate the correlation for 3 participants because there are no variations in their fairness or control answers. For the 79 remaining participants, the Spearman ρ is positive for 95% of them, at least of medium strength ($\rho \geq .30$) for 92%, and strong ($\rho \geq .60$) for 63%. The ρ is significantly greater than zero at the .05 significance level for 62% of participants, and at the .10 level for 71%, while it is significantly smaller than zero at the .10 level for none. For the interested reader, the mean control ratings for the Reverse Block are shown in Appendix A.

To provide a picture of the correlation at the group level, we can employ an individual-level random effects parametric Tobit regression with lower-bound censoring. Fairness is the dependent variable and control is the explanatory variable. The resulting control coefficient of 0.985 ($SD=.048$, $N=902$, $p < .001$) is significant and indicates that, on average, there is a positive correlation between control and fairness. Moreover, we note that a PCA reveals the presence of two main groups (eigenvalues ≥ 1) in terms of control: (1) height, gender, nationality, ethnicity, and income (all biological and sociological factors that we employ, except weight; 35.8% of variance), and (2) effort, knowledge, benevolence, and weight (22.3% of variance). This paints a picture similar to the one we obtain from pairwise comparisons of factors in terms of controls.

We also examine whether a participant's characteristic could influence his or her control ratings when facing a situation that allocates chances based on that characteristic. We conduct a non-parametric Wilcoxon-Mann-Whitney test to test whether this is the case for each of the following 7 self-reported characteristics: gender, height (below or above median sample value), weight (below or above median sample value), skin color, general knowledge (below or above median sample value), laziness (below or above median sample value), and parental income. We find no statistically significant effect for each of the 7 tests on control ratings (p -values $> .153$).

Our third result indicates that a substantial share of participants exhibit a positive correlation between fairness and control when they make ex ante judgments about

unequal distributions of chances. This is in line with what other studies have found for ex post judgments of unequal outcomes, for involved participants (Almås et al., 2020; Cappelen et al., 2007; Gächter & Riedl, 2005; Konow, 2000) and for spectator participants (Almås et al., 2020; Cappelen et al., 2007; Konow, 2000). That is, the judgments of many individuals appear broadly consistent with the liberal-egalitarian fairness ideal, whereby individuals find unequal chances based on factors over which one has control to be fair. However, the fact that the factor randomly allocating high chances is as fair ex ante as the factors advantaging those who exert effort or are knowledgeable—while at the same time being judged to be under no control—is inconsistent with the liberal-egalitarian fairness ideal.

Table 2.4: Mean Control and Wilcoxon Signed-Rank Test Comparisons

Procedure	Benev.	Effort	Know.	Weight	Luck	Inc.	ID	Gender	Nat.	Height	Ethn.
Benevolence (Benev.)	5.91 (1.51)										
Effort	***	5.22 (1.41)									
Knowledge (Know.)	***		4.98 (1.49)								
Weight	***	***	***	2.95 (1.65)							
Luck	***	***	***	***	1.55 (1.00)						
Family Income (Inc.)	***	***	***	***		1.50 (1.03)					
ID	***	***	***	***			1.45 (.72)				
Gender	***	***	***	***				1.28 (.76)			
Nationality (Nat.)	***	***	***	***					1.28 (.86)		
Height	***	***	***	***						1.27 (.74)	
Ethnicity (Ethn.)	***	***	***	***							1.26 (.70)

Note: Standard deviations are indicated in parentheses. Stars in a cell indicate a significant difference in fairness for a factor depending on who is advantaged. Holm-Bonferroni-corrected p -values: * $p < .05$; ** $p < .01$; *** $p < .001$

2.4 Discussion

This study addresses a gap in the existing distributive fairness ideals literature regarding how individuals evaluate the ex ante fairness of distributions of chances based on different factors. We exposed impartial or uninvolved spectators to different factors used to distribute unequal chances to win a monetary prize between two individuals. Before the chances were realized, participants were asked to rate the fairness of each factor as well as to rate how much individual control each factor allowed for.

Our results indicate that, as other studies have found for ex post inequality, for both

involved participants (Almås et al., 2020; Cappelen et al., 2007; Gächter & Riedl, 2005; Konow, 2000) and for spectator participants (Almås et al., 2020; Cappelen et al., 2007; Konow, 2000), the fairness of ex ante inequality depends on the causes that generate this inequality. Factors advantaging those who are benevolent, knowledgeable, exert more effort or advantaging those who are simply lucky are rated similarly in terms of fairness by uninvolved spectators. The assessment of luck differs from the ex post perspective of both involved and spectator individuals, in which factors that advantage individuals based on luck are often considered to be less fair than meritocratic factors that advantage those who exert more effort or who are more knowledgeable (Almås et al., 2020; Cappelen et al., 2007; Gächter & Riedl, 2005; Konow, 2000).

The group of factors based on gender, height, weight, nationality, ethnicity or family income, which we could group together as biological and socioeconomic factors for ease of exposition, are substantially less fair than the other factors that we study, none of which are biological or socioeconomic. The difference between those two types of factors is in line with what we regularly witness in societies: unequal chances based on biological or socioeconomic characteristics are denounced as unfair and can elicit strong reactions, such as social movements against racism and sexism demanding equal chances for members of different groups. Generally, the different fairness ratings that we observe reinforce the need to differentiate inequality and fairness (Starmans, Sheskin, & Bloom, 2017).

We note that the differences in fairness ratings between the different factors in our study appear unlikely to be due to individuals being more sensitive to some specific information (e.g., gender or ethnic information). If this was the case, one could expect individuals to be more sensitive to scenarios in our study in which their own attributes or characteristics served to create chance inequality. However, results show that individuals' characteristics (e.g., gender, skin color, general knowledge, weight, parental income) are not significantly related to their fairness ratings or to their control ratings in situations where those characteristics determine chance inequality. In addition, despite keeping information on factors constant in the Regular and Reverse blocks (only changing which individual receives higher chances), we observe variability in the fairness ratings of factors between the two blocks. Finally, we note that the differences and ordering in control ratings between factors are not exactly the same as for fairness ratings (e.g., luck and weight). Still, it would be interesting to further explore whether and how sensitivity to information can impact fairness judgments in future research.

The asymmetry observed in the fairness of certain factors is consistent with at least a substantial number of individuals supporting Affirmative Action for disadvantaged groups, such as ethnic minorities. For instance, 63% of Americans reported in 2014 that they thought that affirmative action programs increasing black and minority uni-

versity students are a “good thing” (Drake, 2014), while 26% stated in 2019 that race should be a factor in university admission (Graf, 2019). Even in our setting of a simple lottery among university students, it is indeed fairer to favor certain disadvantaged groups, such as individuals with dark skin. We observe, however, that increasing the chances of certain groups is still considered unfair on average in this context relative to advantaging those who exert more effort or are more knowledgeable. We do not find that it is fairer to give higher chances to one gender over the other, although we note that this might be the result of using students in a relatively gender-balanced environment. Overall, asymmetries in perceived fairness provide a potential source of expansion for current research.

Furthermore, factors allocating chances in a fairer manner rate higher in individual control. This is broadly consistent with the liberal-egalitarian fairness ideal that a large share of individuals have been shown to hold in terms of ex post fairness (Cappelen et al., 2007). Interestingly, unlike ex post, liberal egalitarianism fails to hold ex ante in the case of luck, which is considered both fair and outside of one’s control. On the one hand, the factor randomly allocating higher chances is considered as fair as the factors advantaging those who exert effort or are knowledgeable. On the other hand, whereas factors based on effort or knowledge are judged to be under individuals’ control, luck is obviously considered to be under no control, as are factors based on biological or socioeconomic factors.

How is it possible for the random allocation to be fair from an ex ante perspective when previous work highlight that it is unfair ex post (Almås et al., 2020; Cappelen et al., 2007; Gächter & Riedl, 2005; Konow, 2000)? Theoretical work suggests that individuals can be time-inconsistent when making ex ante and ex post fairness judgements (Myerson, 1981; Trautmann & Wakker, 2010). For instance, they can first support policies that aim at ex ante chance equality, but lead to unequal incomes, and, once these unequal incomes are realized, they then support policies that aim at ex post income equality. This problem can arise when, at the moment of making an ex ante choice, individuals do not take into account possible ex post inequality. A recent working paper also reports behavior consistent with this phenomenon: individuals often make an ex ante fair choice before outcomes are realized, only to then switch to an ex post fair choice once outcomes are known (Andreoni, Aydin, Barton, Bernheim, & Naecker, 2016). A qualitative comparison between our fairness results in the ex ante domain and fairness results of other studies in the ex post domain (Almås et al., 2020; Cappelen et al., 2007; Gächter & Riedl, 2005; Konow, 2000) also suggests that individuals may make different ex ante and ex post fairness judgements. However, our study cannot provide a direct test of this time-inconsistency explanation because it does not measure individuals’ perception of both ex ante and ex post fairness, and differences in designs and contexts with previous studies could also have contributed to the observed differences. It would be interesting to investigate not only if fairness ratings differ ex ante and ex post, but to explore if the extent of these differences

depend on the source of inequality. An extrapolation of our results would suggest that while differences may be observed for luck, other factors such as effort and knowledge might be considered equally fair from an *ex ante* and *ex post* view.

In addition, we note that it can be puzzling that individuals evaluate chances allocated based on luck as fairer than chances allocated based on other factors that could be easily rationalized as coming from luck, such as height. We note that luck being perceived as fair *ex ante* and unfair *ex post* may provide an explanation for this phenomenon. That is, on the one hand, an allocation of chances based on height may be seen through *ex post* lenses, as the luck that could determine height has already been realized. On the other hand, an allocation of chances based on luck may be seen as still not realized—i.e., as part of a compound lottery—and therefore be perceived through *ex ante* lenses. Another possibility is that the exception of luck might have arisen through social conventions. That is, although die rolls cannot be controlled, they could be perceived as fair because individuals often voluntarily opt to use them to settle indivisible claims, whereas individuals rarely settle claims based on height.

Importantly, our results on fairness contrasts in some respects with Krawczyk (2010), the only previous study that has empirically investigated the role of different factors in *ex ante* fairness views. Krawczyk (2010) aimed to compare how distributions of chances based on “sheer luck” vs. “performance” impact individuals’ *ex ante* choice of future redistribution by using chances based on height vs. a combination of effort and knowledge in a quiz. While we do not study redistribution decisions, our results suggest that there are large differences in fairness perceptions between height and luck, whereas luck rates similarly in fairness as effort and knowledge. Future research will need to address whether this difference between height and luck also translates into a large difference in *ex ante* redistribution decisions.

Our findings carry two potential implications for policymakers. First, the causes of unequal distributions of chances need to be carefully considered if one wants to make chance-equalizing policies that correspond to the fairness perceptions of individuals. Second, considered with the results of other studies, our study suggests that individuals exhibit time-inconsistency regarding the fairness of different redistribution policies. That is, they may support policies that grant equal chances, but create income inequalities, only to later switch their support to policies that aim at equal incomes. A way to avoid this reversal is perhaps to conscientiously consider the *ex post* inequalities that equal chances may generate, whenever there are public debates on equal-chance versus equal-income policies.

We also note that in our study we opted to investigate the judgments of uninvolved spectators, whose judgment should be impartial (Konow, 2009). It would be interesting for future research to explore how *ex ante* judgments of involved agents deviate from those of spectators. Despite the fact that spectators, just like involved agents,

tend to take ex ante inequality into consideration (Cappelen et al., 2013a; Cettolin & Riedl, 2016) and are also sensitive to the different sources causing inequality in outcomes (Almås et al., 2020; Cappelen et al., 2007; Konow, 2000), previous studies have also pinpointed differences in the behavior of stakeholders and third-party individuals in general. To start with, spectators tend to fully achieve their distributive fairness ideals more often (due to this achievement being monetarily cheaper) than stakeholders (Cappelen et al., 2007; Konow, 2000). Furthermore, when individuals are themselves affected by an unfair allocation of outcomes, they tend to punish fairness violations more strongly (Fehr & Fischbacher, 2004b; Leibbrandt & López-Pérez, 2012) and show more intense emotional reactions to unfairness than third-party individuals do (Civai et al., 2010). Neural mechanisms in response to unfairness have also been reported to differ depending on whether individuals are directly affected by a fairness violation or a third-party observer in the situation (Corradi-Dell'Acqua et al., 2013; Stallen et al., 2018). Although these differences are restricted to the ex post domain, it is plausible that some differences will emerge between stakeholders and spectators in the ex ante domain, e.g., stakeholders are likely to act in more selfish ways. However, it is unclear whether there will be differences between stakeholders and spectators in how they evaluate the relative fairness of different factors generating unequal chances.

An additional interesting question for future research concerns the extent to which differences between cultures arise regarding ex ante fairness evaluation of chance inequality. It is well known in economics that different cultures exhibit different social preferences (Henrich et al., 2005) and it has been shown that ex post fairness views can differ substantially across cultures (Almås et al., 2020; Huppert et al., 2019). We can therefore also expect that ex ante fairness is affected by culture.

We point out that a limitation of our study is that participants always rated the source of inequality first in terms of fairness and then in terms of individual control. We chose this ordering because we are primarily interested in ex ante fairness evaluations, and only interested in control ratings to the extent that they relate to fairness. Considering the strength of the relationship between fairness and individual control and the fact that it is at the core of liberal egalitarianism (Roemer, 1998), our conjecture is that the positive correlation between fairness and control would not change substantially if we were to reverse the order of presentation between fairness and control. Nevertheless, we cannot fully rule out that asking participants first for their fairness or control ratings would not influence their assessments.

Finally, we realize that while in our study participants were clearly aware of the reason behind inequality in chances, this is often not the case in real life. Individuals' misconceptions of the reasons why someone might have higher or lower chances might considerably affect their fairness judgments, and consequently their support for redistributive policies. Recent studies have found that ambiguity in the perception of

others' responsibility in their life outcomes leads to lower allocation of resources to them (Safra, Ma, & Melkonyan, 2019), and that individuals are less supportive of income redistribution when it is unclear whether outcome inequality comes from effort or luck than when it clearly arises from luck (Cohn, Jessen, Klasnja, & Smeets, 2019). It would be interesting to measure the contribution of these misconceptions to the opposition to and support for public policies that aim to establish ex ante equality, such as Affirmative Action.

3

More opportunities, better outcomes: Does inequality in opportunity call for outcome redistribution?

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Abstract

The rise of economic inequality has brought to light the debate of unequal opportunities in societies. While the demand for levelling the playing field is currently high, it is less clear how inequality in opportunity should be rectified. Here, we explore whether outcome redistribution is seen as a legitimate compensation for unequal opportunities. In doing so, we examine the behavior of both involved and non-involved individuals (i.e., stakeholders and spectators). In an experimental setting, stakeholders received either high or low chances to win a monetary prize. Before knowing who the winner was, stakeholders were asked to report how they would redistribute the monetary prize in case they were themselves the winner while spectators were asked how they would redistribute the prize in case a person with high or low chances was the winner. The source of inequality in opportunities was varied. Results show that stakeholders with higher winning chances felt more entitled to the monetary prize and redistributed less of it than stakeholders with low winning chances. Moreover, source of inequality differentially influenced ex ante redistribution of stakeholders with high and low winning chances. Spectators' ex ante redistributive decisions were neither influenced by individuals' chances nor by the source of inequality. Results are discussed in light of possible implications to redistributive policies that aim to address inequality in opportunities.

3.1 Introduction

The gap between the poor and the rich keeps growing in both Europe and the United States (Piketty & Saez, 2014) and is likely to be exacerbated across the globe by the COVID-19 pandemic (Blundell, Costa-Dias, Joyce, & Xu, 2020; van Dorn, Cooney, & Sabin, 2020). Besides bringing significant negative consequences to societies, for example by reducing economic growth (OECD, 2015) and well-being (Keeley, 2015), the rise of economic inequality bears another societal challenge due to its direct relationship to how opportunities are distributed between individuals. In fact, the higher the income inequality in a country, the more economic disadvantages are passed on between parents and their children (Corak, 2013). Children of low-income families often face poor educational and health opportunities (e.g., access to quality education and healthcare), which in turn can greatly influence their chances of landing in high-paying jobs in the future. Although correcting for unequal opportunities is a pressing challenge faced by many societies, it is still unclear how this inequality should be rectified. This becomes especially difficult when opportunities cannot be redistributed, for example because they are personal or non-transferable (e.g., talents) (Peragine, 1999). Correcting for unequal opportunities may therefore require some level of income redistribution, and as a matter of fact, many policies attempting to correct for unequal opportunities include a component of income redistribution (e.g., land reforms and cash transfer programs) (Bourguignon, 2016). Yet, little is known about how inequality of opportunity may affect individuals' preferences for income redistribution. Gaining this insight is important as it can advance our understanding of individuals' support for redistributive policies aimed at levelling the playing field for disadvantaged groups.

In the present research we explore whether individuals redistribute outcomes as a way to compensate for unequal opportunities. In doing so, we explore different factors that could influence the legitimacy of outcome redistribution as a compensation for unequal opportunities. First, we investigate whether a good or bad opportunity to achieve an outcome makes individuals more or less prone to redistribute outcomes. As previous literature has shown self-interest and subjective entitlement to play a role in fairness and redistributive considerations (Cappelen, Moene, Sørensen, & Tungodden, 2013b; Feng et al., 2013; Rodriguez-Lara & Moreno-Garrido, 2012; Rutström & Williams, 2000), it could be that being in the privileged position of having better opportunities (versus having worse opportunities) affects how one sees the need to compensate for inequality in opportunity. Second, we explore whether the different ways in which unequal opportunities come about influence outcome redistribution. In our daily lives, individuals may face unequal opportunities due to a wide variety of reasons, which vary in how much individual control they enable one to have over the chances received. For example, unequal opportunities to get a job promotion may arise due to circumstances outside individuals' control (e.g., gender), due to individuals' own merits (e.g., hours worked) or simply due to luck. Experimen-

tal evidence demonstrates that the belief of holding individuals accountable only for factors under their control - typically known as liberal egalitarianism (Roemer, 1998) - influences redistribution of outcomes (Almås et al., 2020; Cappelen et al., 2007). Although individuals may also be guided by liberal egalitarianism when judging inequality in opportunities (Micheli & Gagnon, 2020), less is known concerning how different procedures determining the unequal distribution of opportunities may ultimately influence outcome redistribution. Third, we examine the behavior of both participants who have stakes in the outcomes (henceforth stakeholders) as well as participants whose payoffs do not depend on their redistributive decisions (henceforth spectators). The contrast between stakeholders and spectators is important because while self-interest and entitlements influence redistributive decision when decision-makers have stakes in the outcomes, judgments from spectators can be expected to be devoid of self-interest, providing a more normative view of what is fair in the context of unequal opportunities leading to unequal outcomes (Cappelen et al., 2013a; Konow, 2009). Thus, this comparison has important implications, revealing potential similarities and differences in redistributive preferences of involved individuals and non-involved agents (e.g. policy-makers and politicians), who often have the power of putting forward and influencing policies aimed at addressing inequality.

In the present study, our main focus of investigation is on how unequal opportunities to achieve outcomes affect preferences for *ex ante* outcome redistribution, as in many real life situations individuals may have to think of outcome redistribution before the outcomes are even realized. For instance, during the COVID-19 pandemic many individuals and organizations found themselves in difficult situations which could severely harm their financial outcomes both in the present and in the future. Governments had to act quickly to propose financial aid that could help those who were in vulnerable positions even before the disadvantages imposed on them by the pandemic could have translated into further inequality in outcomes. Thus, it is relevant to explore how outcomes are planned to be redistributed to compensate for unequal opportunities when uncertainty about outcomes is still existent. In addition, as a secondary aim of this paper, we compare redistributive preferences revealed *ex ante* (i.e., while there is still uncertainty about the outcome distribution) and *ex post* (i.e., once the distribution of outcomes is known). This is done because previous research has shown individuals can show inconsistencies in redistributive behavior depending on whether their preferences are asked *ex ante* or *ex post* (Andreoni et al., 2016). Comparing *ex ante* and *ex post* redistribution in the present experiment can shed light into possible temporal differences in how outcomes may be used to compensate for unequal opportunities.

In our experimental design, participants are randomly assigned to be either stakeholders or spectators. Stakeholders are informed they will be matched with another stakeholder and that chances to win a lottery prize will be allocated between them. Across pairs of stakeholders, chances are allocated based on one of three procedures that vary in their levels of fairness and individual control (i.e., participants' height,

participants' luck in a dice throw and merit based on a real effort task). Allocations of chances are always unequal, such that in each pair, one stakeholder is allocated higher chances than the other stakeholder. They are informed that only one of the two matched stakeholders will receive the lottery prize. Stakeholders are also informed about the procedure used to distribute chances and the allocation of chances in their pair. Before knowing who is the lottery winner, they are asked to decide how they would allocate the lottery prize in their pair in case they are the lottery winner. Spectators do not receive chances to win the lottery prize themselves. Instead, they witness the unequal allocation of chances between two other individuals based on one of the same three procedures used for stakeholders. Before knowing which individual is the winner of the lottery prize, spectators perform an allocation task in which they are asked how they would allocate the lottery prize between the winner and the loser individual. Spectators make this decision for the scenario in which an individual with high chances would be the lottery winner, as well as for the situation in which an individual with low chances would be the lottery winner. After the lottery winners are revealed, winner stakeholders as well as spectators have the chance to revise their ex ante allocation.

The present research builds on growing literature suggesting that fairness preferences often cannot be explained solely by outcome-based models (Krawczyk & Le Lec, 2010) and that individuals may care about two distinct notions of equality - namely *ex ante* (i.e., equality of opportunity) and *ex post* (i.e., equality of outcomes) (Saito, 2013). In fact, just like individuals dislike inequality in outcomes (Bolton & Ockenfels, 2000; Dawes et al., 2007; Fehr & Schmidt, 1999), dissatisfaction and emotional unpleasantness equally well arise when opportunities are unequal (Aoki et al., 2014). Experimental evidence demonstrates that individuals often distribute opportunities even if this behavior hurts their own chances of getting a monetary outcome (Brock et al., 2013; Krawczyk & Le Lec, 2010). Moreover, both stakeholders as well as spectators seem to take *ex ante* inequality into consideration when making redistributive decisions (Cettolin & Riedl, 2016; Cettolin, Riedl, & Tran, 2017). Altogether, this demonstrates that individuals do not only compare final payoffs, but also seem to care about how opportunities to achieve outcomes are distributed.

Previous research has demonstrated that perceptions of inequality of opportunities influence individuals' support towards redistributive policies, such that those who believe that a society offers equal opportunities to its members are typically not in favor of income redistribution (Alesina & La Ferrara, 2005; Alesina et al., 2018). This is consistent with an *ex ante* view of fairness, which favors equality of opportunity over outcomes, positing that unequal outcomes are acceptable whenever opportunities were equally distributed. An *ex post* fairness perspective, on the other hand, tends to favor outcome equality regardless of how opportunities were initially distributed. Importantly, both views coexist, as different individuals may have dissimilar perspectives on what is fair (Cettolin & Riedl, 2016) or may even switch from one perspective

to the other depending on the time of their decision (Andreoni et al., 2016).

Thus far, three studies have investigated how a distribution of opportunities affects redistribution of outcomes. The study most closely related to ours is conducted by Krawczyk (2010). In his study, stakeholders were assigned probabilities of winning a monetary prize and were asked to decide how the winner should distribute the prize with the other participants. Similar to our study, the decision was made *ex ante*, that is, before they were informed on who the winner actually was. Results showed that stakeholders with higher winning chances proposed less redistribution than participants with lower chances. There are two important elements in which our study differs from Krawczyk (2010). First, while Krawczyk (2010) investigates stakeholders only, our research investigates the redistributive behavior of both involved stakeholders and non-involved spectators. Second, in Krawczyk (2010) opportunities were distributed based on one procedure only (i.e. participants' height), whereas in our experiment different procedures that vary in terms of fairness and individual control are investigated.

Cappelen et al. (2013a) investigate *ex ante* versus *ex post* fairness preferences in involved and uninvolved participants. In their experiment, individuals were exposed to a risk-taking phase where they could choose between safe and risky alternatives. Individuals were later paired and asked to redistribute the outcomes originating from the first part of the experiment. Thus, *ex ante* opportunities were equal for all (as all individuals were exposed to the same alternatives in the risk taking phase), while *ex post* outcomes could be different due to individuals' risk taking behavior or luck. Findings revealed that most individuals were driven by *ex-ante* fairness concerns and did not redistribute outcomes. However, the source of inequality in outcomes mattered, such that less redistribution took place when inequality in outcomes originated from individuals' choices rather than luck.

The study of Akbaş, Ariely, and Yuksel (2019) is similar to Cappelen et al. (2013a), but they also introduce an experimental condition where *ex ante* opportunities are unequal. In this specific condition, one stakeholder has the choice between a safe and a risky lottery while the other stakeholder is automatically assigned the safe option, which has a lower expected utility. Results showed redistribution was significantly higher when opportunities were distributed unequally. Importantly, in their experiment inequality of opportunity is operationalized in terms of constraints of choice: while one individual has agency over how much risk they would like to take, the other does not. In our experiment, however, individuals do not have choices that can lead to different outcomes. Rather, opportunity is operationalized as chances to receive an outcome. Our study further differs from the studies conducted by Cappelen et al. (2013a) and Akbaş et al. (2019) in three important aspects. First, it investigates situations in which there is inequality in opportunity, while Cappelen et al. (2013a) investigates equality of opportunity and Akbaş et al. (2019) compares equality and in-

equality of opportunity. Second, the outcome redistribution in their studies is *ex post*, that is, it occurs only after participants are informed about choices and outcomes in the previous risk-taking phase of the experiment, while in the present study redistribution is *ex ante* but conditional on outcomes. Third, a non-competitive framework is employed in their study, where each subject faces chances to win an outcome prize independent of other participants, as opposed to our study where only one participant of each pair earns the money prize in the experiment.

Our main results can be summarized as follows. First, unequal distribution of opportunities affects stakeholders' behaviors. Although both stakeholders with high and low winning chances redistribute only a small percentage of the lottery prize, we find that, similar to Krawczyk (2010), stakeholders with high winning chances redistribute less of the prize than stakeholders with lower winning chances. Thus, there is little to no compensation for unequal opportunities. Second, we find that this effect is mediated by subjective entitlements, such that stakeholders with higher chances feel more entitled to the lottery prize and therefore redistribute less of it. This result adds to the literature by shedding light into a possible mechanism underlying the effect of winning chances on stakeholders' redistribution behavior. Third, procedures leading to unequal chances influence stakeholders with high and low winning chances differently. While procedures have a small effect on the behavior of stakeholders with high winning chances, who redistribute marginally significantly less in the merit than in the height procedure, no difference between procedures is observed for stakeholders with low winning chances. Finally, in contrast to our expectations, spectators' *ex ante* decisions were neither affected by individuals' chances nor by the different procedures.

The lack of a pronounced effect of different procedures on redistribution for both stakeholders and spectators contrasts with a vast literature showing that different procedures greatly influence redistribution of outcomes (Alesina et al., 2018; Almås et al., 2020; Cappelen et al., 2007; Cappelen et al., 2013a; Rustichini & Vostroknutov, 2014). Our results suggest that procedures leading to an unequal distribution of opportunities weigh in less heavily on redistributive decisions than procedures that directly affect outcomes. Furthermore, the fact that neither stakeholders with high chances nor spectators used redistribution of outcomes to compensate stakeholders with low winning chances when procedures were unfair and enabled little control hints to the idea that neither stakeholders nor spectators find redistribution of outcomes to be a legitimate way to compensate those negatively affected by an opportunity gap.

The remainder of the paper is organized as follows. Section 3.2 introduces the experimental design, section 3.3 presents the hypotheses, section 3.4 display the results and section 3.5 concludes.

3.2 Experimental design

Participants were recruited using the online recruitment system for economic experiments (ORSEE) (Greiner, 2015) at a large European university. The experiment was conducted at the Behavioral and Experimental Economics laboratory at this university using the Z-Tree software (Fischbacher, 2007). In total, 331 participants ($Age = 21$ years, 59.2% female) took part in the experiment. 76.7% of the sample was composed of students in the fields of Business and Economics. The remainder of the sample was composed of students from a variety of courses. Stakeholders and spectators earned on average 17.84 EUR ($SD=6.56$ EUR) and 20.92 EUR ($SD=6.18$ EUR) respectively and experimental sessions lasted on average 60 minutes.

A between-subjects experimental design consisting of three parts was implemented. In part 1, participants were exposed to three different procedures that are used in part 2 to determine who receives high or low chances to get the monetary prize. In part 2, each participant was randomly assigned to only one of these procedures. Participants were informed about the procedure implemented for the distribution of chances, about who received high and low chances and asked to decide how the monetary prize should be redistributed. In part 3, participants' risk preferences were elicited and demographic questions were asked.

3.2.1 Part 1: Exposure to procedures

Three different procedures were used to determine the distribution of chances that would lead to the monetary prize - participants' height, their luck in a dice roll and merit based on a real effort task. These specific procedures were chosen based on results of a separate study (chapter 2 of this thesis), showing they differed in terms of perceptions of fairness and individual control over the chances received (Micheli & Gagnon, 2020).¹ Importantly, although each subject was randomly assigned to only one of these procedures in part 2, in part 1 they were exposed to all three procedures (i.e., height, luck and merit) as to minimize potential differences between the treatment groups.

Upon arrival, participants were requested to enter the laboratory one by one. First, participants had their height measured by one experimenter and were asked to toss three six-faced dice. Participants' height and the number tossed in the dice throw were noted down by the experimenter on a paper, which was given to participants.

¹In this study, non-involved respondents were asked to evaluate the ex ante fairness of several procedures used to allocate unequal chances, as well as the individual control one could have over the chances received through each procedure. Results show that unequal chances based on biological factors such as height are evaluated to be both unfair and not under one's control, while merit based allocations of unequal chances are evaluated as fair and under one's control. Distribution of chances based on luck receives mixed evaluations, rating high in fairness but low on individual control.

After all participants were seated, they were required to enter this information into their computers. To avoid that participants wrongly entered their height and/or the number tossed in the dice throw, the experimenter checked the numbers entered by participants. If the numbers were correct, the experimenter provided participants with a password to move forward with the experiment.

Next, participants were requested to complete a general knowledge quiz composed of 16 multiple choice questions covering a variety of topics such as sports, music, geography, history and so on. Questions were adapted from Gächter and Riedl (2005) and were pre-tested with a different sample of students to ensure an adequate level of difficulty for undergraduate students. The criterion was that participants should be able to answer a reasonable number of questions and recognize that their general knowledge was being examined. All questions had five possible answers and only one correct answer (see Appendix B for all questions and instructions). All participants were presented with the same questions and had a maximum of 30 seconds to answer each question. Unanswered questions counted as wrong answers. After the end of the quiz, no feedback on the number of correct answers was provided as to avoid that positive or negative qualitative feedback about performance could influence participants' redistributive decisions in part 2 of the experiment. To control for participants' beliefs about their own performance and others' performance in the general knowledge quiz, participants were asked - after having finished the quiz - to estimate how many questions they themselves answered correctly as well as to estimate how many questions were correctly answered on average (rounded to next integer) by the other participants in the experimental session. Both estimations were incentivized with a payment of 1 EUR for a correct estimate.

3.2.2 Part 2: Distribution of chances and allocation task

In part 2, participants were randomly assigned to be either stakeholders (N=232) or spectators (N=99). All subjects remained in the same role throughout the experiment. Randomization of participants' roles was done at the session level, such that each session had participants in the role of stakeholders and spectators. Likewise, procedures were also randomized at the session level to avoid session specific effects (Fréchette, 2012). Thus, each session had stakeholders and spectators assigned to each one of the three procedures.

3.2.2.1 Stakeholders

Stakeholders were anonymously matched with another stakeholder in the same experimental session and were informed that chances to win a monetary prize of 10 EUR would be assigned between themselves and the stakeholder they were matched with. For better understanding, chances were framed as lottery tickets. It was known

to all participants that 10 lottery tickets would be distributed and each lottery ticket would give a 10% chance to win the lottery prize. Furthermore, participants knew that only one of the two matched stakeholders would win the lottery prize.

Chances were distributed using the three procedures described above and each dyad of stakeholders was randomly assigned to exactly one of these procedures. In the height treatment, the tallest stakeholder in a dyad would receive 9 lottery tickets, while the other stakeholder would receive 1 lottery ticket. Likewise, in the luck treatment the stakeholder in a dyad who had tossed the highest number in the dice throw would receive 9 tickets. In the merit treatment 9 tickets would be given to the stakeholder in a dyad with the highest number of correct answers in the knowledge quiz. All participants were informed about the procedure used to determine chances allocation in their dyad as well as the final allocation of tickets. Participants were not informed that in other dyads chances could be distributed based on a different procedure.

After being informed on the allocation of tickets, but before knowing who was the lottery winner, each stakeholder performed an allocation task in which they had to decide how to allocate the lottery prize of 10 EUR between themselves and the stakeholder they were matched with in case they would be the winner of the lottery. Stakeholders were informed that the allocation decision of the winning stakeholder would be implemented.

After they had finished the allocation task, stakeholders were asked to imagine the scenario in which they did not win the lottery prize and report how much of the lottery prize they believed the winning stakeholder would allocate to them. This belief elicitation was incentivized with an additional 1EUR if the expectation was correct. Thereafter, stakeholders answered questions measuring how much they felt deserving and entitled to the chances they received and to the lottery prize. Deservingness of opportunities and deservingness of outcomes were measured with the following two statements respectively: "I deserved the number of lottery tickets that I received" and "Given the number of lottery tickets that I received, I deserve to have a larger share of the lottery prize". Participants answered these questions on a 7-point Likert scale ranging from "Strongly disagree" to "Strongly agree". For entitlement, we used the same measurement as in Gächter and Riedl (2005). Stakeholders had to indicate how much of the lottery prize would be a fair amount to allocate to the losing stakeholder from the point of view of a neutral non-involved observer. Participants could decide on any allocation between 0 and 10 EUR (including non-integer numbers).

Thereafter, the lottery outcome was revealed and participants were informed of which stakeholder in their dyad was the winner. Following that, the winners had the possibility to revise their ex ante allocation decision. Participants were not informed of this revision option beforehand. Winner stakeholders were then informed that this

would be their final decision. Likewise, loser stakeholders had the possibility to revise their earlier decision regarding how much they expected the winner stakeholder to allocate to them. They were also not informed beforehand about this revision opportunity. They were then told this would be their final decision and therefore the one which could be paid out (in case the expectation was correct). Lastly, all stakeholders were asked to rate their procedure used to distribute chances in terms of fairness and individual control. Responses were given on a 7-point Likert scale ranging from “*Very unfair*” to “*Very fair*” and from “*No control*” to “*Full control*”. The exact instructions given and the questions asked to stakeholders can be found in Appendix B.

3.2.2.2 Spectators

Spectators received the same information as stakeholders with a few modifications. As stakeholders, each spectator was randomly assigned to one procedure. However, spectators did not receive chances to win the lottery prize themselves, but they were told they would be informed of the distribution of chances between two individuals. Chances between these two individuals were allocated in the exact same manner as described for stakeholders. Spectators were informed about the procedure used to distribute the chances as well as about the allocation of tickets between the two individuals. Before knowing which individual had won the lottery prize, spectators were asked to decide how the lottery prize should be distributed between the winner and the loser. Spectators were informed their decisions would have real monetary consequences to the individuals they were deciding for. Spectators then made two allocation decisions. First, how to allocate the prize when the winner was an individual with high chances and second, how to allocate the prize when the winner was an individual with low chances. The order of presentation of these two scenarios was counterbalanced across spectators. They were informed that only one of these two decisions would be implemented, depending on whether the individual with high or low chances would win the lottery.

Spectators then answered questions about deservingness and entitlement. The questions used for stakeholders were adapted to spectators, so they could indicate how much they thought individuals with high and low chances deserved the chances they received and how much of the lottery prize each of them were entitled to keep in case they were the winner. After learning if the winner was an individual with high or low chances, spectators were also given the possibility to revise their earlier decision. As stakeholders, spectators were not informed about this possibility beforehand and were told this would be their final decision. Spectators were then asked to rate the procedure used to distribute the chances between the two other individuals in terms of fairness and individual control. Importantly, spectators’ payoffs were not related to their decisions in the experiment. Following the same procedure as in Cettolin and Riedl (2016), spectators could earn 4, 6, 8, 10 or 12 EUR with equal chance. This

procedure was used to minimize a potential anchoring effect which could have been induced when paying a certain amount for sure. At the end of Part 2, spectators were asked to select a marble in a pool of marbles of five different colors. Spectators were informed that each color was associated with a value (i.e., 4, 6, 8, 10 or 12), which would represent their payoff in euros for this part of the experiment. Spectators were not aware of which color was associated with which value. After indicating their selected marble, spectators' payoff for Part 2 was revealed to them.

Spectators participated in the same sessions as stakeholders. Yet, to ensure that spectators' decisions would always be implemented, spectators made decisions for two individuals who would be recruited later to receive the outcome of spectators' decisions. This was implemented as follows. At the end of each experimental session, we asked stakeholders whether they would like to participate in an additional experiment in which they could receive extra earnings that would be determined by another participant (i.e., the spectator). After all experimental sessions were finished, stakeholders who consented were matched to spectators and invited to pick up their extra earnings on a later day. Spectators assigned to a specific procedure were matched to individuals who, as stakeholders, were assigned to the same procedure. For example, a spectator in the luck treatment would be matched to one individual who had previously been a stakeholder with high chances in the luck treatment and to another individual who had been a stakeholder with low chances in the luck treatment. Spectators did not know the previous choices or earnings of the participants for which they were making decisions, thus their decisions could not be influenced by stakeholders' previous choices or earnings.

3.2.3 Part 3: Elicitation of risk preferences.

In the last part of the experiment, all participants completed a measure of risk preferences. We slightly adapted the method from Fehr-Duda, De Gennaro, and Schubert (2006) for the elicitation of certainty equivalents to measure risk preferences. Participants were exposed to ten lotteries, where two outcomes were possible. In each lottery participants made ten decisions between the lottery and a decreasing certain amount, being able to switch from the sure amount to the lottery only once. All lotteries used in the experiment are shown in Appendix B. At the end of Part 3, one lottery was randomly selected for payout. Participants then answered demographic questions and received information about their payout for each part of the experiment. At the end of the experimental session, participants were paid the sum of earnings in the three parts of the experiment in private and in cash.

3.3 Hypotheses

3.3.1 Stakeholders

The first hypothesis states that having high or low winning chances may affect how individuals respond to outcome redistribution. Based on the findings of Krawczyk (2010) one could expect that due to self-serving biases, stakeholders with high winning chances will propose a smaller redistribution of the lottery prize than stakeholders with low winning chances ($H-St_{1a}$). Alternatively, the opposite could be hypothesized if we assume that individuals are averse to both inequality of outcomes and opportunities (Saito, 2013). Aversion to both advantageous inequality of outcome and opportunity would predict redistribution by stakeholders with high winning chances, who may choose to decrease outcome inequality and compensate for inequality of opportunity. For stakeholders with low winning chances, on the other hand, aversion to advantageous inequality of outcomes would predict more redistribution whereas aversion to disadvantageous inequality of opportunity would predict less redistribution. Thus, while aversion to inequality always predicts redistribution by stakeholders with high winning chances, for stakeholders with low winning chances only aversion to inequality of outcomes would predict redistribution. This leads to the hypothesis that stakeholders with high winning chances may propose higher redistribution rates than stakeholders with low winning chances ($H-St_{1b}$).

Next, we expect that if stakeholders with high winning chances allocate a lower amount of the lottery prize to the loser individual than stakeholders with low winning chances, as predicted in $H-St_{1a}$, this may occur as a consequence of stakeholders with high winning chances feeling entitled to the outcome - as they had more chances to achieve it (Cappelen et al., 2013b; Feng et al., 2013; Gächter & Riedl, 2005) and to stakeholders with low winning chances feeling the counterpart of entitlement, that is, an obligation to redistribute (Gächter & Riedl, 2005). Thus, we hypothesize that subjective entitlement will mediate the relationship between winning chances and outcome redistribution ($H-St_2$).

The next three hypotheses concern the role of procedures and its interaction with winning chances. Previous studies have shown that unequal outcomes rooted in individual merits and efforts are generally considered fair, while more redistribution is proposed when inequality originates in luck (Almås et al., 2020; Cappelen et al., 2007; Cappelen et al., 2013a). Moreover, there is evidence that individuals are more tolerant to disadvantageous inequality when they perform worse than partners in a previous effort task (Feng et al., 2013). Following the liberal egalitarianism principle (Roemer, 1998), aversion to unequal opportunities should be greater when the procedures are unfair and enable little control. For stakeholders with high winning chances, this would mean higher redistribution when fairness and control are low, while lower redistribution would take place due to entitlement motives when the pro-

cedure is fair and enables greater control. Thus, we hypothesize that redistribution by stakeholders with high winning chances will be the highest in the height condition (unfair, no control), followed by the luck condition (fair, no control) and the lowest in the merit condition (fair, high control) (H-St₃). Stakeholders with low winning chances, on the other hand, may display the opposite pattern. Aversion to inequality in opportunity should lead to less redistribution when fairness and control are low, while obligation motives may lead to higher redistribution when fairness and control are high. Hence, it is expected that stakeholders with low winning chances will redistribute greater amounts of the lottery prize in the merit condition, followed by the luck condition and the least redistribution will take place in the height condition (H-St₄). Moreover, following from H-St₃ and H-St₄, it is expected that the difference in redistribution between stakeholders with high and low winning chances will be higher in the merit and height conditions than in the luck condition, where the difference in redistribution between stakeholders with high and low winning is expected to be minimal (H-St₅).

3.3.2 Spectators

Spectators also feel aversion to inequality of outcomes and opportunities (Cappelen et al., 2013a; Cettolin & Riedl, 2016). Aversion to inequality of opportunity should lead spectators to compensate loser individuals when they had low winning chances. Thus, redistribution should be greater when an individual with high winning chances wins the lottery prize than when an individual with low winning chances becomes the winner (H-Sp_{1a}). Nevertheless, aversion to inequality of outcomes should lead spectators to redistribute outcomes regardless of how chances were initially distributed (H-Sp_{1b}). In addition, spectators are also expected to take procedures into account. As for stakeholders, the liberal egalitarianism principle (Roemer, 1998) would suggest that spectators are more averse to unequal opportunities when procedures are unfair and enable little control. Thus, when individuals with high winning chances become the winner of the lottery prize, redistribution should be the greatest in the height condition, followed by the luck condition and the smallest in the merit condition (H-Sp₂). On the other hand, when individuals with low chances become the winner, spectators may recognize that individuals with high winning chances had entitlement rights to the lottery prize when the procedure was fair and enabled control. Thus, we expect that when individuals with low winning chances win the lottery prize, spectators will propose higher redistribution rates in the merit condition, followed by the luck condition and the least redistribution in the height condition (H-Sp₃). Finally, we expect that the difference between how much is allocated to loser individuals with low and high winning chances will be greater in the height and merit condition than in the luck condition, where no differences are expected (H-Sp₄).

3.4 Results

In this section, results concerning ex ante allocation decisions made by stakeholders are first presented, followed by results of ex ante allocation decisions made by spectators. For both stakeholders and spectators, we present descriptive results and test our hypotheses. Lastly, results of ex post decisions made by both stakeholders and spectators are briefly discussed. All analyses reported were conducted using the R project for statistical computing (R Core Team, 2014).

3.4.1 Stakeholders' ex ante allocation decisions

Table 3.1 shows descriptive statistics of stakeholders' allocation decisions pooled across all procedures. In general, stakeholders allocated a small fraction of the lottery prize to the other stakeholder they were matched with (13.1% of the pie). Allocations were lower than reported in a meta-analysis of previous Dictator games, where dictators give in general 28.35% of the pie (Engel, 2011). However, the same author notes that samples composed by students - which is the case of the present study - give in general significantly less than non-students (Engel, 2011). Allocations to the loser participants were significantly different from 0, as revealed by a one sample Wilcoxon signed rank test ($W = 8515, p < .001$).

Table 3.1: Descriptive statistics of stakeholders' allocation decisions to loser participants pooled across procedures

Stakeholder's chances	Allocation to loser participant (in %)		
	All Stakeholders (N=232)	Low chances (N=116)	High chances (N=116)
Mean	13.1	15.3	10.9
SD	16.6	17.6	15.4
Median	5	10	0
Min	0	0	0
Max	50	50	50

Note: SD= Standard deviation; Min= Minimum value; Max= Maximum value.

3.4.1.1 The effect of winning chances on stakeholders' allocation decisions

As it can be seen in Table 3.1, stakeholders with low winning chances redistributed, on average, 15.3% of the lottery prize, while stakeholders with high winning chances redistributed a lower amount of the lottery prize (10.9%). To test statistically whether the redistribution proposed by stakeholders with high and low winning chances differed from each other, we first performed a two-sided Wilcoxon rank sum test, which shows that redistribution by stakeholders with high winning chances was significantly lower than redistribution by stakeholders with low winning chances ($W = 7798.5, p = 0.028$). Further, a Tobit regression with a lower limit set to zero was conducted using the VGAM package in R (Yee, 2010), as participants' responses were censored at

zero. The dependent variable was stakeholders' ex ante allocation of the lottery prize to the loser participant. The chances stakeholders had to win the lottery prize (high or low) were included as a dummy in the regression (the baseline category was comprised of low winning chances). Table 3.2 (model 1) reports the regression results, which confirm the non-parametric result ($p = 0.025$). In line with $H-St_{1a}$, and differently than expected in $H-St_{1b}$, ex ante outcome redistribution decreases with a high winning chance. Including control variables in the regression as age, gender, discretionary income and risk preferences decreases the effect of chances on redistribution behavior, although it remains significant at a 10% significance level (see Appendix B, Table B1, model 1).

Table 3.2: Tobit Regression - Stakeholders' allocation to the loser across procedures

Independent variables	Model 1		Model 2	
	Coefficient		Coefficient	
	(Std. err.)	Z value	(Std. err.)	Z value
Intercept	0.87*** (0.26)	3.3	3.3 (0.57)	5.8
High Chances	-0.83* (0.37)	-2.24	-0.51 (0.35)	-1.45
Entitlement			-0.4*** (0.09)	-4.54
Log-L:	-385.43		-375.24	
N:	232		232	

***.001; **.01; *.05, + .1

Result 1. *Stakeholders with higher winning chances redistributed less of the lottery prize than stakeholders with lower chances.*

Next, we explored the role of subjective entitlements as a mediator variable in the relationship between winning chances and ex ante outcome redistribution. We hypothesized that higher chances could make stakeholders feel entitled to the lottery prize and, as a consequence, decide to redistribute less of it. Subjective entitlements were measured with a question asking how much of the lottery prize would be a fair amount to allocate to the loser stakeholder from the perspective of a non-involved person. To answer the entitlement question, participants could choose any number between 0 and 10 EUR. Higher numbers indicated participants considered it would be fair for the winner stakeholder to allocate more of the lottery prize to the loser individual. Hence, higher numbers indicate lower subjective entitlement. On average, stakeholders with high winning chances reported transferring €3.22 ($SD=1.91$) to the loser stakeholder would be fair from a neutral point perspective, while stakeholders with low winning chances reported that transferring €3.97 ($SD=2.18$) would be fair. As shown by the results of a two-sided Wilcoxon rank sum test, the difference in subjective entitlements between stakeholders with high and low winning chances was significant and stakeholders with high winning chances showed higher subjective entitlement than stakeholders with low winning chances ($W=7999$, $p=0.008$). For

ease of interpretation, in the following analyses involving subjective entitlement, the values were recoded such that higher values should indicate higher subjective entitlement.

To get a first evidence of mediation, we ran a Tobit model similar to model 1, but also including subjective entitlements as an additional independent variable (see Table 3.2, Model 2). Results show subjective entitlements was significantly associated with redistributive behavior: the more entitled stakeholders felt, the less they redistributed the lottery prize. Importantly, winning chances was no longer a significant predictor of redistributive behavior, suggesting subjective entitlement may indeed be a mediator in the relationship between winning chances and redistribution. Results do not change if control variables are included in the model (see Appendix B, Table B1, model 2). To get conclusive evidence of mediation, a causal mediation effect was estimated using the bootstrapping method with the package *mediation* in R (Tingley, Yamamoto, Hirose, Keele, & Imai, 2014). Causal mediation analysis is often used to provide insights into psychological mechanisms possibly underlying the effect of the independent variable on the dependent variable. It differentiates the total effect of the independent variable into a direct and an indirect effect, the latter effect being carried to the dependent variable via the mediator. For this analysis, the independent variable was a dummy variable for high winning chances. The dependent variable was the amount of the lottery prize allocated to the losing stakeholder. Subjective entitlements (recoded so that higher values represent higher entitlement) was included as a mediating variable. Unstandardized indirect effects were computed for 1000 bootstrapped samples. As hypothesized, results show a significant indirect effect ($\beta = -0.2$, $CI[-0.37, -0.06]$, $p < 0.001$), suggesting that the decrease in redistribution due to high chances can be explained by the indirect effect of chances on redistribution via increased subjective entitlements (see Appendix B, Table B2).²

Result 2. *The effect of winning chances won redistribution was mediated by subjective entitlement towards the lottery prize.*

3.4.1.2 The effect of procedures on stakeholders' allocation decisions

Before testing our hypothesis concerning the effect of different procedures on stakeholders' ex ante allocation decisions, we explore whether stakeholders perceived the procedures differently in terms of fairness and individual control, as intended. Table 3.3 shows the mean ratings of fairness and individual control per procedure.

²In order to rule out alternative explanations, we also tested other variables that could mediate the effect of winning chances on outcome redistribution. Deservingness of chances and expectations about others' behaviors did not mediate the relationship between chances and redistributive behavior (Deservingness of chances: $\beta = -0.01$, $CI[-0.19, 0.17]$, $p = 0.9$; Expectations: $\beta = 0.05$, $CI[-0.21, 0.33]$, $p = 0.65$). Deservingness of outcomes was a marginally significant mediator in this relationship ($\beta = -0.08$, $CI[-0.2, 0.01]$, $p = 0.09$). See appendix B, Tables B3, B4 and B5 for further information.

We compared participants' ratings for fairness and individual control across the three procedures using a Kruskal-Wallis test. Results show that stakeholders did rate the procedures they were exposed to differently regarding fairness ($\chi(2)=61.4, p < 0.001$). Subsequent Dunn's pairwise comparisons tests corrected for multiple comparisons using the Holm-Bonferroni method show stakeholders rated height as significantly less fair than luck ($Z=-6.96, p<0.001$) and merit ($Z=-6.29, p<0.001$). Comparisons between luck and merit did not yield significant results, suggesting these two procedures were similarly perceived in terms of fairness ($p=0.69$). Likewise, results of a second Kruskal-Wallis test show stakeholders also perceived procedures differently in terms of how much control over chances they would enable ($\chi(2)=47.4, p<0.001$). Subsequent Dunn's pairwise comparisons tests corrected for multiple comparisons using the Holm-Bonferroni method show stakeholders considered merit to enable a significantly higher control over the chances than height ($Z=6.57, p<0.001$) and luck ($Z=5.36, p<0.001$). There were no differences in terms of control between height and luck ($p=0.29$). These results replicate the findings of Micheli and Gagnon (2020) and suggest that individuals perceived the implemented procedures allocating unequal chances differently regarding fairness and individual control.³

Table 3.3: Mean Fairness and Individual control per procedure - Stakeholders

		Fairness	Individual Control
Procedures			
Height	N=90	1.73 (1.25)	1.62 (1.4)
Luck	N=76	3.74 (1.97)	1.75 (1.4)
Merit	N=66	3.57 (1.86)	3.26 (1.82)

Standard deviations are in parentheses.

Next, we examine whether stakeholders' perceptions of differences in fairness and individual control between procedures translated into different redistributive behavior. Table 3.4 shows descriptive statistics of stakeholders' percentage allocation per procedure. Ex ante redistribution ranged from 12% to 14.5% when stakeholders with low and high chances were pooled together. Stakeholders with high winning chances redistributed 13.2% and 11.3% of the lottery prize in the height and luck conditions respectively, and redistribution dropped to 7.3% in the merit condition. Stakeholders with low winning chances redistributed 15.8% of the lottery prize in the height condition and 17.7% in the merit condition, being the lowest redistribution in the luck condition (12.7%).

Results from a Kruskal-Wallis test comparing ex ante redistribution in the three pro-

³Note that the same results regarding the differences across procedures in terms of fairness and control ratings are obtained if analysis are run separately for stakeholders with high and low winning chances.

cedures (for stakeholders with high and low chances together) show no significant difference in ex ante redistributive behavior between procedures ($\chi(2)=1.89$, $p = 0.39$). Results are qualitatively the same if the three procedures are compared among stakeholders with high winning chances only ($\chi(2)=2.92$, $p = 0.23$) or among stakeholders with low winning chances only ($\chi(2)=0.71$, $p = 0.7$), that is, no significant differences emerge between procedures.

Table 3.4: Descriptive statistics of stakeholders' allocation decisions to loser participants per procedure

Stakeholder's chances		Allocation to loser participant (in %)							
		Low chances				High chances			
		Mean	SD	Median	Min	Max	Mean	SD	Median
Height	N=90	15.8	16.3	10	0	50	13.2	17.7	0.1
Luck	N=76	12.7	17	7.5	0	50	11.3	14.8	7.5
Merit	N=66	17.7	19.8	10	0	50	7.3	11.9	0

SD= Standard deviation; Min= Minimum value; Max= Maximum value.

In order to confirm the non-parametric results, we ran separate Tobit regressions for stakeholders with high and low winning chances, with ex ante redistributive behavior as the dependent variable and procedures as the independent variable (baseline was the height procedure). For stakeholders with high winning chances, results can be seen in Table 3.5, panel A. We observe that redistribution in the merit condition is significantly lower than in the height condition at a 10% significance level ($p=0.089$, see Table 3.5, model 1, panel A). Ex ante redistribution in the luck condition is not significantly different than in the height condition. Moreover, a post estimation test of differences between the coefficients of luck and merit did not yield significant results ($F(1, 114) = 2.4$, $p=0.12$). Thus, even though the means in each condition seem to be in line with our hypothesis that stakeholders with high winning chances would redistribute the most in the height condition and the least in the merit condition (H-St₃, see Table 3.4) statistical results only offer weak support for this hypothesis. When controlling for subjective entitlement (Table 3.5, model 2, panel A), we find an overall effect of entitlement such that the more stakeholders with high winning chances felt entitled to the monetary prize, the less they redistributed. No significant interaction effects were observed between subjective entitlements and procedures (see Table 3.5, model 3, panel A). Controlling for gender, age, discretionary income and risk preferences makes the effect of merit on ex ante redistribution stronger (see Appendix B, Table B6, models 1 and 2).

For stakeholders with low winning chances, results can be seen in Table 3.5, panel B. We observe that ex ante redistribution did not change across procedures (Table 3.5, Model 1, panel B). A post estimation test of differences between the coefficients of merit and luck also did not yield significant results ($F(1, 114) = 0.2$, $p=0.66$). Thus, our hypothesis that redistribution would be the greatest in the merit condition and the lowest in the height condition (H-St₄) is not supported. When controlling for subjective entitlement (Table 3.5, Model 2, panel B), we observe that just like

stakeholders with high winning chances, stakeholders with low winning chances also redistribute less the more they feel entitled to the lottery prize (or the less they feel obligated to redistribute). Finally, when the interaction between procedures and subjective entitlements is introduced in the model (Table 3.5, Model 3, panel B), we find that the interaction between luck and subjective entitlement is significant at a 10% significance level, suggesting that subjective entitlement plays different roles in the luck and height condition such that the slope of subjective entitlement in the luck condition is steeper than in the height condition.⁴ Adding control variables to the models (see Appendix B, Table B7) does not meaningfully change the results.

Result 3. *Procedures used to distribute chances affected stakeholders with high and low winning chances differently. While stakeholders with high winning chances redistributed marginally significantly less in the merit condition than in the height condition, no significant differences between procedures were observed for stakeholders with low winning chances.*

Next we test whether the differences between the allocations proposed by stakeholders with high and low winning chances were different between procedures, as we hypothesized differences would be greater in the merit and height procedures (H-St₅). For this, we ran a Tobit regression with chances (low versus high), procedures (height, luck and merit) and the interaction between chances and procedures as independent variables. The dependent variable was ex ante redistribution and the baseline was comprised by luck and low winning chances. Results can be seen in Table 3.6. The interaction term *High Chances * Height* represents the difference in difference between stakeholders with high and low winning chances in the height and luck condition. Likewise for the interaction term *High Chances * Merit*. Contrary to our hypothesis, results show that the difference between how stakeholders with high and low winning chances redistributed the lottery prize in the height procedure does not vary from the differences observed in the luck procedure. Similarly, no differences were observed between the merit and luck procedures. Lastly, when the same regression is run with height as the baseline, we also observe no differences in differences between height and merit procedures ($\beta = -1.04$, $p = 0.26$). Altogether, this suggests that, contrary to what was hypothesized, differences between how much stakeholders with high and low winning chances allocated to the loser stakeholder did not differ between procedures.⁵

⁴In fact, while in the luck condition higher levels of entitlement (and lower levels of obligation) are associated with less redistribution (Pearson's correlation: $r = -0.46$, $p = 0.003$), in the height condition ex ante redistribution is not associated with subjective entitlements (Pearson's correlation: $r = -0.13$, $p = 0.4$).

⁵We also tested whether beliefs about one's own and other performance in the general knowledge quiz could have affected redistribution in the merit procedure. Beliefs about performance in the quiz did not affect stakeholders' redistributive decisions in the merit condition (see Appendix B, Table B8).

Table 3.5: Tobit Regression - Allocations to the loser by stakeholders with high and low winning chances

Independent variables	Panel A: Allocations by stakeholders with high chances						Panel B: Allocations by stakeholders with low chances					
	Model 1			Model 2			Model 3			Model 1		
	Coefficient (Std. err.)	Z value	Coefficient (Std. err.)	Z value	Coefficient (Std. err.)	Z value	Coefficient (Std. err.)	Z value	Coefficient (Std. err.)	Coefficient (Std. err.)	Z value	Coefficient (Std. err.)
Intercept	0.35 (0.44)	0.8	3.02** (0.99)	3.03	2.34+ (1.4)	1.7	1.06** (0.4)	2.6	3.51*** (0.78)	4.5	1.5	1.17 (2.93)
Luck	-0.06 (0.63)	-0.1	-0.12 (0.6)	-0.2	0.49 (2.15)	0.23	-0.4 (0.59)	-0.67	-0.52 (0.55)	-0.94	2.75	1.54 (1.79)
Merit	-1.17+ (0.69)	-1.7	-0.81 (0.67)	-1.2	1.58 (2.6)	0.6	-0.11 (0.61)	-0.19	-0.37 (0.58)	-0.6	2.15	1.3 (1.67)
Entitlement			-0.4** (0.14)	2.8	-0.29 (0.21)	-1.41			-0.39*** (0.11)	-3.4	-0.06 (0.2)	-0.31 (0.54+)
Luck * Entitlement					-0.09 (0.33)	-0.29					-0.54+ (0.28)	-1.9 (0.27)
Merit * Entitlement					-0.34 (0.37)	-0.92					-0.41 (0.27)	-1.5 (0.27)
Log-L:	-176.33		-172.5		-172.03		-207.08		-201.37		-199.3	
N:	116		116		116		116		116		116	

Standard errors in parentheses.

***, 0.01; **, 0.05; +, 0.1

Table 3.6: Tobit Regression: Interaction between chances and procedures

Independent variables	Coefficient (Std. err.)	Z value
Intercept	0.64 (0.45)	1.4
High Chances	-0.33 (0.64)	-0.52
Height	0.4 (0.6)	0.66
Merit	0.28 (0.65)	0.43
High Chances * Height	-0.33 (0.86)	-0.38
High Chances * Merit	-1.37 (0.95)	-1.4
Log-L:	-383.47	
N:	232	

Standard deviations are in parentheses.
***.001; **.01; *.05, +.1

Result 4. *Differences in redistribution proposed by stakeholders with high and low winning chances did not vary between procedures.*

Finally, given the heterogeneity of stakeholders' allocations in each procedure, in an exploratory analysis we classified redistributive decisions into three categories. Stakeholders could decide to not redistribute the monetary prize, keeping it all to themselves ("All to self"), to redistribute something, but still keep more than half of the lottery prize to themselves ("More to self") or to equally split the monetary prize between themselves and the loser stakeholder ("Equal split"). Although stakeholders could also have chosen to give more than half of the monetary prize to the loser stakeholder, this choice was never made neither by stakeholders with high winning chances nor by stakeholders with low winning chances. Figure 3.1 shows the relative frequency of each decision category adopted by stakeholders with high winning chances (left panel) and by stakeholders with low winning chances (right panel). Stakeholders with high winning chances often chose to keep all or most of the lottery prize for themselves regardless of the procedure. The equal split of the lottery prize was not frequent and never chosen in the merit condition. In addition, the pattern of choices made by stakeholders with high winning chances were quite similar in the height and luck condition. In the merit condition, one can observe a slightly higher preference for keeping all to self and a lower preference for an equal split. In order to compare the frequency of each decision category between procedures for stakeholders with high winning chances, we ran an ordered logistic regression including procedures as the independent variable and an ordered dependent variable with decision categories ordered from very selfish ("All to self") to least selfish ("Equal split"). Results reveal that the probability of being selfish marginally increased in the merit condition compared to the luck condition ($\beta = -0.91$, $SE = 0.47$, $t = -1.9$, $p = 0.054$). No significant differences emerged from comparisons between height and merit and height and luck.

Stakeholders with low winning chances (see Figure 3.1, right panel) also frequently chose to keep all or most of the lottery prize for themselves across procedures, although decisions to keep all to self were slightly less prevalent than for stakeholders with high winning chances. Moreover, although the equal split was also not frequently chosen by stakeholders with low winning chances, in the merit condition this choice became slightly more prevalent. The pattern of choices made by stakeholders with low winning chances were also remarkably similar between the height and luck conditions, whereas in the merit condition one observes a decrease in “More to self” choices and an increase in the equal split distributions. Again, to compare the frequency of decision categories employed by stakeholders with low winning chances between procedures, we ran another ordered logistic regression with the same specifications as described above. No significant differences were found in employing selfish versus least selfish strategies between procedures, indicating stakeholders with low winning chances were equally likely to employ these strategies between procedures.

Figure 3.1: Frequency of strategies used by Stakeholders

Relative frequency per procedure of different categories of ex ante allocations made by stakeholders with high winning chances (left panel) and by stakeholders with low winning chances (right panel).

3.4.2 Spectators' ex ante allocation decisions

Spectators were asked to make two decisions - presented in a counterbalanced order: how much to allocate to the loser individual when the winner had high winning chances and when the winner had low winning chances. Table 3.7 shows descriptive statistics of spectators' allocation decisions pooled across procedures. When the two decisions made by spectators are averaged, we observe that 36.7% of the lottery prize is allocated to the loser individual. A one sample Wilcoxon signed rank test shows that the average allocation to the loser individual is significantly higher than zero ($W=3741, p < 0.001$). Moreover, it is noticeable that allocations proposed by specta-

tors, which are around a third of the lottery prize, were higher than those proposed by stakeholders.

Table 3.7: Descriptive statistics of spectators' allocation decisions to loser individuals pooled across procedures

Winner's chances	Allocation to loser individual (in %)		
	Both high and low chances (N=99)	Low chances (N=99)	High chances (N=99)
Mean	36.7	37	36.4
SD	25.43	26.25	24.7
Median	40	40	40
Min	0	0	0
Max	100	100	100

Note: SD= Standard deviation; Min= Minimum value; Max= Maximum value.

3.4.2.1 The effect of winning chances on spectators' allocation decisions

The descriptive statistics of Table 3.7 reveal that spectators decided to allocate very similar amounts to the loser individual when the winner had low or high chances to win the lottery prize. In the former case, 37% of the lottery prize was allocated to the loser individual, compared to 36.4% in the latter case. A paired Wilcoxon signed rank test indicates that there were no significant differences in how spectators decided to allocate the lottery prize to the loser when the winner had high or low chances ($W=604$, $p=0.87$). To test parametrically if spectators took individuals' winning chances into consideration, we ran Tobit regressions with a lower limit set to zero. The *censReg* package in R (Henningsen, 2010) was used to account for panel data, as spectators made two decisions in a counterbalanced order. The model was estimated using the maximum likelihood method. The dependent variable was spectators' ex ante redistribution of the lottery prize. Individuals chances (low versus high) were included as a dummy variable (the baseline category was low winning chances). Table 3.8 (model 1) displays the results, which are in line with the non-parametric test and show that spectators did not vary their allocation decision depending on the winner's chances. Thus, both hypotheses $H\text{-}Sp_{1a}$ and $H\text{-}Sp_{1b}$ are rejected. Controlling for the order in which spectators made the two allocation decisions did not change the results (see Table 3.8, model 2). Furthermore, including control variables as age, gender, discretionary income and risk preferences in the regressions did not affect results either (see Appendix B, Table B9, models 1 and 2).

Given that no differences were observed in how spectators allocated the monetary prize when the winner had high or low winning chances, we asked whether spectators considered that winners with high and low chances should be equally entitled to the lottery prize. On average, spectators reported that when winners were individuals with high winning chances, it would be fair for the loser individual to receive €3.62 ($SD=2.23$) of the lottery prize. In the situation when the winner had low winning chances, on the other hand, spectators reported that it would be fair for the loser indi-

vidual to receive €4.03 ($SD=2.4$) of the lottery prize. A paired Wilcoxon signed rank test comparing entitlement ratings for winners with high and low winning chances reveals no significant differences ($W=322.5$, $p=0.11$), demonstrating that spectators reasoned that winners should be entitled to most of the lottery prize regardless of their winning chances.⁶

Table 3.8: Tobit Regression - Spectators' allocation to the loser individual across procedures

Independent variables	Model 1		Model 2	
	Coefficient (Std. err.)	t value	Coefficient (Std. err.)	t value
Intercept	3.36*** (0.35)	9.6	3.22*** (0.86)	3.73
Winner Chances: High	-0.03 (0.32)	-0.093	-0.031 (0.32)	-0.094
Order			0.09 (0.58)	0.16
Log-L:	-438.18		-438.17	
N:	198		198	

Standard errors in parentheses.

***.001; **.01; *.05

Result 5. *Spectators' ex ante redistributive behavior was not affected by individuals' chances to win the lottery prize.*

3.4.2.2 The effect of procedures on spectators' allocation decisions

As for stakeholders, before proceeding to test whether spectators' allocation decisions were affected by the procedures, we checked whether spectators also perceived the three procedures differently in terms of fairness and individual control, as intended. Table 3.9 shows the mean ratings of fairness and individual control per procedure.

Results of a Kruskal-Wallis test indicate that spectators did recognize differences between procedures in terms of fairness ($\chi(2)=19.5$, $p < 0.001$) and in terms of individual control ($\chi(2)=49.08$, $p < 0.001$). Subsequent Dunn's pairwise comparison tests corrected for multiple comparisons using the Holm-Bonferroni method reveal that, similarly to stakeholders, spectators rated height as significantly less fair than both luck ($Z=-3.1$, $p=0.004$) and merit ($Z=-4.27$, $p<0.001$), while luck and merit were perceived equally in terms of fairness ($Z=-1.17$, $p=0.24$). Furthermore, individual control over chances in the merit procedure was considered significantly higher

⁶We also tested whether entitlement ratings correlated with allocation decisions made by spectators. Interestingly, when the winner had high winning chances, there is a significant correlation between how much spectators thought the winner should be entitled to the prize and how much spectators allocate to the loser ($r=0.27$, $p=0.006$). The positive correlation means that higher scores (lower subjective entitlement) were associated with more redistribution to the loser individual. No correlation is observed between how much spectators thought winners with low chances should be entitled to the lottery prize and how much they chose to allocate to the loser individual ($r=0.14$, $p=0.16$).

than in height ($Z=6.65, p<0.001$) and luck ($Z=5.22, p<0.001$) procedures, while no differences were observed between height and luck ($Z=-1.43, p=0.15$).

Table 3.9: Mean Fairness and Individual control per procedure - Spectators

		Fairness	Individual Control
Procedures			
Height	N=33	2.0 (1.71)	1.21 (0.48)
Luck	N=33	3.21 (1.83)	1.6 (0.93)
Merit	N=33	3.81 (1.97)	3.73 (1.66)

Standard deviations are in parentheses.

Given that spectators identified differences in fairness and individual control between the procedures, we then investigated whether spectators allocated different amounts of the lottery prize to the loser individual depending on the procedure. Table 3.10 shows descriptive statistics of spectators' allocations per procedure. Despite perceiving height was more unfair than luck and merit and rating the merit procedure higher in control than the other two procedures, spectators' allocations to the loser individual did not differ much across the three procedures, always ranging between 30% and 40% of the lottery prize. When the winner had high chances, redistribution was greater in the height procedure, followed by luck and then merit. On the other hand, when the winner had low winning chances redistribution was still the highest in the height condition, but it was the lowest in the luck condition. Interestingly, in all procedures it is possible to observe that redistribution when the winner had low chances was very similar to when the winner had high winning chances.

Table 3.10: Descriptive statistics of spectators' allocation to loser individuals per procedure

		Allocation to loser participant (in %)									
Winner's chances		Low chances					High chances				
		Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max
Height	N=33	40.3	28.6	50	0	90	40.15	22.02	50	0	90
Luck	N=33	32	24.6	40	0	100	36.2	26.4	50	0	90
Merit	N=33	38.6	25.4	40	0	100	32.8	25.7	30	0	100

SD= Standard deviation; Min= Minimum value; Max= Maximum value.

To compare overall redistributive behavior between procedures, we ran a Kruskal-Wallis test. Results show no significant differences in allocation decisions made by spectators between procedures ($\chi(2)=1.94, p = 0.39$). The same results hold if we compare the three procedures only in situations where the winner had high chances ($\chi(2)=2.49, p = 0.29$) and only in situations where the winner had low chances to win the lottery prize ($\chi(2)=1.92, p = 0.38$).

To parametrically test the influence of procedures on spectators' redistributive behav-

ior we ran additional Tobit regressions for the situation in which the winner had high and low winning chances. The dependent variable was spectators' ex ante allocation to the loser individual when the winner had high chances (model 1) or low chances (model 2). Procedures were included as the independent variable (baseline was the height procedure). When the winner had high chances (see Table 3.11, model 1), no significant differences were observed between height and luck and height and merit. Moreover, a post estimation test of differences between the coefficients of luck and merit revealed no significant differences ($F(1, 97) = -0.13, p=0.71$). Controlling for the order in which the allocation decision was made, gender, age, discretionary income and risk preferences did not alter results (see Appendix B, Table B10, model 1). Thus, although the average redistribution per procedure followed the pattern hypothesized in H-Sp₂ (i.e., highest redistribution in the height procedure and lowest in the merit procedure), no significant differences in redistribution were observed between procedures. Results are similar for the situation in which the winner had low chances (see Table 3.11, model 2). No differences in redistribution were observed between height and luck and height and merit. A post estimation test of differences between the coefficients of luck and merit also did not yield significant results ($F(1, 97) = 0.91, p=0.34$). Thus, H-Sp₃ is not supported.

Table 3.11: Tobit Regression - Spectators' allocation to the loser when the winner had high and low chances

Winner's chances	Model 1		Model 2	
	High Chances		Low Chances	
Independent variables	Coefficient (Std. err.)	t value	Coefficient (Std. err.)	t value
Intercept	3.89*** (0.5)	7.73	3.75*** (0.55)	6.9
Luck	-0.62 (0.71)	-0.87	-0.92 (0.78)	-1.2
Merit	-0.88 (0.71)	-1.24	-0.17 (0.77)	-0.22
Log-L:	-222.06		-225.27	
N:	99		99	

Standard errors are indicated in parentheses.

***,001; **,01; *,05

In addition, as results of paired Wilcoxon tests demonstrate, spectators' decisions were likely not driven by ex post fairness concerns, as allocations in all procedures were significantly different than the equal split both when spectators considered the case of an individual with high chances winning (Height: $W=45, p=0.014$; Luck: $W=27.5, p = 0.013$; Merit: $W=60, p = 0.006$, Holm-Bonferroni corrected) and the case of an individual with low chances winning (Height: $W=82.5, p=0.054$; Luck: $W=22, p =0.04$; Merit: $W=76.5, p = 0.003$, Holm-Bonferroni corrected).

Result 6. *Spectators' ex ante redistributive behavior was not influenced by the procedures used to distribute chances.*

In order to further explore potential interactions between winners' chances and procedures, we ran a Tobit regression with winners' chances (low vs high), procedures and the interaction between chances and procedures as independent variables. The baseline was luck and low chances. The dependent variable was spectators' ex ante allocation to the loser individual. Results can be seen in Table 3.12. Contrary to our hypothesis stating that differences between spectators' allocations to the loser when the winner had high or low chances should be greater in the height and merit procedures (H-Sp₄), results indicate that differences in allocation in these two scenarios did not vary between luck and height and luck and merit. When the same regression was run with height and low chances in the baseline, no differences were observed between height and merit ($\beta = -0.71$, $p = 0.42$). Thus, results suggest that variations in allocation to the loser when the winner had high or low chances did not differ between procedures.

Table 3.12: Tobit Regression: Interaction between winners' chances and procedures - Spectators

Independent variables	Coefficient (Std. err.)	Z value
Intercept	2.79*** (0.6)	4.6
High Chances	0.43 (0.57)	0.75
Height	0.98 (0.81)	1.2
Merit	0.75 (0.81)	0.93
High Chances * Height	-0.34 (0.74)	-0.46
High Chances * Merit	-1.05 (0.95)	-1.11
Log-L:	-436.46	
N:	198	

Standard deviations are in parentheses.
***.001; **.01; *.05, +.1

Result 7. *Differences in spectators' allocations when the winner had high or low chances did not vary between procedures.*

As for stakeholders, for an exploratory analysis we further divided spectators' decisions into categories. Spectators could decide to allocate all the lottery prize to the winner ("All to winner"), to allocate more than half of the lottery prize to the winner ("More to winner"), to equally split the prize between the winner and the loser ("Equal split"), to allocate more than half of the lottery prize to the loser ("More to loser") and finally to allocate all the lottery prize to the loser ("All to loser"). Figure 3.2 shows the relative frequency of each decision category adopted by spectators when the winner would have high chances (panel A) or low chances (panel B).

Spectators rarely chose to compensate the loser by giving more or all to them (see

Figure 3.2, left panel). Instead, across the three procedures, favoring the winner (i.e., giving all or more to the winner) was a frequent choice. To compare the frequency of strategies employed by spectators in the scenario in which the winner had high chances, an ordered logistic regression was run with procedures as the independent variable and an ordered dependent variable ordered from favoring the winner (“All to winner”) to favoring the loser (“All to loser”). No significant differences in how frequently strategies were employed emerged from comparisons between height and merit, height and luck and luck and merit.

A similar pattern of strategies was observed when spectators decided how much to allocate to the loser when the winner had low chances to win the lottery prize (see Figure 3.2, right panel). Although in this case preferences across different strategies seem to be more evenly distributed, one can observe that there is still a tendency to favor the winner - which accounts to slightly more than 40% of choices in each procedure. An additional ordered logistic regression with the same specifications as described above was run to compare the frequency of strategies employed by spectators when the winner had low chances. Again, no differences between procedures were observed in the frequency with which strategies were employed.

Figure 3.2: Frequency of strategies used by Spectators

Relative frequency per procedure of different ex ante allocation strategies used by spectators when the winner had high chances (left panel) and low chances to win the lottery prize (right panel).

Altogether, these results indicate that procedures did not affect the allocation decisions made by spectators neither when the winner had high chances nor when the winner had low chances. Interestingly, spectators’ decisions did not seem to be driven by ex ante fairness concerns. If this would be the case, one would expect that when considering an individual with high chances would be the winner, spectators would want to compensate the losers when procedures were unfair and enabled little control.

Instead, results suggest redistributing the lottery prize was not necessarily seen as a compensation for unequal chances and spectators decided to allocate a higher share of the lottery prize to the winner regardless of how the chances were distributed in the first place.

3.4.3 Ex post allocation decisions

Unknown to participants, after the lottery was realized and the winner was revealed, winner stakeholders had the opportunity to revise their ex ante redistributive decisions. Spectators were also able to revise the ex ante decision they made for the context that realized (i.e., individual with low or high chances winning). Importantly, given the distribution of chances, 92.4% of stakeholders with high chances ended up winning the lottery prize. Moreover, for spectators 95% of individuals with high chances won the lottery prize. Thus, comparisons between ex ante and ex post redistributive behavior need to be interpreted with caution, as such comparisons can only be made for stakeholders with high chances as well as for spectators deciding in situations when an individual with high chances would be the winner of the lottery.

3.4.3.1 Ex post redistributive decisions made by stakeholders with high chances

In total, 107 stakeholders with high chances won the lottery prize. From these 107 stakeholders, only 11 decided to revise their earlier allocation decisions when given the chance to. Changes to earlier allocation decision were mixed, with 4 stakeholders deciding to redistribute more than previously and 7 stakeholders deciding to redistribute less than previously. Since only 10.3% of stakeholders with high winning chances decided to review their choices in an ex post context, it seems they did not discriminate between ex ante and ex post decisions.⁷ It remains to be explored whether stakeholders with low chances would redistribute the lottery prize differently ex post than they propose to do ex ante.

Result 8. *Stakeholders with high winning chances made similar redistributive decisions in ex ante and ex post contexts.*

3.4.3.2 Ex post redistributive decisions made by spectators in situations when the winner was an individual with high chances

For a total of 94 spectators the actual winner was an individual who had high chances to win the lottery prize. From these 94 spectators, 26 (27.6%) chose to revise their ex

⁷Alternatively, it could be that this result is due to participants trying to be consistent with their choices in the ex ante and ex post domain.

ante allocations made in the situation where the winner was an individual with high chances. These 26 spectators were evenly distributed across procedures (9 of them participated in the height procedure, 8 in the luck and 9 in the merit procedure). Changes to previous allocation were again mixed, with 16 spectators allocating less to the loser individual than previously (Height: $N=5$, Luck: $N=5$, Merit: $N=6$) and 10 spectators allocating more to the loser individual than previously (Height: $N=4$, Luck: $N=3$, Merit: $N=3$).

We compared the ex ante and ex post redistribution decisions made by these 94 spectators using a paired Wilcoxon signed rank test. For spectators who did not want to revise their earlier allocation, the ex post allocation had the same value as their decision ex ante. Results showed that, overall, redistribution ex ante was slightly greater than redistribution ex post, although the difference did not reach significance ($W(98)=235.5$, $p=0.13$; $M_{exante}=3.74$, $SD=2.46$; $M_{expost}=3.44$, $SD=1.95$).

To gain more insights into potential differences between ex ante and ex post redistributive decisions made by spectators, we ran two separate Kruskal-Wallis tests with these 94 spectators: one considering only ex ante decisions made by spectators in case individuals with high chances would win and a second taking into account only ex post decisions made by spectators in situations when an individual with high chances was the winner. For the ex ante redistributive decisions, we found no significant differences in redistribution between procedures ($\chi(2)=2.69$, $p = 0.26$). However, for ex post decisions we see evidence that redistribution differs between procedures ($\chi(2)=8.58$, $p = 0.01$). Pairwise comparisons obtained with Dunn's test and corrected for multiple comparisons show a significant difference between ex post allocations in the height and merit procedures ($Z=2.89$, $p=0.01$), being allocations to the loser individual significantly lower in the merit than in height procedure. No differences were observed between height and luck ($Z=1.08$, $p=0.28$) and luck and merit ($Z=1.8$, $p=0.14$).

Although these results are restricted to comparisons between ex ante and ex post redistributive decisions made by spectators for situations when individuals with high chances won the monetary prize, they suggest spectators might process allocation decisions which are made ex ante and ex post somewhat differently. Consistent with previous literature, when making ex post decisions spectators took into account procedures used to distribute chances, while this was not the case when decisions were made ex ante. Nevertheless, as in the ex ante domain, there were no signs of compensating the individual with lower chances in the ex post domain, considering we found a decreasing trend in redistribution ex post.

Result 9. *Procedures influenced ex post decisions, with redistribution being significantly lower in the merit condition than in the height condition.*

3.5 Concluding remarks

The present study investigates how unequal opportunities to achieve outcomes influence ex ante outcome redistributive decisions. Unequal chances to earn a lottery prize of 10 EUR were distributed between two individuals based on different procedures such as height, luck and merit. Furthermore, decisions of both stakeholders and spectators were studied.

Results show that winning chances did affect stakeholders' redistributive decisions. High winning chances made stakeholders feel more entitled to the lottery prize, subsequently sharing less of it than stakeholders with low winning chances. This result reinforces existing theoretical and experimental evidence that redistribution decisions are not exclusively outcome-based (Krawczyk & Le Lec, 2010; Saito, 2013), but that distribution of chances also matters to redistributive preferences. One possible explanation for the fact that stakeholders with high winning chances redistributed very little of the lottery prize regardless of how inequality in chances was originated is that their behavior might reflect self-serving bias in the attribution of responsibility (Cassar & Klein, 2019). For example, stakeholders with high winning chances might have felt responsible for the chances obtained even when they had little control over how chances were distributed. Interestingly, we observed a very similar pattern of redistribution between stakeholders and spectators. In general, spectators did not take individuals' chances into consideration and often ruled in favor of the winner of the lottery keeping a higher share of the outcome for themselves. Altogether, this suggests that spectators might have endorsed the self-interest of lottery winners in keeping more of the lottery prize for themselves. As suggested by Krawczyk (2010), our results might indicate that both involved and non-involved individuals do not see outcome redistribution as a legitimate way to compensate unequal chances.

In addition, procedures used to allocate chances did not influence redistribution by stakeholders with low winning chances and by spectators. Moreover, it only had a small effect on redistribution by stakeholders with high winning chances, who redistributed marginally significantly less in the merit procedure than in the height procedure. This happened in spite of the fact that both stakeholders and spectators perceived differences between the three procedures in terms of fairness (i.e., height was considered more unfair than the other procedures) and individual control (i.e., merit was considered to enable higher individual control over chances than the other procedures). This result is especially interesting when considering a vast literature on ex post redistribution showing that the source of outcome inequality matters to redistributive preferences (Alesina et al., 2018; Almås et al., 2010; Cappelen et al., 2007; Cappelen et al., 2013a; Rustichini & Vostroknutov, 2014).

We argue that these differences between the present study and previous literature can be related to three factors. First, while previous literature has investigated dif-

ferent sources of outcome inequality, the present research studies different sources of inequality in opportunities. Our results may suggest that while source of outcome inequality matters for redistribution, source of inequality of opportunities is seen as less important. Second, the difference in results could be due to the time when the decision is made. While previous studies have investigated ex post redistributive decisions, in the present research both stakeholders and spectators were asked to make redistributive decisions before uncertainty concerning the winner of the lottery prize was resolved. As such, it could be that sources of inequality become more important in the ex post domain. We found some evidence in favor of this reasoning. While these results need to be interpreted with caution, a comparison between ex ante and ex post decisions in this experiment reveals that differences between procedures only seem to emerge ex post. This result, however, was only found for spectators. Third, still regarding decision timing, we note that the lack of differences in ex ante redistribution behavior between procedures observed for both stakeholders and spectators could simply reflect the multitude of justice views that arise under uncertainty (Cetolin & Riedl, 2016). In fact, we found great heterogeneity in the strategies employed by both stakeholders and spectators when making a decision ex ante. Importantly, this heterogeneity in strategies could have flattened out possible differences in overall ex ante redistribution behavior between procedures. Future studies are important to more clearly compare how information about source of inequality of opportunities and source of inequality of outcomes may differentially affect ex ante and ex post redistribution decisions. It would be interesting, for example, to more thoroughly explore whether the different ex ante fairness perceptions of the procedures used to distribute chances translate into ex post redistribution of outcomes. It also remains to be seen whether source of inequality of opportunities becomes more relevant when deciding whether or not to redistribute opportunities instead of outcomes.

These results have important implications for policy-making and explain at least in part why support for policies aimed at addressing unequal opportunities by redistributing outcomes are often met with mixed support. For instance, although cash transfer programs have shown to be successful in many developing economies - increasing educational and health opportunities for underprivileged sectors of societies (Glewwe & Kassouf, 2012; Rawlings & Rubio, 2005) - such programs are often put into question by some policy-makers and the lay public alike, who believe that cash transfers are not an effective way to alleviate poverty (Molyneux, Jones, & Samuels, 2016) and that they create dependence on the government (Banerjee, Hanna, Kreindler, & Olken, 2017). Future studies should attempt to better understand what involved and non-involved individuals deem as appropriate policies to address inequality of opportunities. In this context, it would be interesting to examine whether redistribution of chances - when possible - might be considered a more appropriate way to compensate for opportunity disadvantages than outcome redistribution.

To conclude, the present research contributes to the existing literature regarding the inclusion of opportunities into the redistributive debate. Better understanding of possible differences between ex ante and ex post decisions carry important implications to policy designs. Understanding which factors underlie ex ante decisions and how individuals think inequality in opportunities should be compensated might prove relevant to diversify existing policies addressing inequality and to eventually increase support for ex ante redistributive policies. Furthermore, recognizing the importance of the distribution of opportunities in societies might be an important first step towards a fairer society, where individuals have comparable chances of succeeding.

Climbing the ladder: Perceptions of high upward economic mobility increase status consumption among bottom-tier consumers

This paper was co-authored by Caroline Goukens, Kelly Geyskens (Maastricht University) and Barbara Briers (Vlerick Business School). Funding from the Graduate School of Business and Economics for primary data collection is gratefully acknowledged.

5

Love and retaliation. Distinct effects of prefrontal cortex on second and third-party punishment and reward

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Abstract

Punishment and reward are crucial for sustaining cooperation in societies. However, their neural mechanisms are still poorly understood and it is yet unclear whether the same brain networks involved in punishment are engaged in reward, as very little attention has been paid to the latter. In this preregistered study, we use transcranial magnetic stimulation to test the involvement of the right dorsolateral prefrontal cortex (R dlPFC) and medial prefrontal cortex (mPFC) on punishment and reward of greedy and generous monetary transfers. In a within-subjects design, participants received deep continuous theta burst stimulation (cTBS) to inhibit the R dlPFC and the mPFC in addition to sham stimulation. Participants took part in a novel dictator game as Receiver (second-party) or Observer (third-party) with the opportunity to punish and reward the Proposer. In half of the trials, punishment and reward were costly to participants. Results indicate that the stimulated prefrontal regions play distinct roles in punishment and reward. Stimulation of the R dlPFC and mPFC decreased punishment of greedy allocations in all conditions except when participants were Observers and had no costs to punish. These findings are consistent with a broad perspective of the implication of R dlPFC and mPFC in self-centeredness, which includes both a personal and a monetary component. Following generous offers, a decrease in costly reward is observed, presumably because stimulation of these regions allows selfish economic motivations to overtake norm enforcement or reciprocity motives. In the absence of cost, however, reciprocity drives the decision, resulting in increased reward of generous offers. Although reciprocal fairness is influenced by brain stimulation, individuals' perceptions of fairness and social norms remain unaffected.

5.1 Introduction

From lending a hand to assist friends to helping strangers on the street by giving directions or even money, humans are remarkably cooperative towards both kin and non-kin. This is surprising considering that cooperation often involves a tension between own and others' interests and on many occasions not cooperating makes one better off. Reciprocal fairness, which implies reciprocating selfish behavior with punishment and kindness actions with rewards, is essential to discourage defection and to promote cooperation (Egas & Riedl, 2008; Fehr & Gächter, 2002). Research has shown that individuals engage in punishment when they are directly affected by a violation of the fairness norm (Fehr & Gächter, 2000; Gächter, Renner, & Sefton, 2008) but also when they are an unaffected third-party (Fehr & Fischbacher, 2004a). Despite being much less investigated than punishment, rewards have also been proved to promote cooperation in second (Andreoni, Harbaugh, & Vesterlund, 2003; Sefton, Shupp, & Walker, 2007; Szolnoki & Perc, 2010) and third-party interactions (Almenberg, Dreber, Apicella, & Rand, 2010; Nikiforakis & Mitchell, 2014; Sutter, Lindner, & Platsch, 2009). Given the universal human propensity to punish and reward others, several studies have attempted to unravel the neural correlates of these reciprocal behaviors. Despite the accumulating neuroscientific evidence, it is still unclear whether punishment and reward are simply different sides of the same coin and governed by the same brain networks or if they depend on distinct processes.

Neuroscientific studies have repeatedly pointed to the role of the prefrontal cortex in reciprocal fairness. Specifically, the right dorsolateral prefrontal cortex (R dlPFC) has been implicated in a wide variety of higher-level functions, including the control of selfish impulses (Knoch & Fehr, 2007; Knoch et al., 2006; Knoch, Schneider, Schunk, Hohmann, & Fehr, 2009; Van't Wout et al., 2005), the ability to adapt behavior strategically (Ruff, Ugazio, & Fehr, 2013; Spitzer, Fischbacher, Herrnberger, Grön, & Fehr, 2007; Strang et al., 2015) and the ability to integrate intentionality and harm for the selection of an appropriate reaction (Buckholtz et al., 2008; Buckholtz & Marois, 2012; Buckholtz et al., 2015). The medial prefrontal cortex (mPFC) has also been implicated in reciprocal fairness. In this context, it has been suggested that this region is associated with a positive affect response to fairness (Tabibnia, Satpute, & Lieberman, 2008), with mentalizing processes when reacting to unintentional unfairness (Güroğlu, van den Bos, Rombouts, & Crone, 2010) and processing unfairness when it damages the self (Civai et al., 2015; Corradi-Dell'Acqua et al., 2013).

However, the differences in the study designs used in the literature make it difficult to draw comprehensive conclusions about the cognitive mechanisms associated with punishment and reward that generalize beyond the specific conditions tested in these studies. For instance, many studies in the literature focus solely on cases where the person who can reciprocate is the target of someone's actions (e.g., Knoch et al., 2006; Knoch et al., 2009) or where they are unaffected observers (e.g., Buckholtz et

al., 2008; Buckholtz et al., 2015). In the few cases where personal involvement was varied within a study (Civai et al., 2015; Corradi-Dell'Acqua et al., 2013), the cost of reciprocating was also varied, making it hard to disentangle the effect of personal involvement from the effect of costs. In addition, it is still unclear whether R dlPFC and mPFC play a similar role in regulating rewards as they do in punishment, considering that very little attention has been paid to the neural mechanisms of reward in the reciprocal fairness literature (see Knoch et al., 2009 for a notable exception) and we are not aware of any studies that simultaneously investigate the neural mechanisms of punishment and reward at the individual level.

To fill this gap, we present a unified methodological framework where, in a comprehensive within-subjects design using transcranial magnetic stimulation (TMS) to inhibit the functionality of the R dlPFC and mPFC, we provide evidence of the involvement of these prefrontal regions in punishment and reward. Participants took part in a novel monetary allocation game with the opportunity to punish or reward a Proposer after learning how the Proposer divided a monetary amount with the Receiver. During the task, we independently vary personal involvement as each participant receiving TMS takes the role of Receiver (second party) in half of the trials and Observer (third party) in the other half. Also, we vary the cost of punishing and rewarding, such that participants face costly punishment and reward only in half of the trials. Each participant receives stimulation over the R dlPFC, mPFC, and sham stimulation in three separate sessions before completing the monetary allocation game. At the end of each experimental session, participants are also asked to rate the fairness and social appropriateness of Proposer's offers.

This experimental design exhibits several desirable features as we are able to (1) analyze how punishment and reward relate to each other at the behavioral level, (2) discuss whether the different mechanisms associated with the R dlPFC and mPFC extend beyond the contexts in which they have been originally tested, and (3) provide evidence of the differences and similarities between punishment and reward regarding the engagement of the R dlPFC and mPFC. In addition, we provide insights into how punishment and reward are related to motives such as outcome maximization, norm enforcement and reciprocity. Ex-ante hypotheses are derived from literature and pre-registered together with an analysis plan (<https://osf.io/pg7yc>).

Studies investigating reciprocal fairness have often implicated the R dlPFC in punishing unfair behavior. This region has been shown to be activated when individuals punish non-cooperative behavior (Kodaka et al., 2012), when they interact with non-cooperative partners (Suzuki, Niki, Fujisaki, & Akiyama, 2011) and receive unfair allocations in the Ultimatum Game (Sanfey et al., 2003). Since the dlPFC has been previously associated with *cognitive control* mechanisms, subsequent studies using TMS have proposed that this region is necessary to inhibit prepotent responses to behave selfishly and maximize one's own economic resources while facilitating the

implementation of costly punishment in second-party interactions (Knoch et al., 2006; Van't Wout et al., 2005). Consistent with this interpretation, studies have shown that activation in the R dlPFC correlates with the implementation of fair behavior when this is strategically advantageous (Spitzer et al., 2007; Strang et al., 2015). There is also some evidence for the involvement of the R dlPFC in costly rewarding trust in second-party interactions (Van Den Bos, van Dijk, Westenberg, Rombouts, & Crone, 2009). Furthermore, there is evidence that inhibition of this region with TMS decreases the ability to reciprocate trust whenever self-control efforts are necessary to reciprocate in order to build a positive reputation (Knoch et al., 2009). This indicates that the *cognitive control* mechanism of the R dlPFC applies also in the reward domain. This interpretation, however, has been challenged - in studies where reciprocity is absent - by findings showing that inhibition of the dlPFC using cTBS increases offers in a Dictator Game (Christov-Moore, Sugiyama, Grigaityte, & Iacoboni, 2017) and that cathodal transcranial direct current stimulation (tDCS) over right lateral prefrontal cortex decreases immediate selfish responses in voluntary transfers, while anodal tDCS leads to a higher degree of immediate selfishness (Ruff et al., 2013).

Importantly, the *cognitive control* hypothesis for the R dlPFC in reciprocal fairness has been exclusively tested in second-party interactions, when it is costly to punish greedy and reward generous behaviors. Therefore, it is still unclear whether this mechanism applies also in other contexts. One important aspect of our study is that we test whether the *cognitive control* mechanism extends also to third-party situations and to contexts where punishing and rewarding are not costly. Building on previous evidence for the involvement of R dlPFC in reciprocal fairness (Knoch et al., 2006), we formulate our first hypothesis, which posits that if the R dlPFC is crucial for overriding economic selfishness impulses, its inhibition with TMS should lead to decrease in punishment and reward only when these are costly and regardless of personal involvement (i.e., second and third-party interactions when punishment and reward are costly). This decrease in punishment and reward should not be observed when punishment and reward are not costly, given that in these conditions economic selfishness could not be a motivation of individuals' behavior. Thus, cognitive control should not be important in facilitating the implementation of reciprocal fairness.

An alternative explanation for the role of R dlPFC in punishing unfair behavior has been proposed by a different stream of literature, which investigates punishment in third-party interactions using hypothetical scenarios instead of economic games with real incentives. Buckholtz et al. (2008) discuss fMRI evidence showing that the same region of the R dlPFC previously implicated in *cognitive control* mechanisms of reciprocal fairness (Knoch et al., 2006) is involved when disinterested third-party participants respond to individuals who are responsible for harming others and make non-costly decisions about appropriate punishments to such transgressions. A follow-up study demonstrated that TMS over the R dlPFC significantly reduced non-costly punishment for wrongful acts in a third-party context (Buckholtz et al., 2015). According

to the authors' interpretation of the findings, the underlying process that accounts for the engagement of R dlPFC in third-party punishment is the integration of information about harm and blame and the selection of a specific and appropriate response among a range of response options (Buckholtz & Marois, 2012). This *integration-and-selection* hypothesis implies a general role of R dlPFC in reciprocal fairness, which should apply equally in second and third-party interactions (Buckholtz & Marois, 2012). However, it remains to be explored whether the *integration-and-selection* mechanism generalizes beyond the investigated contexts and applies to second-party interactions and to contexts when punishment is costly. Based on the existing evidence we formulate our second hypothesis: holding responsibility constant, if the R dlPFC is needed to generally determine the appropriate punishment regardless of personal involvement or costs to punish, inhibition of this region with TMS should lead to a decrease in punishment in all conditions compared to sham stimulation (i.e., second and third-party interactions when punishment is costly or not). Importantly, we note that the *integration-and-selection* mechanism has not yet been tested in the reward domain. Here, we speculate that this mechanism should presumably work in the same way in the reward domain. That is, we expect that the R dlPFC is important in integrating information to select an appropriate reward for cooperative and fair behavior. Thus, we hypothesize a decrease in reward in all conditions following inhibition of the R dlPFC if this region is involved in integration-and-selection processing.

Regarding the role of mPFC on reciprocal fairness, existing functional imaging evidence indicates that the mPFC is significantly more engaged in second party than in third party interactions. Specifically, Corradi-Dell'Acqua et al. (2013) shows that the anterior mPFC is more active when a participant is confronted with unfair offers in the Ultimatum Game, compared to a situation where, as a disinterested third party, the participant observes another individual receiving an unfair offer and decides on the behalf of this individual whether to accept or reject the offer. A follow-up study later confirmed the role of the anterior mPFC in second-party punishment decisions by applying cathodal stimulation on the mPFC, which resulted in decreased rejection rates of unfair offers in the second party, but not in the third-party condition (Civai et al., 2015). This engagement of mPFC in reciprocal fairness is consistent with neuroscientific evidence which has repeatedly implicated cortical midline structures -including the mPFC- in processing self-referential stimuli, for example during self-reflection (Johnson et al., 2002; Kelley et al., 2002) and evaluative judgments that depend on one's internalized values (Zysset, Huber, Ferstl, & von Cramon, 2002) (for a review, see Northoff and Bermpohl, 2004; Northoff et al., 2006). According to this *self-referential* interpretation, in the context of reciprocal fairness, the mPFC is especially recruited when punishing unfairness that is directed towards oneself. However, studies investigating the role of mPFC on reciprocal fairness have only compared costly second-party punishment with non-costly third-party punishment. The fact that both costs and personal involvement were simultaneously varied leaves room for a *cognitive control* interpretation of results, according to which the mPFC could be involved

in overriding economic selfish impulses in favor of implementing fair behavior (Civai et al., 2015). This would also explain the observed decrease in punishment following inhibition of the mPFC only in second-party interactions, where punishing was costly (Civai et al., 2015). Based on this evidence, we formulate our third hypothesis: if the anterior mPFC is important for *self-referential* thinking during reciprocal fairness, its inhibition should result in a decrease of punishment in second-party conditions compared to sham stimulation, regardless of the cost of punishing. Such an effect should not be observed in third party conditions. We note that the *self-referential* mechanism has not been tested in the reward domain. We propose that a similar process as in punishment could take place when people decide whether and how to reward fair behavior. Alternatively, and according to our fourth hypothesis: if the mPFC is involved in cognitive control mechanisms which inhibit economic selfishness to enforce implementation of fairness, as proposed by Civai et al. (2015), inhibition of the mPFC should lead to reduced punishment and reward in conditions where it is costly, regardless of personal involvement.

Lastly, previous brain stimulation literature has shown that inhibition of R dlPFC affects reciprocal fairness without altering judgments of what is fair (Knoch et al., 2006; Strang et al., 2015). We assume that, just like the R dlPFC, the mPFC is important for implementing fairness behavior but is not involved in assessing the fairness of a given situation. Our fifth hypothesis then posits that inhibition of R dlPFC and mPFC does not affect fairness and social appropriateness judgments. Table 5.1 summarizes the hypotheses formulated in the present study.

Table 5.1: Summary of hypotheses.

Hypotheses	Explanation
H1: Cognitive control (R dlPFC)	Inhibition of the R dlPFC should lead to decrease in punishment and reward only when these are costly and regardless of personal involvement (i.e., second and third-party interactions when punishment and reward are costly). This decrease should not be observed when punishment and reward are not costly.
H2: Integration and selection (R dlPFC)	Inhibition of the R dlPFC should lead to a decrease in punishment and reward in all conditions compared to sham stimulation (i.e., second and third-party interactions when punishment is costly or not).
H3: Self-referential (mPFC)	Inhibition of the mPFC should result in a decrease of punishment and reward in second-party conditions compared to sham stimulation, regardless of the cost of punishing. Such an effect should not be observed in third party conditions.
H4: Cognitive control (mPFC)	Inhibition of the mPFC should lead to decrease in punishment and reward only when these are costly and regardless of personal involvement (i.e., second and third-party interactions when punishment and reward are costly). This decrease should not be observed when punishment and reward are not costly.
H5: Fairness and social appropriateness (R dlPFC and mPFC)	Inhibition of R dlPFC and mPFC does not affect fairness and social appropriateness judgments.

5.2 Methods

5.2.1 Participants

Thirty-three participants (24 women, mean age = 21.9 years, min = 18 years, max = 33 years, SD = 3.4 years, 29 right-handed) took part in the experiment. The study was approved by the local ethical review committee of Psychology and Neuroscience at Maastricht University (ERCPN-192.19.04.2018). Participants were screened to ensure they met the requirements to receive transcranial magnetic stimulation (Rossi, Hallett, Rossini, Pascual-Leone, of TMS Consensus Group, et al., 2009) as well as to guarantee they were never exposed to experiments involving deception. Only participants with normal or corrected-to-normal vision and without any history of neurological or psychiatric disorders were included.

5.2.2 Procedures

Participants attended three different sessions, in which they received, in a counterbalanced order, TMS aiming to inhibit the functionality of the R dlPFC, anterior mPFC or sham stimulation (control). For each participant, sessions were scheduled at least 4 days apart from each other. In each session, participants filled in a TMS screening form and provided written consent. At the start of the first session, participants received general information about TMS and their active motor threshold was determined (see “TMS Procedures” for more details). Prior to brain stimulation, they received written instructions about the experiment task and answered comprehension questions. After that, an electroencephalogram (EEG) cap indicating the electrode positions of the International 10-20 EEG system was placed on participants’ heads to determine the site of stimulation. Cap sizes were chosen based on participants’ head size and were adjusted so that the Cz position would be placed in the middle point between right and left preauricular points and between the nasion and the inion. TMS was then applied and participants started the task immediately after receiving brain stimulation.

Each experimental session lasted on average 75 minutes and participants received a participation fee of €7.50 for each one. In addition, decisions in the experiment were incentivized and participants could earn extra money (between €0 and €25.30) in each session depending on their decisions and on the decisions of the individuals they were matched with. Considering both the participation fee and the extra money, participants earned, on average, €25.80 (SD = € 6.60) per experimental session.

5.2.2.1 TMS Procedures

A MagVenture MagPro X100 stimulator equipped with the high-performance cooling system (MagVenture, Farum, Denmark) and a deep figure-of-eight TMS coil (Cool-D-B80; inner diameter = 67 mm, outer diameter = 95 mm) were used to deliver continuous theta-burst stimulation (cTBS). This coil was selected given its balance between depth of penetration and focality. Because of its geometry, it is suitable for reaching deep regions in the brain (i.e., the mPFC in our study), while still being able to produce a focal stimulation (Deng, Lisanby, & Peterchev, 2013). The protocol consisted of 50Hz triplets delivered 5 times a second for 40 seconds (600 pulses in total) (Huang, Edwards, Rounis, Bhatia, & Rothwell, 2005). This TMS protocol has been shown to produce consistent and rapid electrophysiological and behavioral changes that last for approximately 60 minutes after stimulation, which is considerably longer than other more traditional stimulation protocols (Huang et al., 2005).

The stimulation intensity was 90% of the individual active Motor Threshold (aMT), defined as the lowest machine output intensity able to induce a visible twitch in the stretched out left index finger for 50% of the pulses. The aMT was determined in the first session and used for the other three sessions (mean stimulator output = 29.1% of maximum stimulator output, SD = 4.29; mean realized output = 42 A/ μ s). The same protocol was applied to sham stimulation, but the coil was tilted at 180 degrees.

The stimulation sites were localized using the international 10-20 EEG system, which has been shown to provide a reliable cortical positioning for large scale cortical areas such as the ones our study targets (Herwig, Satrapi, & Schönfeldt-Lecuona, 2003). In all three sessions, participants wore a cap with EEG electrodes, so that stimulation sites could be determined. Based on the Talairach coordinates provided by Knoch et al. (2006) and by Buckholz et al. (2008) for the R dlPFC ($x=39$, $y=37$, $z=22$), we placed the center of the TMS coil on the electrode site F4 while holding the handle of the coil parallel to the cortical midline. Likewise, based on the MNI coordinates reported by Corradi-Dell'Acqua et al. (2013) for the anterior mPFC ($x=0$, $y=58$, $z=8$), this brain region was stimulated by placing the coil between Fp1 and Fp2 while holding the handle of the coil at a 45 degrees angle from the cortical midline. For sham stimulation, the coil was placed in the middle point between the stimulation sites of the R dlPFC and mPFC.

5.2.3 Task: Dictator game with punishment and reward

In each brain stimulation session, participants receiving TMS (henceforth TMS participants) made decisions in 140 trials. In our task, a Dictator Game with punishment and reward, three individuals are randomly matched and are assigned three different roles: Proposer, Receiver, and Observer (task adapted from Spitzer et al., 2007). TMS participants always made decisions in the role of Receiver and Observer, and never

in the role of Proposer. In each trial of the game, the Proposer is endowed with 240 experimental currency units (ECUs), the Receiver is not endowed with any ECUs, and the Observer is endowed with 200 ECUs. All Participants are informed that at the end of the experiment ECUs are converted to Euro at a rate of €0.10 per ECU. In each trial, TMS participants are confronted with a Proposer's decision of how to share his endowment with the Receiver. Proposers could choose between different allocation bundles which range from very greedy to very generous. Specifically, proposers could choose from the offers, 200-40, 160-80, 120-120, 80-160, and 40-200, where the first term refers to what the Proposer keeps for himself or herself and the second term refers to what is allocated to the Receiver (see section "Proposers" for a more detailed description of the possible allocations available to Proposers).

Depending on the experimental condition, either the Receiver or the Observer can punish or reward by decreasing or increasing the Proposer's payoff after learning the allocation decision made by the Proposer. A 2x2 within-subjects experiment design was implemented in which both personal involvement (Receiver vs Observer) and the cost to punish or reward the Proposer (Cost vs. No_cost) vary (see Figure 5.1). In both the Receiver with Cost (Rec_C) and Receiver with No Cost (Rec_NC) conditions, the TMS participant makes decisions in the role of the Receiver and is thus directly affected by the Proposer's choice. In the Rec_C condition, each ECU invested in punishment and reward, respectively, reduces and increases the payoff of the Proposer by 5 ECUs, while decreasing the payoff of the Receiver by 1 ECU. Our design ensured that irrespective of the Proposer's allocation decision, the Receiver always has enough ECUs to invest in punishing or rewarding the Proposer. In the Rec_NC condition, punishing or rewarding the Proposer is not costly to the TMS participant. That is, every ECU invested by the Receiver in Rec_NC reduces or increases the Proposers' payoff by 5 ECUs but does not reduce the Receiver's payoff.

In the Observer with Cost (Obs_C) and Observer with No Cost (Obs_NC) conditions, the TMS participant makes decisions in the role of the Observer. That is, the TMS participant observes the allocation decision of the Proposer regarding the Receiver but is otherwise not affected by it. After learning the allocation, the TMS participant can use the endowment of 200 ECUs to either reward or punish the Proposer. Equivalent to the Receiver conditions, in Obs_C an ECU used for rewarding and punishing the Proposer respectively increases and reduces the Proposer's payoff by 5 ECU and the Observer's payoff by 1 ECU. In the Obs_NC condition, the effect was the same for the Proposer but there are no costs for the Observer.

In all four conditions (i.e., Rec_C, Rec_NC, Obs_C, and Obs_NC), TMS participants are informed they can invest up to 40 ECUs to reward or punish the Proposer. This ensures that in the case of the most greedy allocation by the Proposer, the TMS participant in the Rec_C condition has sufficient ECUs to decrease the Proposer's payoff to zero. Moreover, TMS participants are informed they cannot decrease Proposers'

payoff below 0 or increase Proposers' payoff above 240 ECUs. These rules ensure that TMS participants could never incur losses nor cause losses to Proposers.

Within each condition, the TMS participant and the Proposer are the only individuals who are aware of the decision taken by the TMS participant to punish or reward the Proposer. This means that in the Rec_C and Rec_NC conditions, the TMS participant's decision as Responder to punish or reward the Proposer cannot be seen by the Observer. Likewise, in the Obs_C and Obs_NC conditions, the TMS participant's decision as Observer to punish or reward the Proposer cannot be seen by the Receiver. This ensures that the decisions to punish and reward made by TMS participants are not influenced by reputation or image concerns that could ensue from being observed. Moreover, our set-up implies that in each condition there is only one person who can modify the Proposers' payoff and one person who can only passively watch the behavior of the Proposer. Hence, information is kept symmetric in all conditions.

Figure 5.1: Dictator game with Punishment and Reward

Note: In each trial, three players are involved: a Proposer (P), a Receiver (R) and an Observer (O). The TMS participant (indicated by white circles) makes decisions in the roles of the Receiver (top panels) and in the role of the Observer (bottom panels). The two panels on the left refer to the conditions where it is costly for the TMS participant (Receivers in the Rec_C condition and Observers in the Obs_C condition) to modify the Proposer's payoff. The two panels on the right refer to non-costly conditions, where the TMS participant (Receivers in the Rec_C condition and Observers in the Obs_C condition) can modify the Proposer's payoff without bearing any costs.

In each brain stimulation session, TMS participants face the four different conditions in a randomized block design. In each block, TMS participants are confronted with

35 different proposer's allocations presented in random order, which vary from very greedy to very generous. After the 35 allocations for a given condition are shown to participants, a new block starts featuring a new condition. During this task, facial expressions of the TMS participants were recorded with a webcam. Results of facial expression analysis are not reported here.

At the end of each experimental session, one trial was selected randomly for payment and all three participants in that trial were paid accordingly. Session earnings and total earnings were revealed to the TMS participants only at the end of the last experimental session to avoid that earnings in a session would influence their decisions in the subsequent sessions. All earnings, including participation fees, were transferred to TMS participants' bank accounts within one week from their last experimental session. For a detailed explanation of how the payoffs of each participant were calculated, see Appendix D.

Although every trial required the participation of three individuals, only the participant undergoing brain stimulation was present in the laboratory. Proposers, as well as passive participants (i.e., Observers in Rec_C and Rec_NC and Receivers in the Obs_C and Obs_NC), were real participants, but they were not present during the brain stimulation sessions. Nevertheless, the rules of the task were common knowledge to all of them. The participation of Proposers and passive participants in the experiment is explained in detail below.

5.2.3.1 Proposers

The present experiment does not involve deception, which means TMS participants faced real Proposers' allocations and were matched with a different Proposer in each trial. Proposers' allocations were collected before the brain stimulation experiment via the online platform Prolific (www.prolific.co). Prior to making any decisions, they were informed their choices could be selected and used in a later study and that the rules of this later study would apply to them. Proposers were not informed that the future study would involve brain stimulation. Proposers (N=211) received £0.75 for completing the online study, where they read instructions about the dictator game with punishment and reward and were presented with the four different conditions of the experiment. In each condition, Proposers were endowed with 240 ECUs and were asked to indicate how they would like to allocate the ECUs between themselves and a Receiver. Proposers knew they could be contacted later to receive their earnings according to their allocation decisions and the received reward or punishment in the selected trial. Proposers selected one of five possible allocation bundles (see Table 5.2). For each of these bundles, they were truthfully told that the researchers could select any allocation within the range of ± 3 ECUs from their original choice. For instance, if a Proposer chose the allocation bundle 200-40, the Receiver could

be shown an allocation between 197-43 and 203-37. This procedure allowed us to collect allocations that were real and yet showed some variation, as to keep the task engaging to participants undergoing brain stimulation. Importantly, TMS participants were truthfully informed about the options the Proposers had and about the way researchers could select their choices. After the conclusion of the experiment, Proposers were contacted and paid according to their final payoff in the trial selected for payment in the brain stimulation study. All payments to Proposers were transferred via the online platform Prolific.

Table 5.2: Monetary allocations available to Proposers.

Allocation Bundle	Classification	Proposer payoff	Receiver payoff
1	Very Greedy	200±3	40±3 ¹
2	Greedy	160±3	80±3
3	Equal	120±3	120±3
4	Generous	80±3	160±3
5	Very Generous	40±3	200±3

Monetary allocations are here for convenience labeled ranging from “Very greedy” to “Very generous”. These labels were not used in the experiment. Proposers chose an allocation bundle per condition, and a specific allocation within that bundle (± 3 ECUs) could be presented to a TMS participant during the brain stimulation study. This was common knowledge to all the participants.

5.2.3.2 Passive participants

Observers in the Rec_C and Rec_NC conditions and Receivers in the Obs_C and Obs_NC conditions are passive participants as they could not modify the payoff of any other individual in the experiment. Passive participants (N=96) were contacted via the ORSEE online recruitment system for economic experiments (Greiner, 2015) of the Behavioral and Economics Laboratory (BEELab) at Maastricht University and asked to participate in a study. They received instructions about the dictator game with punishment and reward and its four conditions. Thereafter, they received an email with information about the Proposers’ allocation decision in the trial selected for payment and their own earnings in that specific trial. All payments were transferred via bank transactions.

5.2.4 Fairness and appropriateness of social behavior

Immediately after the Dictator game with Punishment and Reward, TMS participants completed two tasks to test whether brain stimulation affected the perceptions of what constitutes fair and socially appropriate behavior, respectively. Fairness ratings measure the perceived fairness of the different proposals and social appropriateness

¹In case of receiving the most selfish allocation (i.e., 37 ECUs), the Receiver in the 2p.c condition could use all his ECUs to bring the Proposer’s payoff close to zero.

judgments measure descriptive social norms. Fairness and appropriateness ratings were presented in a counterbalanced order and were completed within the range of the TMS intervention (i.e., 25 to 30 minutes after brain stimulation).

5.2.4.1 Fairness ratings

For each of the four conditions, TMS participants were asked to judge the fairness of each of the bundle allocations available to Proposers (40-200; 80-160; 120-120; 160-80; 200-40) on a 7-point Likert scale ranging from “very unfair” to “very fair”.

5.2.4.2 Appropriateness ratings

TMS participants were asked for the social appropriateness of the five possible Proposer’s bundle allocations in each condition using the incentive-compatible norm elicitation task introduced by Krupka and Weber (2013). Social appropriateness was described to participants as the “behavior that most people agree is the correct or ethical thing to do”. Appropriateness was rated on a 4-point Likert scale that ranged from “Very socially inappropriate” to “Very socially appropriate”. At the end of each brain stimulation session, one of the Proposer’s allocations was randomly selected. The appropriateness rating of the TMS participant for the selected allocation was then compared to the most frequent answer for the same allocation provided by another group of individuals, whose answers were collected in a separate online experiment that took place before the brain stimulation experiment (N=41). Collecting answers from a separate group of participants, which were not exposed to brain stimulation, is important as it allows avoiding any deception, ensures the more frequent social appropriateness answer is somewhat representative of the general population beliefs and avoids that these answers are biased by the effects of TMS. The participants in this online experiment received information about the four different conditions and were asked to rate, for each condition, the social appropriateness of each of the five allocation bundles that the Proposer could choose. Their ratings were incentivized with a €5 payment if their appropriateness judgment matched the most frequent answer in their group.

Each TMS participant received €5 if his or her social appropriateness judgment matched the most frequent answer in the separate online experiment. This method is commonly used to measure social norm perception in an incentive-compatible way (Banerjee, 2016; Exley, Niederle, & Vesterlund, 2020; Gneezy, Imas, & Madarász, 2014; Thomsson & Vostroknutov, 2017). TMS participants were only informed about the earnings of the appropriateness task at the end of the last experimental session.

5.2.5 Data Analysis

As the neural mechanisms of reward have never been explored in relation to those of punishment, we investigate these two domains separately to be able to identify potential similarities and dissimilarities between them. For punishment, we focus on trials where TMS participants received Very Greedy (200-40) and Greedy allocations (160-80). Punishment captures almost all responses to these allocations, as counter-intuitive reward of Greedy and Very Greedy allocations was rare (less than 5.2% of the cases). For reward, we consider trials in which TMS participants received Equal (120-120), Generous (80-160) and Very Generous allocations (40-200). As before, reward captures almost all responses to these allocations. Counterintuitive punishment of Equal, Generous and Very Generous allocations was also negligible (less than 6.4% of all cases). In both the punishment and reward domains, the dependent variable of interest is the impact of punishment and reward on Proposer's payoff. For ease of presentation, we code a decrease in the Proposers' payoff due to punishment to positive values. Hence, in both the punishment and reward domains, a value of zero means no punishment or reward and a value of +200 means maximum punishment or reward. Our within-subjects design, where the same participants repeatedly made decisions in the different conditions, provides a panel data set. In addition, the dependent variable is censored at 0 and 200 ECUs. Therefore, in our analysis, we use random-effects Tobit regressions for panel data that are left- and right-censored with standard errors clustered at the participant level. In all regression models, we control for gender, fairness (1-7) and appropriateness ratings (1-4), trial order within an experimental session (1-140), and session number (1-3).

We start by reporting sham stimulation results. We first describe how fair and socially appropriate TMS participants considered the Proposers' offers. We then report whether, without an effective brain stimulation, it matters that punishment and reward are costly or not and whether there is a difference in responses between Receiver and Observer conditions. In the regression model, dummy predictors are used for the roles of Receiver or Observer and whether punishment or reward was costly or not.

We then turn our focus to the effect of stimulation of the R dlPFC and mPFC on TMS participants' responses compared to sham. First, we conduct a Kruskal-Wallis equality-of-populations rank test to investigate whether brain stimulation affects participants' fairness judgments and socially appropriateness ratings of the different experimental allocations. Second, to examine the effect of brain stimulation on punishment or reward, we include in the regression dummy variables coding stimulation (R dlPFC, and mPFC) considering sham stimulation as the baseline category, the two-way interactions between stimulation and cost of punishment or reward and stimulation and personal involvement, and a three-way interaction between stimulation, cost of punishment or reward and personal involvement. For clarity of exposition, we present the marginal effects of brain stimulation relative to sham in the four different conditions.

Marginal effects are computed at the censored expected value. All p-values associated with the comparison between the effect of brain stimulation (i.e., R dlPFC and mPFC) and sham in the four experimental conditions survive multiple comparisons correction using the False Discovery Rate (FDR) method (Benjamini & Hochberg, 1995) at 95% confidence level, unless otherwise stated. All analyses reported were conducted with the statistical software Stata 15.

5.2.5.1 Identifying Weak Reciprocators

We hypothesize that, depending on the functional role of the R dlPFC and mPFC, inhibition of these areas with TMS results in reduced punishment and reward. To test these hypotheses, it is crucial that TMS participants punish and reward Proposers following sham stimulation, such that there is room to observe a reduction of punishment and reward between sham and the other brain stimulation conditions. We identified 8 participants who, across all experimental conditions in sham, decided to not punish or reward Proposers in more than 50% of all trials in sham and for whom it would be hard to test the hypothesized effects of TMS stimulation. We refer to these participants as Weak Reciprocators and we do not include them in the main analysis reported in the paper (for a similar approach see Strang et al., 2015).

This leaves us with a final sample for our main analysis of 25 participants (mean age = 22.28, SD = 3.64, 19 women) who each reciprocated Proposers' offers in at least 50% of the trials and participated in the three brain stimulation sessions.² Importantly, we note that differences in results obtained with this sample and the full sample (which included also the Weak Reciprocators) are not extensive, and mostly related to the punishment domain. However, as this exclusion criteria was not included in our pre-registered analysis plan, results for the whole sample of participants are also presented (see Appendix D).

5.3 Results

5.3.1 Fairness and social appropriateness following sham stimulation

As fairness and social appropriateness ratings might be related to participants' punishment and reward behavior, we start by examining how TMS participants judge the Proposers' allocations following sham stimulation. As Figure 5.2 shows, fairness and

²One participant did not complete all three brain stimulation sessions. Excluding this participant from the main analysis only changes the significance of results in one specific condition, which will be mentioned when reporting the respective results.

social appropriateness ratings vary depending on Proposers' offers during sham stimulation. Very Greedy (200-40) and Greedy (160-80) allocations are in general rated as unfair and socially inappropriate, whereas the equal split (120-120) is the bundle of allocations considered by participants as being the fairest and most socially appropriate. Interestingly, Generous (80-160) and Very Generous (40-200) allocations are perceived as less fair and less socially appropriate than the equal split. There are no differences in fairness and social appropriateness ratings between the four experimental conditions (Kruskal-Wallis equality-of-populations rank test, $p = .998$ and $p = .979$ respectively).

Figure 5.2: Normalized fairness and social appropriateness ratings following sham stimulation.

Fairness and social appropriateness ratings are shown per monetary allocation and per condition in the sham stimulation. As fairness and social appropriateness questions were answered using different scales, we normalized both ratings on a scale ranging from 0 (Very unfair/Very Social inappropriate) to 1 (Very fair /Very socially appropriate) to facilitate comparison.

5.3.2 Punishment following sham stimulation

In Figure 5.3, the light grey lines show the pattern of participants' punishment behavior following the sham stimulation for the different cost and personal involvement conditions. After receiving Greedy and Very Greedy offers in the sham stimulation, participants punish significantly more in the Receiver than in the Observer conditions ($\beta = 7.92, p < 0.05$) and punishment is significantly lower when punishing is costly than when it is not costly ($\beta = -74.0, p < 0.001$). The interaction term between the

cost of punishment and personal involvement represents the difference of the effect of cost of punishing for Observers compared to Receivers ($[\text{Obs.C} - \text{Obs.NC}] - [\text{Rec.C} - \text{Rec.NC}]$). Results indicate that the difference in punishment between costly and non-costly punishment is significantly larger when the TMS participant is the Receiver than when the TMS participant is in the role of the Observer ($\beta = -31.9, p < 0.001$).

Judgments of fairness and social appropriateness influence participants' decisions to decrease Proposers' payoff during the sham treatment. Specifically, the more participants consider Proposers' offers to be unfair and socially inappropriate, the more they punish Proposers ($\beta_{\text{fair}} = -7.10, p < 0.01$; $\beta_{\text{appro}} = -22.66, p < 0.001$).

Figure 5.3: Altruistic punishment and Reward in sham stimulation.

The figure shows the estimated coefficients for punishment and reward expressed as the absolute change on the Proposer's payoff (i.e., 0 = no punishment/reward; +200 = maximum punishment/reward) in different conditions, after sham stimulation. The circles and diamond markers represent the point estimates for reward and punishment, respectively. The bars indicate the 95% confidence intervals.

5.3.3 Reward following sham stimulation

In Figure 5.3, the black lines show the pattern of participants' reward behavior in the sham stimulation for the different cost and personal involvement conditions. The cost of reward is an important predictor of the decision to reward Equal, Generous and Very Generous offers under sham stimulation. Participants reward significantly less when it is costly than when it is not costly ($\beta = -60.44, p < 0.001$). In contrast to

the punishment domain, personal involvement does not affect how much participants reward Proposers ($\beta = 5.11, p = 0.123$). Also, the interaction between the cost of norm enforcement and personal involvement is not significant ($\beta = -4.23, p = 0.52$). Interestingly, we find a negative relationship between fairness and altruistic reward ($\beta = -22.05, p < 0.001$), indicating that overly generous offers are rewarded more although they are viewed as less fair than the equal split. Social appropriateness judgments of allocations have no effect on participants' decisions to reward Proposers ($\beta = 1.87, p = 0.53$).

5.3.4 The effect of brain stimulation on fairness and social appropriateness

Figure 5.4 shows the fairness and appropriateness ratings of Proposers' allocations for sham and for the brain stimulations over R dlPFC and mPFC. Following any brain stimulation (i.e., dlPFC, mPFC) we do not observe any differences in fairness and social appropriateness ratings between the four experimental conditions (Kruskal-Wallis equality-of-populations rank test: $p > 0.941$ for both fairness and social appropriateness). We therefore aggregate the ratings within a brain stimulation session and we find that stimulation of R dlPFC or mPFC did not alter fairness and social appropriateness judgments compared to sham (Kruskal-Wallis equality-of-populations rank test: Fairness $p = 0.222$; Appropriateness $p = 0.249$). Hence, any difference in punishment and reward following brain stimulation compared to sham cannot be attributed to changes in TMS participants' fairness or socially appropriateness judgments.

5.3.5 TMS effect on punishment

Figure 5.5 depicts the effect of brain stimulation over R dlPFC and mPFC on punishment relative to sham, for both roles (Receiver and Observer) and both cost conditions (Cost and No Cost).

5.3.5.1 R dlPFC stimulation

Compared to sham, stimulation of the R dlPFC decreases costly and non-costly punishment of Greedy and Very Greedy offers when TMS participants are in the role of Receivers (Rec.C: $t = -9.38, p = 0.001$; Rec.NC: $t = 8.37, p = 0.04$), and costly punishment when TMS participants are in the role of Observers (Obs.C: $t = -8.15, p = 0.009$). Stimulation of the R dlPFC does not affect non-costly punishment for Observers (Obs.NC: $t = 0.19, p = 0.96$).

Figure 5.4: Effect of brain stimulation on fairness and appropriateness ratings.

Fairness and social appropriateness ratings are shown per stimulation and allocation bundle offered by the Proposer. The ratings shown here are normalized on a scale ranging from 0 (Very unfair/Very Social inappropriate) to 1 (Very fair/Very socially appropriate) to facilitate comparison.

5.3.5.2 mPFC stimulation

Compared to sham, stimulation of the mPFC decreases costly punishment of Greedy and Very Greedy allocations for both Receiver and Observer roles (Rec.C $t = -7.87$, $p = 0.007$; Obs.C: $t = -10.18$, $p < 0.001$). When punishment is not costly, a decrease in punishment is observed, at a marginal significance level, for TMS participants in the role of the Receiver (Rec.NC: $t = -7.26$, $p = 0.06$, FDR corrected < 0.10),³ but not for TMS participants in the role of the Observer (Obs.NC: $t = -1.31$, $p = 0.73$).

³We note that when excluding the participant who did not participate in all the three different experimental sessions, we observe that following mPFC stimulation the decrease of punishment in the Rec.NC condition becomes significant $t = -8.72$, $p = 0.03$. The other results reported in the paper remain the same when excluding this participant.

Figure 5.5: Effect of TMS stimulations on punishment.

The figure summarizes the marginal effect of R dlPFC and mPFC stimulation relative to sham stimulation on punishment of Greedy and Very Greedy offers. The horizontal solid line at zero indicates the point estimate for the sham stimulation in the different conditions. The black circle and the grey diamond markers represent the marginal effects of R dlPFC and mPFC stimulation compared to sham, respectively. The bars indicate the 95% confidence intervals based on the regression analysis.

5.3.6 TMS effect on reward

Figure 5.6 shows the effect of brain stimulation over R dlPFC and mPFC on reward relative to sham, for both roles (Receiver and Observer) and both cost conditions (Cost and No Cost).

5.3.6.1 R dlPFC stimulation

Compared to sham, stimulation of the R dlPFC decreases costly rewards of Equal, Generous and Very Generous allocations when TMS participants are in the role of the Observer (Obs.C: $t=-10.45$, $p < 0.001$), but not when TMS participants are in the role of the Receiver (Rec.C: $t=-2.67$, $p = 0.29$). In stark contrast, stimulation of the R dlPFC strongly increases non-costly reward relative to sham, for both Receiver and Observer roles (Rec.NC: $t=17.67$, $p < 0.001$; Obs.NC: $t=14.27$, $p < 0.001$).

5.3.6.2 mPFC stimulation

Compared to sham, stimulation of the mPFC decreases costly altruistic reward of Equal, Generous and Very Generous allocations, for both Receiver and Observer roles (Rec.C: $t=-6.54$, $p = 0.01$; Obs.C: $t=-7.14$, $p = 0.007$). In stark contrast again, stimulation of the mPFC increases non-costly rewards relative to sham, irrespective of the role of the TMS participant (Rec.NC: $t=14.43$, $p < 0.001$; Obs.NC: $t=15.93$, $p < 0.001$).

Figure 5.6: Effect of TMS stimulations on reward.

The figure summarizes the marginal effect of R dlPFC and mPFC stimulation versus sham stimulation on reward of Equal, Generous and Very Generous offers. The horizontal solid line at zero indicates the point estimate for sham treatment in the different conditions. The black circle and the grey diamond markers represent the marginal effects of R dlPFC and mPFC stimulation compared to sham, respectively. The bars indicate the 95% confidence intervals based on the regression analysis.

5.4 Discussion

We present a comprehensive test of the involvement of the R dlPFC and mPFC in punishment and reward at the individual level (within participant design). We independently vary personal involvement (second vs. third party) and the cost of punishment and reward (cost vs. no cost) in an attempt to test, in diverse social contexts, the different explanations that have been given to the role of the R dlPFC and mPFC in

reciprocal fairness. Furthermore, we provide a direct comparison of the involvement of these regions in punishing greedy and rewarding generous behavior.

We discuss unexpected results which only partly confirm recently proposed mechanisms for the engagement of these two prefrontal regions in punishment and reward. Our findings show that stimulation of the R dlPFC and the mPFC reduces punishment of unfair actions in conditions where punishing is costly to the punisher and when unfairness is targeted at oneself. A different pattern of results emerges in the reward domain, where stimulation of the R dlPFC and mPFC leads to a decrease in costly reward and an increase in non-costly reward. Below we discuss the relevance of these findings in relation to the existent literature and potential psychological mechanisms that might be associated with reciprocal fairness.

5.4.1 The R dlPFC and mPFC on punishment

Compared to sham, we found that disruption of the R dlPFC decreases costly punishment irrespective of personal involvement. This result is consistent with a *cognitive control* mechanism, suggesting that R dlPFC is needed to override economic selfish impulses when reciprocal fairness is costly (Knoch et al., 2006; Van't Wout et al., 2005). Previous studies have proposed this mechanism in the context of second-party interactions. Here, we replicate these previous findings and provide evidence that disruption of R dlPFC reduces costly punishment also when participants are in the role of unaffected Observers. That is, in situations where punishment is costly, but in which the unkind actions are not directed to oneself.

In addition to reducing costly punishment, we observed that stimulation of the R dlPFC reduces also non-costly punishment when unfair actions are directed to oneself. The only condition where no effect is observed is when the uninvolved Observer has no costs to punish the unfair behavior of others. Because we do not observe a decrease in punishment in all conditions, we argue that our results are not consistent with the *integration-and-selection* mechanism, according to which we hypothesized the R dlPFC would be involved in selecting the appropriate reaction to an unfair offer regardless of personal involvement and cost.

Regarding the mPFC, we find that stimulation of this region leads to decreased costly punishment compared to sham. A marginally significant decrease was also observed in non-costly punishment when the Receiver was the target of the unfairness. Our findings replicate those of Corradi-Dell'Acqua et al. (2013) and Civai et al. (2015), as disruption of the mPFC significantly decreases costly punishment for Receivers compared to sham without affecting non-costly punishment for Observers. However, as mPFC stimulation also leads to a reduction of costly punishment when being an unaffected Observer, our findings do not exclusively support the *self-referential* mechanism but suggest the mPFC is also involved in a *cognitive-control* mechanism.

Altogether, given the similar pattern of results obtained following stimulation of the R dlPFC and mPFC, we suggest that these two regions respond both to the economic costs of punishing and to the target of the unfair action. We believe our results point to the need of revisiting the *cognitive control* and *self-referential* mechanisms in an attempt to unify these two accounts. Our results are consistent with a broad perspective of the implication of R dlPFC and mPFC in self-centeredness, which includes not only a personal component (i.e., being the target of someone's greedy action) but also a monetary component (i.e., economic self-interest). In fact, the only condition in the experiment in which we do not observe a decrease in punishment is precisely when a component of self-relevance is absent: the Observer is not the target of the unfairness and he/she also does not bear the costs of punishing the unfair behavior of the Proposer.

Our interpretation is also consistent with findings that lateral prefrontal regions of the brain are also engaged during self-referential tasks, in addition to mPFC and the cortical midline structures often associated with this type of reasoning. This was found to be particularly true in situations with a strong cognitive component, as we believe our task has (Northoff & Bermpohl, 2004; Northoff et al., 2006). Importantly, although the literature on self-referential processing does not investigate economic self-interest per se (i.e., having costs vs. not having costs associated with actions), we argue that bearing monetary costs is an aspect of great relevance to self. Future studies may focus on further unraveling the role of monetary costs on self-referential processing.

5.4.2 The R dlPFC and mPFC on reward

Stimulation of the R dlPFC and anterior mPFC lead to an interesting unanticipated pattern of results, which points to a clear-cut difference between conditions in which rewarding is costly or not. Generally, we observe an increase in non-costly reward following disruption of both the R dlPFC and mPFC. In addition, we observe a reduction of costly reward following inhibition of the R dlPFC mainly when being an unaffected Observer, while inhibition of the mPFC reduces costly reward irrespective of the personal role.

The implication of the R dlPFC in the *cognitive control* mechanism suggests that this brain area is needed to override economic selfish impulses (Knoch et al., 2006). Therefore, we expected that inhibition of R dlPFC would diminish costly reward irrespective of personal involvement. Our results are not consistent with this idea, as we find a decrease in costly reward for Observers but not for Receivers. The lack of differences in costly reward for Receivers following disruption of R dlPFC compared to sham does, however, replicate previous findings showing that inhibition of R dlPFC has no effect on the behavior of a trustee in the Trust Game when interactions are anonymous and building a reputation is not possible (Knoch et al., 2009). Although

reputation building is also not possible for Observers in our experiment, we still observe a decrease in costly reward compared to sham. In addition, since we do not find a decrease in reward across all experimental conditions, our results do also not support the *integration-and-selection* mechanism for the dlPFC in the reward domain.

Regarding the role of the mPFC on costly reward, our findings are consistent with the idea that the mPFC is involved in a *cognitive control* mechanism, as stimulation of this brain area leads to a decrease of costly reward independent of personal involvement. Moreover, as stimulation of mPFC affects reward also when being an Observer, we do not find support for the *self-referential* mechanism in the reward domain.

When rewarding is not costly, we observe a strong and unexpected increase in reward after stimulation of the R dlPFC and mPFC for both roles of Receiver and Observer. This finding could be interpreted as an increase in generosity, which in our task would be expressed via rewards. In line with this, a previous study has reported more prosocial behavior after inhibition of the R dlPFC and dorsal mPFC, although prosocial behavior was characterized by giving in a Dictator game (Christov-Moore et al., 2017). However, the generosity interpretation is controversial as less prosocial behavior was observed following cathodal tDCS of the mPFC (Liao, Wu, Luo, Guan, & Cui, 2018).

A more compelling interpretation of our findings in the reward domain is that behavior is driven by two distinct motives in addition to the economic selfish motivation, namely norm enforcement and reciprocity. According to a selfish motive, an individual should never punish or reward others when it is costly to do so. According to the norm enforcement motive, the allocation that is considered the most fair and socially appropriate (the Equal offers in our case) should be the one that is the most rewarded/least punished. Alternatively, according to a reciprocity motive, the more greedy offers are, the more they should be punished, while the more generous offers are, the more they should be rewarded, irrespective of the fairness and social appropriateness consideration. In the punishment domain, both the norm enforcement and the reciprocity motives lead to the same behavioral outcome. That is, according to both motives greedy offers should be punished more than the equal split. However, in the reward domain, it is possible to disentangle norm enforcement and reciprocity motives as the norm enforcement motive predicts that the most rewarded allocation should be the equal split and the reciprocity motive predicts very generous offers should be the most rewarded. This dissociation allows us to test whether TMS affects these two motives differently.

In the absence of costs, we observe that stimulation of the R dlPFC and mPFC promotes a reciprocity mechanism and results in an increased reward of overly generous offers compared to sham stimulation, where participants seem to follow a norm-based behavior and reward the most the allocation which is considered the fairest (i.e., the equal allocation). This pattern of results is consistent with the idea that the stimu-

lation of the R dlPFC and mPFC hinders the enforcement of the norm of an equal split. Thus, the reciprocity mechanism would be the main force driving the decision, resulting in increased rewarding of Equal, Generous and Very Generous offers compared to sham. Reciprocity has up to now been mainly associated with brain regions not targeted in our study such as the insula, anterior cingulate cortex (Cáceda et al., 2017) and right intraparietal sulcus (Bellucci, Chernyak, Goodyear, Eickhoff, & Krueger, 2017), suggesting that it could have been potentially left unaltered by the brain stimulation. As robustness check of this interpretation, one could expect to find a difference in the effects of brain stimulation between equal vs. generous and very generous offers. Unfortunately, our design was not built to have enough power to conduct such an analysis. Future studies are needed to provide a further test for this explanation and to try to disentangle different norm enforcement motives from reciprocity in the reward domain.

When rewarding is costly, however, stimulation of the R dlPFC and mPFC allows selfish motives to drive the decision, leading to a general decrease of reward. Although this pattern of behavior is present in most of our costly conditions, we note, that it does not happen in the Observer condition following stimulation of the R dlPFC. This finding is not in line with any of the mechanisms considered in this study. Future research should attempt to replicate this finding and clarify whether there are additional components - other than personal involvement and cost - that could be responsible for it.

5.4.3 Fairness and appropriateness evaluations

In each of the three brain stimulation sessions, we observe an inverted u-shape for fairness and social appropriateness ratings, in which equal offers are the ones considered the fairest and the most socially appropriate, while greedy as well as overly generous offers are considered less fair and less socially appropriate. Interestingly, we observe a divergence between fairness and social appropriateness rating in reward behavior, as we observe that the more generous an offer is the more it is rewarded, suggesting that the decision to reward a generous action is not norm based, but reciprocity driven.

We replicate results in the literature showing that fairness ratings are not affected by brain stimulation of the R dlPFC (Knoch et al., 2006; Strang et al., 2015). In addition, we extend this finding by showing that the same holds for the stimulation of the anterior mPFC. This suggests that the mPFC is, just like the R dlPFC involved in implementing reciprocal fairness without influencing fairness judgements.⁴ Moreover, we also provide evidence that behavioral changes following brain stimulation are not

⁴We anticipated that fairness evaluations could change if inhibition of mPFC had influenced theory of mind processing. This possibility was pre-registered, although we were agnostic about what would be the direction of the effect on fairness evaluations.

due to changes in internalized social norms of what is considered socially appropriate behavior.

5.4.4 Sham stimulation

Even in the absence of brain stimulation, our novel within-subjects design can provide insights for behavioral differences in costly and non-costly punishment and reward in second and third-party conditions. During sham stimulation, we find that participants punish more when it is free compared to when it is costly, and when they are in the role of the Receiver (i.e., 2nd party conditions) compared to when they are in the role of the Observer. However, the latter effect seems to be driven by the conditions in which punishing is not costly. While some studies have reported that second-party participants tend to punish more strongly than third-parties when punishing is costly (Fehr & Fischbacher, 2004b; Kim, Schnall, Yi, & White, 2013; Leibbrandt & López-Pérez, 2012; Pedersen, Kurzban, & McCullough, 2013), we find that Observers punish slightly more than Receivers when punishing is costly. We note, however, that the discrepancy between our results and previous literature could be driven by different experimental setups as all these studies employed economic games that differ from ours in at least one dimension.⁵

Regarding reward, we find that participants reward less when doing so is costly, while no effect of personal involvement is observed. Previous studies have shown that rewards are frequently used as tools to enforce social norms and cooperation by second-parties (Andreoni et al., 2003; Sefton et al., 2007) and third-parties (Almenberg et al., 2010; de Kwaadsteniet, Rijkhoff, & van Dijk, 2013; Sutter et al., 2009). Our study provides evidence that second and unaffected third-parties behave similarly and may ultimately have similar motivations when engaging in reward of generous behavior.

5.4.5 Concluding remarks

To conclude, our study provides several contributions to the research on reciprocal fairness. First, we present evidence of the roles of R dlPFC and mPFC on punishment and reward. Our findings partially support some of the explanations proposed in the

⁵Fehr and Fischbacher (2004b) have designed the third-party condition such that the participant who is still affected by the decision of the proposer cannot punish his proposer, but the proposer of another group. In Leibbrandt and López-Pérez (2012), the observer can punish the proposer and/or the receiver. Pedersen et al. (2013) have also a different design: in the first stage, the subject (receiver or observer) only witness the proposer taking or giving to the receiver. On a second stage, the participant (receivers or observers) becomes the dictator while the previous dictator becomes the recipient. There is no third party in the second stage and the dictator can take or give from the recipient. Finally, in Kim et al. (2013) participants played the Ultimatum Game as Receivers for themselves or on behalf of a friend or stranger. Thus, in the third-party condition the costs of rejecting an offer were not paid by the participants themselves.

literature for the involvement of these regions in reciprocal fairness, while challenging others. Regarding punishment, our results are consistent with a broad perspective of the implication of R dlPFC and mPFC in self-centeredness, which includes both a cognitive control (Knoch et al., 2006) and self-referential processing (Civai et al., 2015; Corradi-Dell'Acqua et al., 2013). However, we note a striking difference in the functions of these prefrontal areas in the reward domain. There, we find that when cost is present, stimulation of the R dlPFC and mPFC allows selfish economic motivations to overtake the desire for norm enforcing or reciprocating, which leads to a general decrease of reward. In the absence of cost, our results are consistent with the idea that reciprocity is the main force driving the decision, resulting in increased rewarding of Equal, Generous and Very Generous offers following brain stimulation compared to sham.

Second, our results also contribute to the debate regarding whether dual-system theories can explain altruistic behavior (Dreber, Fudenberg, Levine, & Rand, 2016; Loewenstein & O'Donoghue, 2007; Moore & Loewenstein, 2004; Rand et al., 2014; Schulz, Fischbacher, Thöni, & Utikal, 2014). In other words, whether self interest is a spontaneous response, and people need to deploy self-control to behave altruistically; or alternatively, whether prosociality is the intuitive response and self-control is required in order to behave on behalf of one's self interest. In the punishment domain, our results cannot contribute to this debate, as the decrease in costly punishment observed following stimulation of the R dlPFC and mPFC can be interpreted both as an increase in economic selfishness (Knoch et al., 2006) and an increase in generosity (Christov-Moore et al., 2017). On the other hand, the decrease in costly rewards following stimulation of the R dlPFC and mPFC can only be attributed to an increase in economic selfishness in the absence of cognitive control. Hence, in the reward domain our findings are more in line with economic selfishness being an intuitive response.

Third, by being able to establish a direct qualitative comparison between rewards and punishments in reciprocal fairness, we show important evidence of dissimilarities between these two domains. In the absence of brain stimulation, our findings suggest that personal involvement may weigh in differently for punishment and reward, while costs seem to have similar roles in both dimensions, decreasing the frequency of punishment and reward. Furthermore, stimulation of the R dlPFC and mPFC have a different effect on punishment and reward domains. Although reward in second and third-party interactions has received considerably less attention than punishment, a few studies on this participant have already started to show asymmetries between reciprocating a positive versus a negative behavior (Keysar, Converse, Wang, & Epley, 2008; Offerman, 2002). Future studies will benefit from approaches that enable qualitative and quantitative direct comparisons of behavioral and neural mechanisms in these two domains, revealing the extent of dissimilarities between them.

Lastly, our results indicate that stimulation of the R dlPFC and mPFC lead to a similar

pattern of behavior in the punishment domain. The same is observed in the reward domain, although to a lesser extent. A possible explanation for the similar effect following disruption of the R dlPFC and mPFC is that stimulation of one region may have affected the functioning of the whole network involved. We note that although the two investigated regions are sufficiently distant from each other so that TMS effects should be specific and the coil used is known for its good balance between depth and focality (Deng et al., 2013), brain stimulation is not necessarily focal and we cannot rule out network effects. Moreover, the connectivity between the R dlPFC and the posterior mPFC has already been demonstrated to be responsible for normative decisions in second-party interactions (Baumgartner, Knoch, Hotz, Eisenegger, & Fehr, 2011). Although in our study we target the anterior mPFC, evidence of coupling between this region and the right dlPFC has also been reported (Corradi-Dell'Acqua et al., 2013). Future studies should focus on unraveling the functional specificities of these two regions and how they are connected in reciprocal fairness. Reciprocal fairness is a complex behavior that is likely not restricted to a single area of the frontal cortex (Ruff et al., 2013). The combination of fMRI and TMS techniques may be of great value to this endeavor.

6

General Discussion

The objective of this dissertation was to investigate the impact of inequality (of outcome and opportunity) and unfairness on interpersonal decision-making. Despite the fact that research on inequality has been on the rise, it is still not well known how situations of inequality and unfairness influence the decisions we make when interacting directly or indirectly with others. This investigation is important because our social interactions have the potential to intensify or lessen inequality in our surroundings. To achieve this dissertation's aim, an interdisciplinary and multi-method approach was used throughout the four empirical chapters (chapters 2-5) presented here. In this chapter, I provide an overview of the findings presented in the empirical chapters, discuss their contributions and suggest directions that can be fruitful for future research.

6.1 Overview of the findings in this dissertation

Chapter 2 provided an initial understanding of how individuals react to different sources of inequality in opportunity. Although previous research has shown that individuals have different preferences for redistributing outcomes depending on the source originating unequal outcomes, it was not yet known if individuals also differentiated between varied sources of unequal opportunities. Chapter 2 addressed this research gap. In an online survey, respondents assessed different factors generating unequal opportunities in their fairness and control. Results revealed that, just like for inequality of outcomes, the fairness of inequality of opportunity also depends on its source. This means that not all situations of inequality in opportunities are the same. Inequality in opportunity due to merit (e.g., knowledge, effort, benevolence) is considerably fairer than inequality in opportunity due to biological and socioeconomic factors (e.g., height, gender, parental income). In addition, an asymmetry in fairness ratings was found, such that for some factors, fairness depends on who is being advantaged by higher opportunities. For example, inequality in opportunity due to parental income is fairer when the individual with lower parental income receives higher chances than the other individual. This finding reveals that individuals' responses to inequality in opportunity resembles the rationale behind Affirmative action. That is, individuals recognize that favoring those who are generally disadvantaged in society is fairer than favoring those who are already in an advantageous position. Lastly, results provide evidence of a positive correlation between fairness and individual control, such that factors considered fairer also rank higher in individual control. This is generally consistent with the principle of individual responsibility (Roemer, 1998), typically observed when individuals are exposed to inequality in outcomes. Thus, this result points to some similarities in how inequality in chances and outcomes are interpreted. Nevertheless, when unequal opportunities are distributed based on luck, such a relationship is not present. Surprisingly, luck is considered to be fair even though it does not allow individuals to have control over the chances received. This result is especially interesting considering that previous research has

revealed that unequal outcomes due to luck are often not regarded as fair. As pointed out in chapter 2, this unexpected result may be due to the fact that individuals' fairness preferences are time-dependent, that is, what is fair *ex ante* (i.e., before chances lead to outcomes) is not necessarily fair *ex post* (i.e., after outcomes are known).

Altogether, these findings are helpful in understanding how uninvolved individuals perceive different causes behind unequal opportunities. Nevertheless, chapter 2 does not directly investigate whether these differences in perceptions of fairness and control across different sources of inequality actually reflect on redistributive behavior. For example, in situations in which opportunities are thought to be unfairly allocated between people, are individuals more in favor of redistribution? **Chapter 3** investigated this question focusing specifically on *ex ante* redistribution of outcomes. In other words, this chapter assessed whether individuals planned to redistribute outcomes to compensate for unequal opportunities before these opportunities actually translated into different outcomes. In addition, I investigated how unequal opportunities affected the redistribution behavior of involved (i.e., stakeholders) and non-involved participants (i.e., spectators). Results of chapter 3 showed that the distribution of opportunities influenced how stakeholders thought of outcome redistribution. Stakeholders with higher chances to win the monetary prize were less prone to redistribution, an effect that was mediated by subjective entitlements. That is, stakeholders with higher chances to win the monetary prize felt overall a higher entitlement to the prize than stakeholders with low chances, which in turn affected how much they proposed to redistribute.

Regarding the different sources of inequality in opportunity, results of chapter 3 replicated the findings of chapter 2. Both involved and non-involved individuals recognized differences between varied sources of inequality of opportunity regarding their fairness and how much individual control over the circumstances they enabled. In line with chapter 2, inequality of opportunity based on merit was perceived as both fair and under one's control, while the opposite was found when inequality of opportunity was based on a biological factor (e.g., height). Interestingly, the same pattern found in chapter 2 emerged in chapter 3 for inequality of opportunity based on luck, which was considered fair despite the little control it enabled people to have over the opportunities received. Nevertheless, evaluations of fairness and control did not exactly translate into redistribution concerns. For stakeholders with higher chances, differences in proposed redistribution of outcomes were only observed between inequality in opportunities due to merit and height, such that redistribution was significantly lower in the merit condition. For stakeholders with lower chances, no differences were observed between the varied sources of inequality in opportunity. While one could argue that this pattern of results was a consequence of self-serving bias, such that across different sources of inequality stakeholders tried to maximize their own payoff, results from spectators also revealed a disregard for the source of unequal opportunities. Hence, this may suggest that both involved and non-involved individuals

do not perceive ex ante redistribution of outcomes as a legitimate compensation for unequal opportunities (Krawczyk, 2010). In line with previous literature (Akbaş et al., 2019; Cappelen et al., 2013a), results suggest that different sources of inequality may play a bigger role in redistributive behavior ex post (i.e., after chances realize into different outcomes). Alternatively, it could be that individuals consider that unequal opportunities should be compensated in a different way. For example, by redistributing opportunities rather than outcomes.

Chapter 4 shifts the focus of the investigation in this dissertation to the domain of consumer behavior. It aimed to research how perceptions of economic mobility and inequality influence low-income consumers. Across four studies, evidence was presented for the fact that the more low-income individuals perceive economic mobility to be high, the more prone they are to engage in status consumption. Studies 1a and 1b provided evidence that while perceptions of economic mobility affect individuals' willingness to consume status goods, perceptions of high or low inequality have no effect on this specific compensatory consumption behavior. Study 2 showed that the effect of perceptions of high upward economic mobility on status consumption is only present when income cannot be directly observable. That is, in these circumstances, low-income individuals use status consumption to signal to others their socioeconomic status. Lastly, study 3 provides evidence for the mechanism underlying the effect of perceptions of economic mobility on status consumption. Perceiving a society as mobile enhances the perceived legitimacy of inequality. In other words, individuals start to recognize differences in outcomes between people as legitimate and fair indications of their efforts, merits and hard work. This contributes to the acceptance of inequality and to the recognition of status goods as a credible signal of one's socioeconomic status. As a consequence, low-income individuals become more prone to use status goods to signal their achievements and status to others.

Overall, these results suggest that rather than perceptions of inequality, it is the legitimization of inequality granted by high economic mobility that influences individuals' intentions to consume status goods. Importantly, these results contradict previous literature showing a correlation between income inequality and overall status consumption (Walasek et al., 2018; Walasek & Brown, 2015). In trying to reconcile the findings of chapter 4 with previous research, it is important to notice that the focus here was on the consumption behavior of the poorest, while previous studies have focused on aggregate levels of interest for status goods (across the income spectrum). Thus, one potential explanation is that perceptions of inequality and economic mobility influence people at different ends of the income spectrum in diverse ways. Moreover, while previous research has been correlational, focusing on overall levels of inequality in society, the research presented in chapter 4 puts forward causal evidence for the role of perceptions of mobility and inequality on consumer behavior.

Finally, **chapter 5** investigated the roles of the right dlPFC and mPFC on reactions to

(in)equality and unfairness and tested different psychological motivations that have been put forward in the neuroeconomics literature to explain the involvement of different regions of the prefrontal cortex in reciprocating unfairness. Using TMS to inhibit the activity of either the right dlPFC or mPFC, I explored the role of these brain regions on reciprocating fairness and unfairness in different conditions (i.e., with and without monetary incentives at stake and when we are ourselves the target of unfairness or not). Inhibition of the right dlPFC and mPFC leads to a decrease in punishment of unfair offers in all conditions except when there were no monetary stakes and the decision-maker was not the target of unfairness. Regarding the reciprocation of fair offers, inhibition of these regions of the brain led to a decrease in reward when the decision had monetary stakes. When reciprocating fairness was not costly, however, inhibition of these regions resulted in a sharp increase of reward.

Altogether, results of chapter 5 indicate that the right dlPFC and mPFC play different roles in reciprocating fairness and unfairness. When reacting to unfairness, these regions seem to be involved in processing self-centeredness, which can have both a monetary and a self-involvement component. That is, whenever there is a factor relevant to the self - being it having costs to punish or being the target of unfairness, these regions are important to enforce punishment. When reciprocating a fair offer, however, the monetary component seems to have a more important role in driving the psychological motive underlying the behavior. When costs to reward are present, these brain regions seem to be important to override economic selfishness and enforce reciprocation of fairness. On the other hand, when costs to reward are absent, results seem to be consistent with the idea that these brain regions would be important to make behavior consistent with one's social norms of fairness. In this case, equal offers, which were deemed as the most socially appropriate should be the most rewarded. In the absence of a working right dlPFC and mPFC, reciprocity seems to drive behavior, such that the more fair an offer is, the more it is rewarded. Hence, while these prefrontal regions are broadly involved in overriding self-centered processing to facilitate the punishment of unfairness, these same brain regions are crucial to inhibit both selfishness and reciprocity motivations when deciding how to reward fairness.

6.2 Practical relevance

The results presented in this dissertation do not only contribute to further the literature on distributive and social justice, but also offer some practical implications to policy-makers and managers. While these implications have already been highlighted in each individual empirical chapter, in this section I integrate the overall practical implications of this dissertation.

6.2.1 Public policy implications

The investigation of how individuals perceive and react to inequality can bring important insights to policy-makers. Understanding individuals' views on inequality of outcomes and opportunities can help shape policies aimed at reducing inequality which are in consonance with the population's needs and expectations. In specific, results of chapter 2 imply the existence of time-inconsistencies between fairness preferences before and after unequal opportunities lead to unequal outcomes. To minimize such inconsistencies, policies focusing on rectifying inequality in opportunity should make the potential inequalities in outcomes resulting from this policy explicit to the lay public. This practice may help individuals to anticipate what could be the consequences of such policies and think of their fairness both from an *ex ante* and *ex post* perspective.

In addition, findings of chapter 3 indicate that sources of inequality of outcomes and opportunities may weigh in differently in redistributive decisions. This could suggest that when putting forward policies aimed at addressing unequal outcomes, policy-makers could try to make explicit what are the causes behind such inequality. By pointing out the unfairness of the source of inequality in outcomes, public support for redistributive policies may increase. On the other hand, results of chapter 3 put in question whether the same approach would prove useful when proposing policies aimed at reducing inequality of opportunity. Further studies are needed to clarify how individuals envision rectification of unequal opportunities and what is the role of source of inequality in this process. Results ensuing from this future investigation could be insightful for policy-makers in addressing inequality in opportunity.

Results of chapter 4 showcase how one's perception of society can have consequences on consumer behavior. Given that individuals in some societies might be quick in buying into the idea of a fair economic system where anyone can achieve higher socioeconomic status with hard work, it may be important to make information available regarding what is the actual mobility rate of a specific society. Accompanying this, understanding individuals' motivations to spend can be useful to foster policies that help especially poor consumers to develop financial literacy to manage their finances and avoid debt in spite of pressing needs to consume more and display status.

6.2.2 Managerial implications

Results of chapter 2 and chapter 3 reveal that individuals are sensitive to the source of inequality in opportunity, changing their perceptions of how (un)fair inequality is, depending on its causes. Although results of chapter 3 show that fairness perceptions due to the source of inequality do not necessarily translate into redistribution behavior, it is possible that other behaviors are affected. For example, in the context of

companies and institutions, the source of unequal chances can have an impact on labor supply (Gagnon, Bosmans, & Riedl, 2020). Recognizing unequal opportunities to achieve job promotions and bonus payments as unfair could further impact worker's motivation, performance and psychological well-being. Moreover, in situations in which opportunities may be indivisible, it is important to make sure distribution of opportunities is based on factors considered to be fair and that enable control, as to minimize as much as possible the negative downstream consequences of inequality in opportunity in the work environment.

Findings of chapter 5 can also be of use for managers. According to the results, overcoming self-interest is important in reciprocating fairness when reciprocation involves costs to the self, while social norms of fairness guide this behavior in the absence of costs. Understanding the psychological motivations behind reciprocation of fairness can guide managers in trying to foster cooperation and reciprocity among co-workers. Results of chapter 5 would suggest that situations in which there is a conflict between self-interest and reciprocity of generous behaviors should be avoided. This could be done by implementing external incentives to behave generously in the workplace which also advance one's self interest. Moreover, fairness norms can be implemented and encouraged in the workplace, making it easier for individuals to recognize what is the expected behavior and to abide by the norms.

The examination of consumer behavior in chapter 4 can be of relevance for marketers. Results suggest that in societies where beliefs on upward economic mobility are prevalent, individuals' need to display status may be high. In these situations, marketers should try to position their brands as status enhancing. In doing so, it would also be advisable to make brand's names and logos stand out in products, facilitating in this way the need consumers have to display to others the status granted by the brand. Results of chapter 4 are also useful for marketers targeting low-income sectors of the population. Research on consumer behavior has already shown that individuals at the bottom of the income pyramid are not only motivated to fulfill survival needs - as previously thought, but also attend to higher order needs, such as displaying status and gaining social recognition (Subrahmanyam & Gomez-Arias, 2008). In this sense, brands targeting this market sector could try to appeal to status needs. It is important to notice, however, that corporations also ought to act in a socially responsible manner, keeping in mind the welfare of consumers. Encouraging low-income individuals to engage in consumption of status goods can have quite impactful financial consequences to these already financially-restrained consumers. Taking this into consideration, other alternatives which appeal to status needs without endangering consumers' financial well-being should be explored. A possibility is for example to invest in loyalty programs, which capitalize on social comparisons without necessarily stimulating over-consumption.

6.3 Future research

The research presented in this dissertation provides several avenues for future research. First, chapter 2 and chapter 3 point to potential differences in how fairness considerations may be shaped *ex ante* and *ex post*, suggesting that an interesting future line of work lies on the direct comparison between individuals' fairness and redistributive preferences *ex ante* and *ex post*. Although there is already some work in this direction (Andreoni et al., 2016), many questions are still unanswered. Future research could attempt to directly compare whether sources of inequality of opportunity and outcome affect individuals' fairness concerns in different ways. Moreover, it would be interesting to examine whether these concerns reflect differently in *ex ante* and *ex post* redistribution. Unravelling which factors weigh in *ex ante* and *ex post* can greatly contribute to the better understanding of how *ex ante* and *ex post* inequality should be addressed and rectified. In addition, following the insights generated in chapter 3, future research could attempt to unravel what individuals deem as an appropriate compensation for inequality in opportunities. It is possible that individuals perceive redistribution of opportunities (and not outcomes) as the appropriate compensation for inequality in opportunity. If this is the case, it would also be interesting to understand whether redistribution of opportunity is affected by the source of inequality in opportunity. These clarifications can have a positive impact in the making of policies that reflect individuals' beliefs about fairness and redistribution.

Second, it is important to notice that although the distinctions made by experimental research between different sources of inequality help advance our understanding of individuals' fairness views, they are ultimately artificial. In real life, it is more likely that a combination of different factors contribute to the generation of inequality of outcomes and opportunities. Moreover, in many situations the reasons behind inequality may not be directly known or recognizable by individuals. For these reasons, it would be interesting to investigate in future public opinion surveys or field studies what are the causes that individuals attribute to inequality and how these perceptions affect redistribution concerns. Shifting misguided beliefs about the causes of inequality can be an important approach in increasing popular support for redistributive policies (Piff et al., 2020).

Third, future research should further explore the effects of perceptions of economic mobility on behavior. Although such perceptions are quite pervasive in many societies, the investigation of the impact of beliefs in economic mobility on behavior is rather recent. Hence, there is a wide array of behaviors that could be investigated in its relationship to economic mobility. Ensuing from the findings of chapter 4, it would be interesting to examine how economic mobility affects competitive behavior in society. Related, because economic mobility prompts individuals to think that socioeconomic status is a result of one's hard work, it would be interesting to establish whether perceptions of economic mobility influence one's choices of labor supply. Previous

research has demonstrated that higher levels of inequality are associated with higher working hours (Bell & Freeman, 2001). Nevertheless, just like demonstrated in chapter 4, it may well be that this effect is better explained by the effect of perceptions of economic mobility on the legitimization of economic differences and on one's hope for future economic success. Additionally, it would be important to examine whether the effects described in chapter 4 extend to other socioeconomic classes. Differences in how wealthy and poor individuals display status have been previously reported (Han, Nunes, & Drèze, 2010), such that one could expect that perceptions of high economic mobility have different effects across the income spectrum. Furthermore, while most research has focused on the role of perceptions of upward mobility, understanding how fear of downward mobility influences behavior is also crucial, given that in a mobile society, movement across economic stations is possible in both directions. Fear of downward mobility could be especially prevalent in those occupying higher layers of the economic pyramid.

Fourth, research on the neural mechanisms of reciprocal fairness would benefit from taking an approach that enables a direct comparison between reciprocating fairness and unfairness. Although punishing unfairness and rewarding fairness are generally considered two sides of the same coin, previous behavioral research has shown asymmetries in how individuals make decisions to reciprocate positive and negative actions against themselves (Keysar et al., 2008; Offerman, 2002). Results presented in chapter 5 advance this line of research by showing that the prefrontal cortex is important in supporting different psychological motivations to punish unfairness and reward fairness. Future studies should further the investigation of the behavioral and neural similarities and differences between reciprocating fairness and unfairness. Furthermore, results of chapter 5 indicated that inhibiting the right dlPFC led to the same behavioral patterns of inhibiting the mPFC when dealing with fairness and unfairness. As discussed in chapter 5, this might indicate that these regions indeed play similar roles in reciprocal fairness. Alternatively, results could be explained by functional connectivity between these two regions, such that inhibiting one also impairs the functionality of the other. Future studies possibly combining TMS with other imaging techniques such as functional magnetic resonance would be important in clarifying how these two regions interact when dealing with fairness and unfairness.

6.4 Concluding remarks

This dissertation aimed to investigate individuals' social and consumer decision making in contexts of inequality (of outcomes and opportunities). Altogether, results suggest inequality impact the way we reason about and react to (un)fairness. In turn, some of our behavior might have important consequences in intensifying inequality and poverty. For example, through lack of support for redistribution, via retaliation of unfairness and through sub-optimal consumption patterns. Despite its limitations,

it is my hope that this work inspires future research to explore the impact of inequality on interpersonal decision-making through interdisciplinary lenses and encourages individuals to be conscientious about how inequality might impact their interactions with others in society.

Appendix A: Supplementary Material

Chapter 2

1 Instructions

1.1 Questions Fairness—Regular Block

Consider a situation in which lottery tickets are distributed between two persons. Generally we ask you to assume that these two persons have a similar social, economic and educational background. In some cases this will not be so and you will be explicitly informed about it. Each ticket gives a 10% chance to win the lottery. There can be only one winner in the lottery, who receives 10 EUR as a prize. The ticket allocation is as follows: one person gets 9 tickets and thus has a 90% chance of winning the lottery prize, whereas the other person gets 1 ticket and thus has a 10% chance of winning the lottery prize. The allocation of tickets is based on various procedures. We would like to know how fair or unfair you consider each of the following procedures to be. Please also note that you cannot win the lottery prize in question.

How fair/unfair would you consider the distribution of chances to win the lottery prize based on the following procedure:

Note: the titles of each question—displayed in Italics below—were not shown to participants.

-Knowledge: Chances are allocated based on the results in a general knowledge quiz. The person with the higher results receives a 90% chance to win, and the person with the lower results receives a 10% chance to win.

-Effort: Chances are allocated based on the results of a task that depends on effort. In the task, people see dots appearing randomly on horizontal bars on their computer screen. Their task is to position as many dots as possible in the middle of the horizontal bars. The person who places more dots in the correct position in a given time receives a 90% chance to win, and the person who places less dots in the correct position receives a 10% chance to win.

-Luck: Chances are allocated by throwing a 6-faced die. If the die number is smaller than or equal to 3, one person receives a 90% chance to win, and the other person receives a 10% chance to win. If the die number is greater than 3, the chances are reversed.

-Height: Chances are allocated based on height. The taller person receives a 90% chance to win, and the shorter person receives a 10% chance to win.

-Weight: Chances are allocated based on weight. The heavier person receives a 90% chance to win, and the lighter person receives a 10% chance to win.

-Gender: Chances are allocated based on gender. The two persons have different genders. The man receives a 90% chance to win, and the woman receives a 10% chance to win.

-ID: Chances are allocated based on student ID number. The person with the higher student ID number receives a 90% chance to win, and the person with the lower student ID number receives a 10% chance to win.

-Nationality: Chances between students at the School of Business and Economics of Maastricht University are allocated based on one's country of origin. The German student receives a 90% chance to win, whereas the non-German student receives a 10% chance to win.

-Ethnicity: Chances are allocated based on one's skin color. The two persons have different skin colors. The person with the lighter skin color receives a 90% chance to win, whereas the person with the darker skin color receives a 10% chance to win.

-Benevolence: Chances are allocated based on one's decision to help. The two persons both had an opportunity to help someone in need and only one decided to help. The person who helped receives a 90% chance to win, whereas the person who did not help receives a 10% chance to win.

-Family Income: Chances are allocated based on one's parental income. The person whose parents have a higher income receives a 90% chance to win, whereas the person whose parents have a lower income receives a 10% chance to win.

1.2 Questions Individual Control—Regular Block

Consider the same situation in which lottery tickets are distributed between two persons. Generally we ask you to assume that these two persons have a similar social, economic and educational background. In some cases this will not be so and you will be explicitly informed about it. The allocation of tickets is based on various procedures. Now we would like to know how much control you consider people have over the distribution of chances for each of the following procedures. Again, there are no right or wrong answers. We are solely interested in your preferences and opinions. It is important for our research that you answer all questions honestly.

How much control do you think people have over the chances they receive to win the lottery prize, when the distribution of chances is based on the following procedure.

Note: Procedures were described in the same manner as in the Fairness questions.

2 Additional Information Concerning the Reverse Block

Although we did not present Luck as a procedure in the Reverse Block, we present fairness and control ratings for Luck (obtained in the Regular Block) in the following tables for comparison purposes.

Table A1: Mean Fairness and Wilcoxon Signed-Rank Test Comparisons—Reverse Block

Procedure	Luck	Family Inc.	Effort	ID	Know.	Benev.	Nat.	Height	Ethn.	Weight	Gender
Luck	4.63 (1.77)										
Family Income (Inc.)	***	2.74 (1.79)									
Effort	***		2.52 (1.65)								
ID	***			2.33 (1.66)							
Knowledge (Know.)	***				2.17 (1.39)						
Benevolence (Benev.)	***		**			1.93 (1.44)					
Nationality (Nat.)	***	***	**	*	+		1.66 (1.21)				
Height	***	***	***	**	**			1.50 (.92)			
Ethnicity (Ethn.)	***	***	***	**	**				1.44 (.98)		
Weight	***	***	***	***	***					1.35 (.62)	
Gender	***	***	***	***	***	*					1.32 (.83)

Note: Standard deviations are indicated in parentheses. Stars in a cell indicate that the procedure in the column is fairer than the procedure in the corresponding row. Holm-Bonferroni-corrected p -values: + $p < .10$ * $p < .05$; ** $p < .01$; *** $p < .001$.

Table A2: Mean Control and Wilcoxon Signed-Rank Test Comparisons—Reverse Block

Procedure	Benev.	Effort	Know.	Weight	Luck	ID	Inc.	Height	Gender	Ethn.	Nat.
Benevolence (Benev.)	5.61 (1.85)										
Effort	***	4.90 (1.70)									
Knowledge (Know.)	***		4.63 (1.70)								
Weight	***	***	***	2.78 (1.66)							
Luck	***	***	***	***	1.55 (1.00)						
ID	***	***	***	***		1.46 (.88)					
Family Income (Inc.)	***	***	***	***			1.32 (.68)				
Height	***	***	***	***				1.29 (.76)			
Gender	***	***	***	***	+				1.23 (.73)		
Ethnicity (Ethn.)	***	***	***	***						1.23 (.65)	
Nationality (Nat.)	***	***	***	***	**	*					1.20 (.74)

Note: Standard deviations are indicated in parentheses. Stars in a cell indicate that the procedure in the column is under more control than the procedure in the corresponding row. Holm-Bonferroni-corrected p -values: + $p < .10$ * $p < .05$; ** $p < .01$; *** $p < .001$.

Appendix B: Supplementary Material

Chapter 3

1 Support Statistical Information

1.1 Stakeholders

The table below shows the Tobit regression examining the effect of stakeholders' winning chances on redistribution controlling for gender, age, discretionary income and risk preferences.

Table B1: Tobit Regression - Stakeholders' allocation to the loser pooled across procedures controlling for gender, age, income and risk preferences

Independent variables	Model 1		Model 2	
	Coefficient		Coefficient	
	(Std. err.)	Z value	(Std. err.)	Z value
Intercept	-1.9 (2.03)	-0.9	0.98 (2.0)	0.49
High Chances	-0.61+ (0.37)	-1.6	-0.32 (0.35)	-0.9
Female	1.1** (0.39)	2.9	1.03** (0.36)	2.8
Age	0.02 (0.08)	0.3	0.006 (0.08)	0.08
Discretionary Income	0.07 (0.1)	0.77	0.09 (0.09)	0.97
Risk	-0.05 (0.05)	-0.8	-0.04 (0.05)	-0.69
Entitlement			-0.39*** (0.09)	-4.5
Log-L:	-385.43		-370.88	
N:	232		232	

Standard errors in parentheses.

***.001; **.01; *.05, + .1

The tables below show the results of the mediation analyses for the following variables: subjective entitlement, deservingness of chances, deservingness of outcomes and expectations about other participant's behavior. In all analysis, the independent variable is a dummy variable for winning chances, where low winning chances is coded as 0 and high winning chances is coded as 1. The dependent variable is the amount of the lottery prize allocated to the loser stakeholder. The average causal mediation effect (ACME) represents the estimated average increase (or decrease) in the dependent variable as a result of the mediator. The average direct effect (ADE) is the effect of winning chances on ex ante redistributive behavior controlling for the mediator and the total effect is the total direct and indirect effect of winning chances on ex ante redistribution behavior.

Table B2 shows that subjective entitlement significantly mediates the effect of winning chances on ex ante redistributive behavior. Of the estimated -0.46 decrease in redistribution due to high winning chances, an estimated -0.2 is a result of the effect of subjective entitlements originated from high winning chances on redistribution.

Table B2: Testing the mediation effect of subjective entitlement on ex ante redistributive behavior.

	Estimate	[CI]
ACME	-0.2***	[-0.37, -0.06]
ADE	-0.26	[-0.7, 0.14]
Total effect	-0.46*	[-0.89, -0.05]
N:	232	
***.001; **.01; *.05, + .1		

Table B3 shows that deservingness of chances does not significantly mediate the effect of winning chances on ex ante redistributive behavior, as the indirect effect of winning chances on redistributive behavior via deservingness of chances (see ACME) is not significant.

Table B3: Testing the mediation effect of deservingness of chances on ex ante redistributive behavior.

	Estimate	[CI]
ACME	-0.01	[-0.19, 0.17]
ADE	-0.43+	[-0.89, 0.05]
Total effect	-0.44*	[-0.84, -0.03]
N:	232	
***.001; **.01; *.05, + .1		

In Table B4, we can see that deservingness of outcomes mediates the effect of winning chances on ex ante redistributive behavior at a 10% significance level. This means that of the -0.44 estimated decrease in redistribution due to high winning chances, an estimated -0.08 is a result of the effect of deservingness of outcomes - due to high winning chances - on redistributive behavior.

Table B4: Testing the mediation effect of deservingness of outcomes on ex ante redistributive behavior.

	Estimate	[CI]
ACME	-0.08+	[-0.2, 0.01]
ADE	-0.36+	[-0.78, 0.07]
Total effect	-0.44+	[-0.86, 0.02]
N:	232	
***.001; **.01; *.05, + .1		

Finally, Table B5 shows that expectations of others' redistributive behavior does not mediate the effect of high winning chances on ex ante redistributive behavior.

Table B5: Testing the mediation effect of expectations of others' redistributive behavior on ex ante redistributive behavior.

	Estimate	[CI]
ACME	0.05	[-0.21, 0.33]
ADE	-0.5**	[-0.83, -0.18]
Total effect	-0.44*	[-0.86, -0.01]
N:	232	
***.001; **.01; *.05, + .1		

The tables below display the tobit regressions separated by stakeholders with high and low winning chances and controlling for age, gender, risk preferences and discretionary income.

Table B6: Tobit Regression - Allocations to the loser by stakeholders with high winning chances - (with control variables)

	Model 1		Model 2		Model 3	
Independent variables	Coefficient (Std. err.)	Z value	Coefficient (Std. err.)	Z value	Coefficient (Std. err.)	Z value
Intercept	-3.4 (2.7)	-1.3	-0.42 (2.78)	-0.15	-0.48 (2.88)	-0.17
Luck	-0.89 (0.68)	-1.3	-0.8 (0.65)	-1.24	-0.74 (2.1)	-0.35
Merit	-1.64* (0.7)	-2.34	-1.2+ (0.69)	-1.7	-0.93 (2.72)	0.34
Entitlement			-0.38** (0.14)	-2.69	-0.37+ (0.21)	-1.8
Luck * Entitlement					-0.008 (0.31)	-0.026
Merit * Entitlement					-0.04 (0.37)	-0.1
Risk	-0.23 (0.17)	-1.3	-0.3+ (0.17)	-1.8	-0.29+ (0.17)	-1.7
Female	1.76** (0.6)	2.9	1.47* (0.58)	2.5	1.46* (0.6)	2.4
Age	0.06 (0.1)	0.56	0.05 (0.1)	0.5	0.05 (0.1)	0.5
Discretionary Income	0.05 (0.16)	0.3	0.07 (0.15)	0.48	0.07 (0.15)	0.47
Log-L:	-171.05		-167.4		-167.4	
N:	116		116		116	

Standard errors in parentheses.

***.001; **.01; *.05, +.1

Table B7: Tobit Regression - Allocations to the loser by stakeholders with low winning chances - (with control variables)

Independent variables	Model 1		Model 2		Model 3	
	Coefficient (Std. err.)	Z value	Coefficient (Std. err.)	Z value	Coefficient (Std. err.)	Z value
Intercept	0.89 (3.14)	0.28	4.0 (3.06)	1.3	1.4 (3.22)	0.4
Luck	-0.28 (0.59)	-0.47	-0.4 (0.55)	-0.7	3.56* (1.8)	1.99
Merit	-0.11 (0.61)	-0.18	-0.37 (0.58)	-0.6	2.28 (1.66)	1.4
Entitlement			-0.4*** (0.11)	-3.6	-0.04 (0.19)	0.2
Luck * Entitlement					-0.65* (0.28)	2.29
Merit * Entitlement					-0.43 (0.26)	-1.6
Risk	-0.01 (0.06)	-0.2	0.002 (0.06)	0.05	0.004 (0.06)	0.08
Female	0.9 (0.55)	1.6	0.96+ (0.52)	1.8	1.12* (0.52)	2.15
Age	-0.08 (0.13)	-0.6	-0.11 (0.13)	-0.9	-0.12 (0.12)	-0.9
Discretionary Income	0.08 (0.12)	0.7	0.07 (0.11)	0.66	0.1 (0.11)	0.9
Log-L:	-205.38		-199.06		-196.2	
N:	116		116		116	

Standard errors in parentheses.

***.001; **.01; *.05, +.1

Since beliefs about one's own performance as well as beliefs about other participants' performance in the general knowledge quiz could affect allocation decisions in the merit condition, an additional Tobit regression was run only for the merit condition. Chances (low versus high) and the difference in beliefs between one's own performance and the performance of others in the general knowledge quiz ("Diff-quiz-beliefs"), as well as the interaction between this variable and winning chances were included as independent variables. The dependent variable was ex ante redistribution in the merit condition. Table B8 show beliefs about performance in the general knowledge quiz did not significantly influence how stakeholders (both with low and high winning chances) decided to allocate the lottery prize between themselves and the stakeholder they were matched with in the merit condition.

Table B8: Tobit Regression: Influence of beliefs about quiz performance on stakeholders' redistributive behavior in the Merit condition

Independent variables	Coefficient (Std. err.)	Z value
Intercept	0.26 (0.69)	0.38
High Chances	-1.37 (0.92)	-1.48
Diff-quiz-beliefs	-0.34 (0.26)	-1.3
High Chances * Diff-quiz-beliefs	0.21 (0.4)	0.53
Log-L:	-387.06	
N:	66	

Standard deviations are in parentheses.

1.2 Spectators

Table B9 shows the Tobit regression examining the effect of winners' chances on spectators' redistribution controlling for gender, age, discretionary income and risk preferences.

Table B9: Tobit Regression - Spectators' allocation to the loser individual pooled across procedures controlling for gender, age, income and risk preferences

Independent variables	Model 1		Model 2	
	Coefficient (Std. err.)	t value	Coefficient (Std. err.)	t value
Intercept	5.75+ (3.09)	1.86	5.64+ (3.34)	1.7
Winner Chances: High	-0.03 (0.33)	-0.1	-0.03 (0.33)	-0.1
Order			0.13 (0.62)	0.21
Female	-0.8 (0.58)	-0.13	-0.09 (0.59)	-0.15
Age	-0.12 (0.15)	-0.78	-0.12 (0.15)	-0.79
Discretionary Income	0.03 (0.14)	0.2	0.03 (0.15)	0.2
Risk	-0.04 (0.27)	-0.14	-0.04 (0.28)	-0.13
Log-L:	-437.8		-437.77	
N:	198		198	

Standard errors in parentheses.

***.001; **.01; *.05

Table B10 below shows the Tobit regression examining the effect of procedures on spectators' redistribution controlling for gender, age, discretionary income and risk preferences. Model 1 refers to the situation when the winner had high chances, while model 2 refers to when the winner had low chances to win the monetary prize.

Table B10: Tobit Regression - Spectators' allocation to the loser when the winner had high and low chances (with control variables)

Winner's chances Independent variables	Model 1 High Chances		Model 2 Low Chances	
	Coefficient (Std. err.)	t value	Coefficient (Std. err.)	t value
Intercept	9.01** (3.5)	2.6	2.18 (3.74)	0.58
Luck	-0.54 (0.73)	-0.75	-1.21 (0.79)	-1.52
Merit	-0.67 (0.72)	-0.94	-0.24 (0.78)	-0.3
Order	-0.41 (0.6)	-0.68	1.03 (0.65)	1.58
Female	0.07 (0.59)	0.12	-0.43 (0.64)	-0.67
Age	-0.23 (0.16)	-1.45	0.01 (0.17)	0.06
Discretionary Income	0.05 (0.14)	0.33	0.04 (0.166)	0.28
Risk	-0.16 (0.17)	-0.94	0.04 (0.18)	0.22
Log-L:	-220.28		-223.8	
N:	99		99	

Standard errors in parentheses.

***.001; **.01; *.05

2 General knowledge quiz - (Part 1 of the experiment)

Now, you and the other participants in the lab will be asked to answer questions of a **general knowledge quiz**. For each question, there is exactly **one correct answer** and several wrong answers. The questions concern several fields of knowledge. In total there are 16 questions. Each participant receives the **same questions** in the **same order**. You will answer the questions in the computer. To answer a question you will have at most **30 seconds**. Unanswered questions count as wrong answers.

You answer a question by choosing the answer you think is correct and subsequently pressing the "OK" button within 30 seconds. The next question then shows up automatically. **We ask you to correctly answer as many questions as possible!**¹

1. Who is the composer of the famous ballets Nutcracker and Swan Lake?

A) Rachmaninov **B) Tchaikovsky** C) Paganini D) Bach E) Mozart

2. Which of the following cities hosted the 2004 summer Olympic Games?

A) Berlin B) Barcelona C) Lisbon **D) Athens** E) Beijing

3. Which Italian author described his journey through the three realms of the dead?

A) Pasolini B) Eco C) Vespucci D) da Vinci **E) Dante**

¹Please note correct answers are in bold.

-
4. Which of the following countries does not have a border with Italy?
A) Switzerland **B) Croatia** C) Austria D) Slovenia E) France
5. Who is the author of the novel "Eugenie Grandet"?
A) Umberto Eco B) Marcel Proust C) Gustav Flaubert **D) Honore de Balzac** E) Andre Gide
6. Who was awarded the Nobel Peace Prize in 2007?
A) Bill Gates B) Silvio Berlusconi **C) Al Gore** D) Kofi Annan E) Bono
7. Which of the following is not classified as a bird?
A) Penguin B) Canary **C) Bat** D) Parrot E) Crow
8. The Canary Islands are part of which country?
A) Portugal **B) Spain** C) France D) Italy E) Greece
9. The Canary Islands are part of which country?
A) Portugal **B) Spain** C) France D) Italy E) Greece
10. Which of the following deserts is the largest one?
A) Sahara B) Taklamakan C) Gobi D) Colorado E) Sonoran
11. Which country's official currency is called dinar?
A) Saudi Arabia B) Kazakhstan C) Turkey **D) Kuwait** E) Indonesia
12. Which of the following painters has a famous painting named "Persistence of Memory"?
A) Monet **B) Dali** C) Chagal D) Picasso E) Van Gogh
13. What is the smallest country in Latin America?
A) Ecuador B) Guyana **C) El Salvador** D) Uruguay E) Honduras
14. Which of the following actors did not play in any part of the Godfather trilogy?
A) Robert DeNiro **B) Jack Nicholson** C) Al Pacino D) Marlon Brando E) Andy Garcia
15. Which of the following scientists has put forward the theory of relativity?
A) Sir Isaac Newton **B) Albert Einstein** C) Stephen Hawking D) Thomas Bayes E) Felix Hausdorff
16. In which city did the first Conference on Security and Co-operation in Europe take place?
A) Helsinki B) Oslo C) Vienna D) Paris E) New York

3 Instructions of part 2 of the experiment

3.1 Instructions - Stakeholders

General instructions - part 2

Please read the instructions carefully. In Part 2 of the experiment *you can earn additional money*. How much money you earn may depend on your decisions and on the decisions of one other participant you are matched with. The identity of the other participant will not be revealed to you, nor will the other participant get to know your identity.

Lottery tickets

In the following, 10 lottery tickets will be distributed between you and the other participant. Each ticket gives a **10% chance to win the lottery prize of 10 EUR**. That is, the more tickets you have, the greater are your chances to receive the lottery prize. Importantly, there can be only **one winner** of the prize. In other words, either you or the other participant will win the lottery prize of 10 EUR.

Distribution of lottery tickets

The distribution of the 10 lottery tickets between you and the other participant will be made based on (Height / Luck / Scores in the knowledge quiz).

Remember that in the beginning of this experiment we measured all participants' height (we asked all participants to toss 3 dice/we asked all participants to answer questions of a general knowledge quiz). We will now use this information to distribute the lottery tickets between you and the other participant such that: the **(taller participant / the participant who tossed the greater number / the participant with a high score of correct answers in the knowledge quiz)** will receive more tickets to play the lottery. The **(shorter participant / the participant who tossed the smaller number / the participant with a lower score of correct answers in the knowledge quiz)** will receive less tickets to play the lottery. On the next screen you will see how many lottery tickets you and the other participant receive.

Height: You are taller (shorter) than the other participant. Because of this you received 9 tickets (1 ticket) to play the lottery. The other participant received 1 ticket (9 tickets). That is, you have a 90% (10%) chance to receive the lottery prize whereas the other participant has a 10% (90%) chance to receive the lottery prize.

Luck: You tossed a greater (smaller) number than the other participant. Because of this you received 9 tickets (1 ticket) to play the lottery. The other participant received 1 ticket (9 tickets). That is, you have a 90% (10%) chance to receive the lottery prize whereas the other participant has a 10% (90%) chance to receive the lottery prize.

Merit: You had a higher (lower) score than the other participant. Because of this you received 9 tickets (1 ticket) to play the lottery. The other participant received 1 ticket (9 tickets). That is, you have a 90% (10%) chance to receive the lottery prize whereas the other participant has a 10% (90%) chance to receive the lottery prize.

Instructions to decision

Before the lottery is played out, we ask you to **imagine that you receive the lottery prize**. Please consider the following carefully as it will affect your and the other participants' earnings. In case you receive the lottery prize of 10 EUR, how would you distribute the lottery prize between you and the other participant? You can give the other participant as little or as much of the lottery prize as you want (from 0 EUR to 10 EUR in steps of 0.05 EUR). The other participant will answer the same question.

To determine your and the other participant's actual earnings the following procedure applies:

1. After you and the other participant have decided how to allocate the 10 EUR the lottery will be played out and it will determine who receives the lottery prize of 10 EUR.
2. In case you receive the prize of 10 EUR you and the other participant will be paid according to your allocation decision. In case the other participant receives the prize of 10 EUR you and the other participant will be paid according to the other participant's allocation decision.

Ex ante decision

If you receive the lottery prize, how are you allocating the lottery prize between you and the other participant?

The other participant receives:
I keep for myself:

Elicitation of expectations

Before the lottery is played out, we would like to ask you a number of questions. Please read and answer them carefully. With some you can earn additional money.

Suppose that you do not receive the lottery prize. How much of the 10 EUR do you think the other participant will allocate to you? Please think carefully and give your best guess. You can earn 1 EUR extra if your guess is correct.

Elicitation of deservingness

In the following, we ask you to answer a few questions concerning the decision you just made. There are no correct or incorrect answers and your answers will remain anonymous. Please indicate how strongly the statements below apply to you.

1. I deserved the number of lottery tickets I received.
2. Given the number of lottery tickets I received, I deserve to have a larger share of the lottery prize.

Measure of entitlement

Suppose you receive the lottery prize. In your opinion, what would be a **fair amount** to allocate to the other participant **from the "point of view" of a non-involved neutral person?**

Announcement of winner

To the winner: The lottery was run and **you received the lottery prize of 10 EUR**. Earlier,

you decided that if you would receive the lottery prize, you would allocate x EUR to the other participant. Do you want to revise your earlier decision? If yes, you will be given a chance to do so in the next screen.

To the loser: The lottery was run and **the other participant received the lottery prize of 10 EUR**. Earlier, you said that if you did not win, you would expect the winner to allocate you x EUR. Do you want to revise your earlier decision? If yes, you will be given a chance to do so in the next screen.

Revise choices

To the winner: You indicated that you want to revise your earlier decision. Earlier, you decided to allocate x EUR to the other person. How do you want to allocate the lottery prize of 10 EUR? Please note this is your final decision!

The other participants receives:
I keep for myself:

To the loser: You indicated that you want to revise your earlier decision. Earlier, you said that if you did not win, you would expect the winner to allocate you x EUR. How much of the 10 EUR do you think the other participant will allocate to you? Please think carefully and give your best guess. You can earn 1 EUR extra if your guess is correct. Please note this is your final decision!

Additional questions

Please answer the questions below carefully. The questions concern Part II of the experiment you just participated in. Please indicate how strongly you agree to the statements below:

- How fair was the procedure used to determine the chances of receiving the lottery prize?
- How much control do you think you had over the chances to receive the lottery prize?

Payment part 2

To the winner: Here you can see how much money you earned for this task. You decided to keep x EUR for yourself and to allocate x EUR to the other participant.

To the loser: Here you can see how much money you earned for this task. The winner has decided to keep x EUR and to allocate x EUR to you.

3.2 Instructions - Spectators

General Instructions - Part 2

Please read the instructions carefully. In Part 2 of the experiment *you can earn additional money*. At the end of this part you will be asked to choose between marbles of different colors. Each color is associated with a number that represents your payment for this part of the experiment, but you do not know which color is associated with which value. Depending on which color you choose you can get either 4EUR, 6EUR, 8EUR, 10EUR or 12EUR.

In this part of the experiment, you will observe two other participants playing a game. You

will not know the identity of the other participants and your identity will also not be revealed to them.

Lottery tickets

In the following, 10 lottery tickets will be distributed between these two other participants in this study. Each ticket gives a **10% chance to win the lottery prize of 10 EUR**. That is, the more tickets a person has, the greater are his/her chances to receive the lottery prize. Importantly, there can be only **one winner** of the prize. In other words, either one participant or the other will win the lottery prize of 10 EUR. Please note you are not participating in the lottery and thus you cannot win the lottery prize.

Distribution of lottery tickets

The distribution of the 10 lottery tickets between the two participants will be made based on (Height / Luck / Scores in the knowledge quiz).

Remember that in the beginning of this experiment we measured all participants' height / we asked all participants to toss 3 dice / we asked all participants to answer questions of a general knowledge quiz). We will now use this information to distribute the lottery tickets between the two participant such that: the **(taller participant / the participant who tossed the greater number / the participant with a high score of correct answers in the knowledge quiz)** will receive more tickets to play the lottery. The **(shorter participant / the participant who tossed the smaller number / the participant with a lower score of correct answers in the knowledge quiz)** will receive less tickets to play the lottery. On the next screen you will see how many lottery tickets each participant receives.

Height: Participant A is taller than Participant B. Because of this **Participant A** received 9 tickets to play the lottery and **Participant B** received 1 ticket. That is, **Participant A** has a 90% chance to receive the lottery prize whereas **Participant B** has a 10% chance to receive the lottery prize.

Luck: Participant A tossed a greater number than Participant B. Because of this **Participant A** received 9 tickets to play the lottery and **Participant B** received 1 ticket. That is, **Participant A** has a 90% chance to receive the lottery prize whereas **Participant B** has a 10% chance to receive the lottery prize.

Merit: Participant A had a higher score than Participant B. Because of this **Participant A** received 9 tickets to play the lottery and **Participant B** received 1 ticket. That is, **Participant A** has a 90% chance to receive the lottery prize whereas **Participant B** has a 10% chance to receive the lottery prize.

Instructions to decision

Before the lottery is played out, we ask you to **imagine that Participant A or Participant B receives the lottery prize**. Please consider the following carefully as it will affect Participant A's and Participant B's earnings. Your task is to decide how to distribute the lottery prize between the two participants. You can give each participant as little or as much of the lottery prize as you want (from 0EUR to 10EU in steps of 0.05EUR).

To determine Participant A's and Participant B's actual earnings the following procedure ap-

plies:

1. Participant A and Participant B do not have a say on the distribution of the lottery prize. After we play the lottery and determine who the winner is, Participant A and Participant B will receive as much of the lottery prize as you choose.
2. Please remember your decision only affects the payment of Participant A and Participant B in this part of the experiment. Your decision does not influence how much money YOU get in this part of this experiment.

*Ex ante decision*²

If Participant A, who had a 90% chance of winning the lottery, wins the lottery prize, how are you allocating the lottery prize between Participant A and Participant B?

Participant A receives:

Participant B receives:

If Participant B, who had a 10% chance of winning the lottery, wins the lottery prize, how are you allocating the lottery prize between Participant A and Participant B?

Participant B receives:

Participant A receives:

Elicitation of deservingness

In the following, we ask you to answer a few questions concerning the decision you just made. There are no correct or incorrect answers and your answers will remain anonymous. Please indicate how strongly the statements below apply to you.

1. Participant A, who had a 90% chance of winning the lottery, deserved the number of lottery tickets received.
2. Participant B, who had a 10% chance of winning the lottery, deserved the number of lottery tickets received.
3. Given the number of lottery tickets that Participant A received (90% chance of winning the lottery), Participant A deserves to have a larger share of the lottery prize.
4. Given the number of lottery tickets that Participant B received (10% chance of winning the lottery), Participant A deserves to have a larger share of the lottery prize.

*Measure of entitlement*³

Suppose Participant A, who had a 90% chance of winning the lottery, receives the lottery prize. In your opinion, what would be a **fair amount** to allocate to Participant B **from the point of view of a non-involved neutral person**?

Suppose Participant B, who had a 10% chance of winning the lottery, receives the lottery prize. In your opinion, what would be a **fair amount** to allocate to Participant A **from the point of view of a non-involved neutral person**?

²The two decisions were presented in counterbalanced order.

³The two decisions were presented in counterbalanced order.

Announcement of winner

The lottery was run and **Participant A/B received the lottery prize of 10 EUR**. Earlier, you decided that if Participant A/B would receive the lottery prize, you would allocate x EUR to Participant B/A. Do you want to revise your earlier decision? If yes, you will be given a chance to do so in the next screen.

Revise choices

You indicated that you want to revise your earlier decision. Earlier, you decided that if Participant A/B would receive the lottery prize, you would allocate x EUR Participant B/A. How do you want to allocate the lottery prize of 10 EUR between Participant A and Participant B? Please note this is your final decision!

Participant A/B receives:

Participant A/B receives:

Additional questions

Please answer the questions below carefully. The questions concern Part II of the experiment. Please indicate how strongly you agree to the statements below:

- How fair was the procedure used to determine the chances of receiving the lottery prize?
- How much control do you think Participant A and Participant B had over the chances to receive the lottery prize?

Payment part 2

The other two participants will be paid according to your decision of how much of the lottery prize should be given to the winner and to the loser. Now, we will determine how much money you get for this part of the experiment. Please choose a color of a marble. Each color is associated with a value for your payment. You can get either € 4, € 6, € 8, € 10 or € 12 with equal chance.

- Red Marble
- Blue Marble
- Black Marble
- Yellow Marble
- Green Marble

4 Instructions of part 3 of the experiment

You are now going to make a series of decisions. These decisions will not influence your earnings from the first and second parts of the experiment, nor will the decisions you made in the

first and second parts of the experiment influence the earnings from this part. Furthermore, the decisions you are going to make will only influence **your own earnings**.

You will be confronted with 10 decision situations. All these decision situations are completely independent of each other. A choice you made in one decision situation does not affect any of the other following decision situations.

Each decision situation is displayed on a screen. The screen consists of 10 rows. You have to decide for **every** row whether you prefer **option A** or **option B**. Option A is the same for every row in a given decision situation, while option B takes 10 different values, one for each row. Note that within a decision situation you can only switch once from option B to option A: if you switch more than once a warning message will appear on the screen and you will be asked to change your decisions. By clicking on NEXT you will see a example screen of the decision situations you will face.

This is a **screen shot** of a typical decision situation that you are going to face. You are not asked to make choices now! Please have a careful look. Thereafter click on NEXT to proceed.

	OPTION A LOTTERY	YOUR CHOICE	OPTION B SURE AMOUNT
Choice 1	<p>With 20% chance you receive 16.00 Euro, with 80% chance you receive 5.00 Euro.</p>	A ☐ B	16.00 Euro
Choice 2		A ☐ B	14.80 Euro
Choice 3		A ☐ B	13.60 Euro
Choice 4		A ☐ B	12.40 Euro
Choice 5		A ☐ B	11.20 Euro
Choice 6		A ☐ B	10.00 Euro
Choice 7		A ☐ B	8.80 Euro
Choice 8		A ☐ B	7.60 Euro
Choice 9		A ☐ B	6.40 Euro
Choice 10		A ☐ B	5.20 Euro
			OK

Figure B1: Lottery example.

Determination of earnings:

At the end of the experiment **one** of the 10 decision situations will be randomly selected with equal probability. Once the decision situation is selected, **one** of the 10 rows in this decision situation will be randomly selected with equal probability. The choice you have made in this specific row will determine your earnings.

Consider, for instance, the screen shot that you have seen. Option A gives you a 20% chance to earn 16 Euro and a 80% chance to earn 5 Euro. Option B is always a sure amount that

ranges from 16 Euro in the first row, to 5.20 Euro in the 10th row. Suppose that the 9th row is randomly selected. If you would have selected option B, you would receive 6.40 Euro. If, instead, you would have selected option A, the outcome of the lottery determines your earnings. At the end of the experiment the lottery outcome will be publicly determined by randomly drawing a card from a stack of numbered cards.

Please note that each decision situation has the same likelihood to be the one that is relevant for your earnings. Therefore, you should **view each decision independently** and consider all your choices carefully. If you like to, you can review the examples screens once more by clicking on BACK. If you have any questions please raise your hand. When you are ready, please press the BEGIN button below.

5 Lotteries (Part 3 of the experiment)

Lottery 1		
Choice	Option A	Option B
1		12 EUR
2		10.9 EUR
3		9.8 EUR
4	0.3 chance of	8.7 EUR
5	receiving 12 EUR	7.6 EUR
6	and 0.7 chance of	6.4 EUR
7	receiving 2 EUR	5.3 EUR
8		4.2 EUR
9		3.1 EUR
10		2 EUR

Lottery 2		
Choice	Option A	Option B
1		15 EUR
2		13.7 EUR
3		12.3 EUR
4	0.5 chance of	11 EUR
5	receiving 15 EUR	9.7 EUR
6	and 0.5 chance of	8.3 EUR
7	receiving 3 EUR	7 EUR
8		5.7 EUR
9		4.3 EUR
10		3 EUR

Lottery 3		
Choice	Option A	Option B
1		11 EUR
2		9.9 EUR
3		8.8 EUR
4	0.8 chance of	7.7 EUR
5	receiving 11 EUR	6.6 EUR
6	and 0.2 chance of	5.4 EUR
7	receiving 1 EUR	4.3 EUR
8		3.2 EUR
9		2.1 EUR
10		1 EUR

Lottery 4		
Choice	Option A	Option B
1		10 EUR
2		9.1 EUR
3		8.2 EUR
4	0.5 chance of	7.3 EUR
5	receiving 10 EUR	6.4 EUR
6	and 0.5 chance of	5.6 EUR
7	receiving 2 EUR	4.7 EUR
8		3.8 EUR
9		2.9 EUR
10		2 EUR

Lottery 5		
Choice	Option A	Option B
1		16 EUR
2		14.2 EUR
3		12.4 EUR
4	0.25 chance of	10.7 EUR
5	receiving 16 EUR	8.9 EUR
6	and 0.75 chance of	7.1 EUR
7	receiving 0 EUR	5.3 EUR
8		3.6 EUR
9		1.8 EUR
10		0 EUR

Lottery 6		
Choice	Option A	Option B
1		7 EUR
2		6.2 EUR
3		5.4 EUR
4	0.3 chance of	4.7 EUR
5	receiving 7 EUR and	3.9 EUR
6	0.7 chance of	3.1 EUR
7	receiving 0 EUR	2.3 EUR
8		1.6 EUR
9		0.8 EUR
10		0 EUR

Lottery 7		
Choice	Option A	Option B
1		18 EUR
2		16.3 EUR
3		14.7 EUR
4	0.2 chance of	13 EUR
5	receiving 18 EUR	11.3 EUR
6	and 0.8 chance of	9.7 EUR
7	receiving 3 EUR	8 EUR
8		6.3 EUR
9		4.7 EUR
10		3 EUR

Lottery 8		
Choice	Option A	Option B
1		20 EUR
2		17.8 EUR
3		15.6 EUR
4	0.1 chance of	13.3 EUR
5	receiving 20 EUR	11.1 EUR
6	and 0.9 chance of	8.9 EUR
7	receiving 0 EUR	6.7 EUR
8		4.4 EUR
9		2.2 EUR
10		0 EUR

Lottery 9		
Choice	Option A	Option B
1		5 EUR
2		4.6 EUR
3		4.1 EUR
4	0.8 chance of	3.7 EUR
5	receiving 5 EUR and	3.2 EUR
6	0.2 chance of	2.8 EUR
7	receiving 1 EUR	2.3 EUR
8		1.9 EUR
9		1.4 EUR
10		1 EUR

Lottery 10		
Choice	Option A	Option B
1		6 EUR
2		5.6 EUR
3		5.1 EUR
4	0.7 chance of	4.7 EUR
5	receiving 6 EUR and	4.2 EUR
6	0.3 chance of	3.8 EUR
7	receiving 2 EUR	3.3 EUR
8		2.9 EUR
9		2.4 EUR
10		2 EUR

Appendix C: Supplementary Material

Chapter 4

1 Study 1a

Upward mobility items

1. Going from “rags to riches” is still very much possible in this country.
2. People who are poor often become rich in America.
3. In general, people can climb the social ladder in the U.S.
4. Social status is something that is highly volatile.

Perceptions of wealth inequality

Before we start this question, we want to give you a sense of some terms we will use:

Wealth, also known as net worth, is defined as the total value of everything someone owns minus any debt that they have.

A person's net worth includes his or her bank account savings plus the value of other things such as property, stocks, bonds, art, collections and etc. minus the value of other things like loans and mortgages. If the USA consisted of 100 individuals with an overall 100 units of wealth, how much wealth do the 20 people at the very top have versus the next 20 highest, etc, versus the bottom 20? (Answers must add to 100)

1st (Top) 20 people:

2nd 20 people:

3rd (Middle) 20 people:

4th 20 people:

5th (Bottom) 20 people:

Attitudes towards status seeking

1. I admire people who own luxurious homes, cars and clothes*
2. I like when people think I am successful
3. I aspire to have a job that gives more money than I can spend
4. I pay attention to what other people buy*
5. The things a person owns say a lot about how well she/he is doing in life*
6. I like to own things that other people want or admire*
7. I would get a lot of pleasure from owning expensive (luxurious) goods
8. I would like to live in a very expensive, high-class neighborhood

*These items were adapted from the Material Value Scale (Richins, 2004; Richins & Dawson, 1992)

2 Study 1b

Inequality manipulation

Inequality was manipulated by showing the income distribution in two hypothetical countries (one in which inequality was high and one in which inequality was low). Display of low and high inequality countries (left-right) was counterbalanced, such that Country A represented the country with low inequality for half of the participants and the country with high inequality for the other half of participants (see Figure C1).

Economic mobility manipulation

While trying to find out more about the country to which you are moving to, you find the following information: Social Mobility describes the ability for any individual to move between social classes through hard work and skills. Economists divide societies into five income classes, or quintiles. These range from the bottom 20% to the top 20%.

The assumption that any individual can move from the bottom quintile to the top quintile describes complete social mobility – everyone has an equal chance of eventually ending up in any of the five quintiles, regardless of where they were born. The other extreme, zero social mobility, would mean that each individual would grow old in the same quintile he or she was born into.

Recent research conducted by economists in Country A has shown that social mobility in country A is actually *very high (very low)* and economists predict that *most young people will (barely) move away from the quintile they were born into*. Indeed, these trends have been building for a while and there is general agreement that little change is on the horizon.

Purchase intentions of status-enhancing and non-status enhancing items

“Please indicate the likelihood that you would spend your money with the following items below” (ranging from ‘*Extremely unlikely*’ to ‘*Extremely likely*’)

- Going for dinner with friends in a fancy restaurant*
- Buying electronics from an upscale brand (e.g., cell phone, laptop)*
- Buying new clothes from a famous brand*
- Buying stylish accessories (e.g., sunglasses, watches, jewelry)*
- Buying high-end kitchenware (e.g., knives, set of pans)*
- Buying elegant home decoration*
- Buying a bike for transportation
- Going for dinner with friends in a pizzeria
- Buying books
- Buying a gym membership
- Buying insurance
- Spending money on household repairs

*Status-enhancing items

Distribution of Income in COUNTRY B		
Quintiles	Income Share	
Richest 20%	35% of total income in the country	
Second Richest 20%	22% of total income in the country	
Middle 20%	18% of total income in the country	
Second Poorest 20%	15% of total income in the country	
Poorest 20%	10% of total income in the country

Distribution of Income in COUNTRY A		
Quintiles	Income Share	
Richest 20%	56% of total income in the country	
Second Richest 20%	20% of total income in the country	
Middle 20%	12% of total income in the country	
Second Poorest 20%	8% of total income in the country	
Poorest 20%	4% of total income in the country

Figure C1: Inequality manipulation

Note: In the figure, the pie chart on the left represents a hypothetical country with high income inequality while the pie chart on the right side depicts a country with low income inequality.

3 Study 2

Income visibility manipulation

High visibility:

The Human Resources department of the company you work for in Country A informs you that they have a strong policy favoring **salary disclosure**. This means that the company is **transparent about the income of all employees**. Information concerning how much each employee earns per month is **available** in the intranet of the company and **could be easily accessed by any employee**. Moreover, employees are **encouraged to feel free to discuss** their salaries with coworkers.

Low visibility:

The Human Resources department of the company you work for in Country A informs you that they have a strong policy favoring **salary confidentiality**. This means that the company is **not transparent about the income of all employees**. Information concerning how much each employee earns per month is **not available to any employee**. Moreover, employees are **encouraged to avoid discussing** their salaries with coworkers.

4 Study 3

Legitimacy of economic inequality

“Now, please think back of COUNTRY A and answer the following questions:”
(ranging from ‘*Strongly disagree*’ to ‘*Strongly agree*’)

- The differences in financial resources among people living in Country A seem fair
- The income inequality in Country A is not just
- Economic differences in Country A seem reasonable
- Economic success among people in Country A is achieved in a fair manner
- Economic differences in Country A are legitimate reflections of people's achievements
- In general, the people living in Country A who have more money, deserve to have more than others
- In Country A, people deserve the outcomes they get

Items Interpersonal Competitiveness

“Now, please think back of COUNTRY A and answer the following questions:”
(ranging from ‘*Strongly disagree*’ to ‘*Strongly agree*’)

- I would get satisfaction from competing with others in Country A
- I would try to outperform others in Country A
- I would consider myself a competitive individual in Country A
- I would try to avoid at any cost to have an argument with someone else in Country A
- I would not enjoy challenging others in Country A even if I thought they were wrong

-
- I would not like to compete against other people in Country A
 - I would find competitive situations in Country A unpleasant
 - I would try to avoid competing with other people in Country A
 - I would enjoy being on a debate on Country A
 - I would enjoy competing against an opponent in Country A
 - I would like competitive situations in Country A
 - I would prefer to remain quiet rather than hurt someone in Country A
 - I would prefer to go along with the group rather than create conflict

Self-presentation concerns

“Still thinking of COUNTRY A, please indicate how much you agree / disagree with the following statements:”

(ranging from ‘*Strongly disagree*’ to ‘*Strongly agree*’)

- It would be important to me to emphasize my own merits to other people
- I would like to make the impression of being a person occupied with important matters
- I would like to come across as a person who knows things
- I could easily talk about my economic success
- It would be important to me to emphasize my own strengths to other people
- I would try to make people aware of my talents and qualifications
- I would like other people to know I am competent

Appendix D: Supplementary Material

Chapter 5

1 Payoff Information

In each experimental session, one trial was randomly selected and the three individuals (i.e., Proposer, Receiver and Observer) were paid their earnings in the task in that selected trial. Payoff calculations were made in ECUs and then converted to Euros (1 ECU = €0.10). Proposers' payoff were always calculated in the same way regardless of the condition selected for payment while Receivers' and Observers' payoff were calculated slightly different depending on the condition selected for payment. Table D1 summarizes how the payoffs were calculated. In addition to the earnings from the game, TMS participants, who played in the role of Receivers in the Rec_C and Rec_NC conditions and in the role of Observers in the Obs_C and Obs_NC conditions received the participation fee of €7.5 and an additional €5 depending on their answers in the Social Appropriateness task.

Table D1: Payoff calculations in the Dictator game with punishment and reward.

Payoffs			
Condition	Proposers	Receiver	Observer
Rec_C	$E_p - A + 5 \times (PR)$	$A - \text{abs}(PR)$	Eo
Rec_NC	$E_p - A + 5 \times (PR)$	A	Eo
Obs_C	$E_p - A + 5 \times (PR)$	A	$E_o - \text{abs}(PR)$
Obs_NC	$E_p - A + 5 \times (PR)$	A	Eo

Note: E_p stands for the Proposers' endowment of 240 ECUs; A equals the number of ECUs allocated by the Proposer to the Receiver; PR equals the amount of positive or negative ECUs used by the TMS participant to reward or punish the Proposer. Eo stands for the Observers' endowment of 200 ECUs.

2 Statistical models for the analysis reported in the chapter

2.1 Sham stimulation – Punishment and reward

Table D2 shows the results of a random-effects Tobit regression for panel data left-censored at zero and right-censored at +200 with standard errors clustered at the participant level. Only trials in the sham stimulation are considered. The dependent variable is participants' decisions to punish or reward the Proposer when the Proposer's offer was Very Greedy and Greedy (Model 1) or Equal, Generous and Very Generous (Model 2). Dummy predictors coding cost of punishment/reward and personal involvement are included as within-subject

variables. In addition, we controlled for gender, fairness and appropriateness ratings, trial order within an experimental session (i.e., 1-140) and session number (i.e., 1-3). Baseline is composed by Obs_NC condition. Table D3 is similar to table D2, but it presents the results of Tobit regression models including also a dummy for the interaction between cost and personal involvement.

Table D2: Sham main effect.

	(1) Punishment	(2) Reward
Cost	-74.00*** (3.087)	-60.44*** (3.339)
Receiver	7.920* (3.104)	-5.114 (3.314)
Fairness	-7.098** (2.433)	-22.05*** (1.323)
Appropriateness	-22.66*** (3.758)	1.872 (3.000)
Male	11.57 (19.76)	66.67* (30.28)
Trial Number	0.0696+ (0.0378)	0.0266 (0.0407)
Session Number 2	-8.865 (20.89)	-33.80 (31.80)
Session Number 3	2.384 (20.18)	21.01 (30.78)
constant	141.9*** (15.60)	152.1*** (23.65)
sigma_u	40.22*** (6.597)	62.09*** (9.383)
sigma_e	52.77*** (1.240)	65.58*** (1.453)
N	1329	1983

Standard errors in parentheses

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table D3: Sham interaction effects.

	(1)	(2)
	Punishment	Reward
Cost	-57.81*** (4.279)	-58.34*** (4.665)
Receiver	23.02*** (4.193)	-3.178 (4.478)
Cost x Receiver	-31.88*** (6.034)	-4.233 (6.589)
Fairness	-6.750** (2.403)	-22.01*** (1.324)
Appropriateness	-23.67*** (3.721)	1.776 (3.004)
Male	11.61 (19.76)	66.70* (30.29)
Trial Number	0.0771* (0.0373)	0.0282 (0.0408)
Session Number 2	-9.312 (20.90)	-33.79 (31.81)
Session Number 3	2.301 (20.18)	21.00 (30.79)
constant	134.8*** (15.62)	151.1*** (23.69)
sigma_u	40.24*** (6.616)	62.11*** (9.385)
sigma_e	51.98*** (1.222)	65.57*** (1.453)
<i>N</i>	1329	1983

Standard errors in parentheses

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

2.2 dlPFC and mPFC stimulation – Punishment and reward

Random-effects Tobit regressions for panel data left-censored at zero and right-censored at +200 are run with standard errors clustered at the participant level. The dependent variable is participants' decisions to punish or reward the Proposer when the Proposer's offer was Very Greedy or Greedy (Table D4, Model 1) or Equal, Generous and Very Generous (Table D4, Model 2). Dummy predictors coding stimulation, cost of punishment/reward, personal involvement and the interaction between stimulation and cost, stimulation and personal involvement as well as the three-way interaction between stimulation, cost of punishment/reward and personal involvement are included as within-subject variables. We controlled for gender, fairness and appropriateness ratings, trial order within an experimental session (i.e., 1-140) and session number (i.e., 1-3). Baseline is composed by Obs_NC condition in the sham treatment.

Table D4: Effect of stimulation on Punishment and Reward

	(1)	(2)
	Punishment	Reward
dIPFC	0.227 (4.739)	22.34*** (5.262)
mPFC	-1.573 (4.690)	24.89*** (5.208)
Cost	-59.04*** (4.783)	-59.34*** (5.358)
dIPFC x Cost	-13.42* (6.821)	-45.80*** (7.690)
mPFC x Cost	-15.16* (6.795)	-40.47*** (7.596)
Receiver	23.05*** (4.648)	-3.234 (5.184)
dIPFC x Receiver	-10.19 (6.633)	5.370 (7.420)
mPFC x Receiver	-7.073 (6.601)	-2.162 (7.326)
Cost x Receiver	-30.10*** (6.751)	-6.437 (7.625)
dIPFC x Cost x Receiver	6.991 (9.692)	12.04 (10.90)
mPFC x Cost x Receiver	10.23 (9.632)	2.448 (10.83)
Fairness	-4.945*** (1.215)	-14.87*** (0.725)
Appropriateness	-22.03*** (1.945)	-5.595** (1.878)
Male	12.70 (14.52)	77.13** (27.59)
Trail Number	-0.0184 (0.0244)	0.0815** (0.0278)
Session Number 2	15.67*** (2.509)	0.764 (2.798)
Session Number 3	15.50*** (2.435)	10.14*** (2.699)
constant	124.0*** (8.562)	126.8*** (15.03)
sigma_u	30.62*** (4.468)	58.62*** (8.405)
sigma_e	58.80*** (0.839)	76.28*** (1.029)
N	3948	5907

Standard errors in parentheses

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Below the marginal effect on the censored expected value are computed, given that the observed values are censored at 0 and +200. Control variables include fairness, appropriateness ratings, gender, trial number and session number.

Table D5: Marginal effects for altruistic punishment (model 1 in Table D4).

Condition	df	chi2	P>chi2	Contrast	Std.Err.	[95% CI]	
(dlpfc vs sham) Rec_NC	1	4.38	0.036	-8.37	4.0	-16.21	-0.53
(dlpfc vs sham) Rec_C	1	10.23	0.0014	-9.38	2.93	-15.13	-3.63
(dlpfc vs sham) Obs_NC	1	0.00	0.96	0.19	3.96	-7.58	7.96
(dlpfc vs sham) Obs_C	1	6.8	0.009	-8.15	3.13	-14.28	-2.02
(mpfc vs sham) Rec_NC	1	3.41	0.065	-7.26	3.93	-14.97	0.44
(mpfc vs sham) Rec_C	1	7.17	0.007	-7.87	2.94	-13.63	-2.11
(mpfc vs sham) Obs_NC	1	0.11	0.74	-1.31	3.92	-8.99	6.37
(mpfc vs sham) Obs_C	1	10.96	0.0009	-10.18	3.08	-16.21	-4.15
Joint	8	27.25	0.0006				

Table D6: Marginal effects for altruistic reward (model 2 in Table D4).

Condition	df	chi2	P>chi2	Contrast	Std.Err.	[95% CI]	
(dlpfc vs sham) Rec_NC	1	25.89	0.0000	17.67	3.47	10.86	24.48
(dlpfc vs sham) Rec_C	1	1.11	0.29	-2.68	2.53	-7.65	2.29
(dlpfc vs sham) Obs_NC	1	17.46	0.0000	14.27	3.41	7.58	20.97
(dlpfc vs sham) Obs_C	1	15.18	0.0001	-10.46	2.68	-15.72	-5.2
(mpfc vs sham) Rec_NC	1	18.15	0.0000	14.43	3.39	7.79	21.07
(mpfc vs sham) Rec_C	1	6.64	0.0099	-6.55	2.54	-11.53	-1.57
(mpfc vs sham) Obs_NC	1	21.99	0.0000	15.93	3.4	9.27	22.6
(mpfc vs sham) Obs_C	1	7.32	0.007	-7.14	2.64	-12.32	-1.97
Joint	8	70.39	0.0000				

3 Fairness and social appropriateness ratings per condition and per site of stimulation

Figure D1 displays the fairness and social appropriateness ratings per stimulation and per condition, for each allocation bundle available to Proposers. Ratings provided by all TMS participants (full sample) are considered in the figure. Fairness ratings ranged from 1 (Very unfair) to 7 (Very fair) while Social appropriateness ratings ranged from 1 (Very socially inappropriate) to 4 (Very socially appropriate).

Figure D1: Fairness and social appropriateness ratings per condition and per site of stimulation.

Note: 2pc: Receiver cost; 2pnc: Receiver no cost, 3pc: Observer cost; 3pnc: Observer no cost.

4 Results considering the full sample

The section below presents the results from the full sample (i.e., weak reciprocators included). Random-effects Tobit regressions for panel data left-censored at zero and right-censored at +200 are run with standard errors clustered at the participant level. Same specifications as reported for the regression conducted with the reduced sample apply for the full sample.

Table D7: Effect of stimulation on Punishment and Reward - Full Sample

	(1) Punishment	(2) Reward
dlPFC	2.482 (4.181)	19.42*** (4.782)
mPFC	6.345 (4.184)	15.64** (4.771)
Cost	-77.55*** (4.353)	-88.37*** (5.064)
dlPFC x Cost	-7.983 (6.172)	-29.38*** (7.193)
mPFC x Cost	-16.97** (6.206)	-24.76*** (7.192)
Receiver	25.60*** (4.109)	-1.791 (4.719)
dlPFC x Receiver	-12.26* (5.845)	-0.798 (6.749)
mPFC x Receiver	-16.72** (5.873)	-3.679 (6.733)
Cost x Receiver	-34.85*** (8.793)	-0.226 (10.19)
dlPFC x Cost x Receiver	8.889 (8.763)	5.517 (10.19)
mPFC x Cost x Receiver	22.88** (8.793)	1.316 (10.19)
Fairness	-7.330*** (1.112)	-13.90*** (0.683)
Appropriateness	-20.88*** (1.694)	-13.22*** (1.652)
Male	12.29 (18.50)	49.81* (23.69)
Trail Number	0.0199 (0.0222)	0.122*** (0.0262)
Session Number 2	14.19*** (2.256)	5.436* (2.592)
Session Number 3	10.02*** (2.224)	17.67*** (2.567)
constant	121.0*** (10.59)	151.2*** (13.76)
sigma_u	47.04*** (6.145)	60.28*** (7.527)
sigma_e	59.31*** (0.773)	80.64*** (0.987)
N	5227	7829
adj. R^2		

Standard errors in parentheses

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.1 TMS effect on Punishment - Full Sample

Below the marginal effects for punishment (Model 1 in Table D7) on the censored expected value are computed, given that the observed values are censored at 0 and +200. Control variables include fairness, appropriateness ratings, gender, trial number and session number.

Table D8: Marginal effects for altruistic punishment. Full Sample (model 1 in Table D7).

Condition	df	chi2	P>chi2	Contrast	Std.Err.	[95% CI]	
(dlpfc vs sham) Rec_NC	1	5.40	0.0201	-7.72	3.32	-14.23	-1.21
(dlpfc vs sham) Rec_C	1	3.52	0.0606	-3.96	2.11	-8.10	-0.18
(dlpfc vs sham) Obs_NC	1	0.35	0.5528	1.94	3.27	-4.46	8.34
(dlpfc vs sham) Obs_C	1	1.40	0.2364	-2.75	2.32	-7.30	1.80
(mpfc vs sham) Rec_NC	1	6.15	0.0132	-8.19	3.30	-14.67	-1.72
(mpfc vs sham) Rec_C	1	0.90	0.3418	-2.04	2.15	-6.24	2.17
(mpfc vs sham) Obs_NC	1	2.30	0.1297	4.97	3.28	-1.46	11.40
(mpfc vs sham) Obs_C	1	5.05	0.0247	-5.18	2.30	-9.70	-0.66
Joint	8	18.31	0.0190

Figure D2: Effect of TMS stimulations on punishment. Full sample.

The figure summarizes the marginal effect of R dlPFC and mPFC stimulation versus sham stimulation on punishment of Greedy and Very Greedy offers for the whole sample. The horizontal solid line at zero indicates the point estimate for sham treatment in the different conditions. The black circle and the grey diamond markers represent the marginal effects of R dlPFC and mPFC stimulation compared to sham, respectively. The bars indicate the 95% confidence intervals based on the regression analysis.

4.2 TMS effect on Reward - Full Sample

Below the marginal effect for reward (Model 2 in Table D7) on the censored expected value are computed, given that the observed values are censored at 0 and +200. Control variables include fairness, appropriateness ratings, gender, trial number and session number.

Table D9: Marginal effects for altruistic reward. Full sample (model 2 in Table D7).

Condition	df	chi2	P>chi2	Contrast	Std.Err.	[95% CI]	
(dlpfc vs sham) Rec_NC	1	14.61	0.0001	11.75	3.07	5.71	17.73
(dlpfc vs sham) Rec_C	1	0.93	0.3353	-2.03	2.10	-6.14	2.09
(dlpfc vs sham) Obs_NC	1	16.20	0.0001	12.27	3.05	6.30	18.25
(dlpfc vs sham) Obs_C	1	3.29	0.0695	-3.83	2.11	-7.97	0.31
(mpfc vs sham) Rec_NC	1	6.13	0.0133	7.49	3.03	1.56	13.42
(mpfc vs sham) Rec_C	1	4.23	0.0398	-4.32	2.10	-8.44	-0.02
(mpfc vs sham) Obs_NC	1	10.62	0.0011	9.86	3.02	3.93	15.79
(mpfc vs sham) Obs_C	1	2.75	0.0975	-3.52	2.13	-7.70	-0.64
Joint	8	40.14	0.0000

Figure D3: Effect of TMS stimulations on reward. Full sample.

The figure summarizes the marginal effect of R dlPFC and mPFC stimulation versus sham stimulation on reward of Equal, Generous and Very Generous offers for the whole sample. The horizontal solid line at zero indicates the point estimate for sham treatment in the different conditions. The black circle and the grey diamond markers represent the marginal effects of R dlPFC and mPFC stimulation compared to sham, respectively. The bars indicate the 95% confidence intervals based on the regression analysis.

4.3 Differences between Weak and Strong reciprocators

R dlPFC Punishment. Differently than the main results reported in the Chapter where we observed a significant decrease in punishment after stimulation of the R dlPFC in the Rec.C condition following Very Greedy and Greedy offers, when considering the full sample this result is only marginally significant ($t = -3.96$, $p = .06$, FDR correction not significant at 90% CI). Furthermore, no differences between right dlPFC and sham stimulation were observed in the Obs.C condition ($t = -2.75$, $p = .23$). Results for the Rec.NC and Obs.NC are the same of the ones reported in the paper.

mPFC Punishment. In the main results reported in the Chapter we observe a significant reduction in punishment of Very Greedy and Greedy offers in the Rec.C condition and a marginally significant decrease in punishment in the Rec.NC condition following downregulation of the mPFC. When considering the full sample we observe no differences between mPFC and sham stimulation in the Rec.C condition ($t = -2.04$, $p = .34$). Moreover, we find a significant decrease in punishment in the Rec.NC condition compared to sham stimulation ($t = -8.19$, $p = .01$, FDR corrected at 95% CI). No differences in results between the full and partial sample were found for the Obs.NC and Obs.C conditions.

R dlPFC Reward. Regarding reward, while I report in the Chapter a significant decrease in reward of Equal, Generous and Very Generous offers following stimulation of the R dlPFC compared to sham stimulation in the Obs.C condition, this result is only marginally significant when considering the full sample of participants ($t = -3.83$, $p = .07$, FDR corrected at 90% CI).

mPFC Reward. Differences between the full and partial sample were only found for the Obs.C condition. While we observe a significant decrease in reward of Equal, Generous and Very Generous offers in the Obs.C condition following mPFC stimulation when considering the partial sample, this result is only marginally significant for the full sample of participants ($t = -3.52$, $p = .097$, FDR corrected at 90% CI).

5 Frequency of Reciprocation by Weak and Strong Reciprocators

Figure D4 displays the frequency to which weak reciprocators chose to transfer negative ECUs to Proposers (punishment) and positive ECUs to Proposers (reward) across all four experimental conditions under sham. Participant IDs are displayed at the top of each panel, Y axis represents the percentage of trials in sham stimulation (collapsed across the four experimental conditions) and the X axis represents the number of ECUs transferred to Proposers (negative ECUs represent punishment, while positive ECUs represent rewards). For these participants, frequency of non-reciprocation was high, as they chose to not punish or reward the Proposer in more than 50% of trials.

Figure D4: Relative frequency of reciprocity (punishment and reward) in trials under sham stimulation for weak reciprocators.

Figure D5 displays how weak and strong reciprocators chose to respond to Proposers. The left panel displays the pattern of response for 25 participants who punished or rewarded Proposers in at least 50% of the trials (strong reciprocators), while the right panel displays the pattern of responses of all participants who chose to not punish or reward Proposers in more than 50% of trials (weak reciprocators). The Y axis represents the percentage of trials in sham stimulation (collapsed across the four experimental conditions) and the X axis represents the number of ECUs transferred to Proposers (negative ECUs represent punishment, while positive ECUs represent rewards).

Figure D5: Relative frequency of reciprocity (punishment and reward) in trials under sham stimulation for strong and weak reciprocators.

6 Effect of TMS for weak reciprocators.

For completeness, this section presents the results when considering only the Weak Reciprocators who are excluded from the main analysis presented in the main text of the paper because they did not punish or reward more than 50% of the times following sham stimulation. Importantly, we report below the effect of brain stimulation for this subset of participants to check whether TMS over dlPFC and mPFC changes their behavior compared to sham. Results show that TMS over dlPFC and mPFC does not change punishment of Greedy and Very Greedy offers. It also does not change reward of Equal, Generous and Very Generous offers. This indicates that, as expected, brain stimulation did not affect the behavior of Weak Reciprocators. Table D10 shows the result of a random-effects Tobit regressions for panel data left-censored at zero and right-censored at +200 with standard errors clustered at the participant level. The dependent variable is participants' decisions to punish or reward the Proposer when the Proposer's offer was Very Greedy or Greedy (Model 1) or Equal, Generous and Very Generous (Model 2). Baseline is composed by the sham treatment.

Table D10: Effect of TMS for Weak reciprocators only.

	(1)	(2)
	Punishment	Reward
dIPFC	-7.029 (8.415)	10.92 (9.076)
mPFC	4.409 (8.904)	8.550 (9.585)
Fairness	-36.87*** (2.817)	22.43*** (2.508)
Appropriateness	-25.01*** (4.677)	-5.625 (4.960)
constant	63.42+ (35.89)	-183.3*** (19.20)
sigma_u	97.22*** (27.12)	34.66*** (9.565)
sigma_e	124.0*** (4.178)	162.0*** (4.986)
N	2949	3034

Standard errors in parentheses

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

7 Instructions

Welcome to this decision-making experiment. The webcam on top of your computer screen will be turned on and you will be filmed for part of this experiment. You will be informed when the camera will be turned on and when it will be turned off. The video will be seen only by the experimenters and will be destroyed once data have been gathered from it. The content of the video will not affect your payment. If you disagree with being filmed, you are free to leave at any time. In this case, you will receive the show-up fee, but you will not receive additional payment.

While being filmed, we kindly ask you to pay attention to the following aspects:

- Please do not touch the camera or move the screen. If you think there is a problem with the camera, please inform the experimenter.
- Please avoid placing your hands on your face.
- Please remove any caps or hats.
- Remain seated properly and please avoid leaning on the chair.
- Please do not turn away from your screen.

For your participation in this experiment, you will receive a fixed participation fee of €7.5.

In addition, you can earn money with the decisions you make. Please read these instructions carefully. Importantly, we employ a **strict non-deception policy**. This means that all information you receive from this experiment is truthful and when you are told to interact with other participants these other participants do actually exist.

This experiment consists of a Practice Part, followed by a Task Part. The Practice Part consists of these instructions and some comprehension questions. It is important that you answer the comprehension questions correctly. When you have answered all comprehension questions correctly you can proceed to the Task Part.

In the Task Part, you **can earn money** by making choices. These earnings depend on your decisions and on the decisions of other participants of this experiment. This will be explained in detail later in these instructions. In the experiment, we will use **ECU (Experimental Currency Units)**, which will be converted to Euro at the end of the experiment. For all the participants in this experiment, each ECU will be converted to Euros at a rate of 1 ECU to €0.10.

If you have any questions during the experiment, please raise your hand and an experimenter will come to you to answer your question in private.

Description of the decision situations

In this experiment, you have to make choices in **different decision situations**. Each decision situation will be different and it will be explained in detail. In each decision situation, there are three different participants, randomly matched with each other (Figure D6). The pairing is anonymous, meaning that neither individual will ever know the identity of the other individuals with whom he or she is matched. One participant will be known as **Person A**, one participant will be known as **Person B** and the other participant as **Person C**.

Figure D6: Participants in each decision situation.

In each decision situation, Person A allocates money between him/herself and Person B. Each decision situation consists of two stages:

The first stage

At the beginning of the first stage:

- Person A has 240 ECU at his/her disposal.
- Person B has 0 ECU at his/her own disposal.
- Person C has 200 ECU at his/her disposal

Person A decides how to distribute his/her 240 ECU between him-/herself and Person B. Person A is always represented by a red stylized human (Figure D7). When making the decision, Person A can choose one of the following options:

- Keep 200 ECU (± 3 ECU) and Give 40 ECU (± 3 ECU) to Person B
- Keep 160 ECU (± 3 ECU) and Give 80 ECU (± 3 ECU) to Person B
- Keep 120 ECU (± 3 ECU) and Give 120 ECU (± 3 ECU) to Person B
- Keep 80 ECU (± 3 ECU) and Give 160 ECU (± 3 ECU) to Person B
- Keep 40 ECU (± 3 ECU) and Give 200 ECU (± 3 ECU) to Person B

The indicated ± 3 ECU means that, for instance, if Person A chooses the fourth option then it may be that Person A kept anything between 83 and 77 ECU and that Person A gave anything between 163 and 157 ECU. The exact amount is randomly decided. Equivalently for the other options.

Figure D7: Person A's action.

The second stage

Your Role. In some decision situations you will be Person B and in some decision situations you will be Person C. You will never be Person A. You will always be represented by a blue stylized man in a rectangular shape.

In each decision situation, you will learn about Person A's choice. Thereafter, you can make the decision to increase, decrease or leave unchanged Person A's payoff. How exactly this can be done will be described in details later in the instructions.

In each decision situation, before you make your decisions, you will be informed whether you are Person B or Person C.

- If you are Person B: Figure D8 depicts a decision situation where you are Person B. In this type of situation, Person A has chosen how to allocate the 240 ECU at his/her own disposal between him/herself and you. After having learned about Person A's allocation, you can decide to increase, decrease or leave unchanged Person A's payoff. In this case, Person C, who is another participant of this experiment, has 200 ECU and will only be informed about Person A's decision, but he/she will not know what you decide. Person C cannot modify yours or Person A's payoffs.

Figure D8: Decision situation in which you are Person B.

- If you are Person C: Figure D9 below depicts a decision situation where you are Person C. In this case, Person A has chosen how to allocate the 240 ECU at his/her own disposal between him/herself and Person B, who is another participant of this experiment. After having learned about Person A's allocation, you can decide to increase, decrease or leave unchanged Person A's payoff. In this case, you receive 200 ECU at the beginning of the decision situation. Person B will only be informed about Person A's decision, but he/she will not know what you decide. Person B cannot modify yours or Person A's payoffs.

Figure D9: Decision situation in which you are Person C.

Your decision

In some decision situations your decisions can be costly and in some other decision situations, they will not be costly. In each decision situation, before having to make a choice, you will be informed whether your decision is costly or non-costly.

- Costly decisions: In some decision situations, you will have to use some of your ECU to modify Person A's payoff (Figure D10). Specifically:
 - if you choose to increase Person A's payoff, you pay 1 ECU for each 5 ECU by which Person A's payoff is increased,
 - if you choose to decrease Person A's payoff, you pay 1 ECU for each 5 ECU by which Person A's payoff is decreased,
 - if you choose to leave unchanged Person A's payoff, you do not pay any ECU.
- Non-Costly decisions: In some decision situations, you will not have to use your ECU to modify Person A's payoff (Figure D11). Specifically:
 - if you choose to increase Person A's payoff, you pay 0 ECU for each 5 ECU by which Person A's payoff is increased,
 - if you choose to decrease Person A's payoff, you pay 0 ECU for each 5 ECU by which Person A's payoff is decreased,
 - if you choose to leave Person A's payoff unchanged, you do not pay any ECU.

Figure D10: Costly decisions.

In this type of decision situations, you pay with your ECU to modify Person A's payoff.

Figure D11: Non-costly decisions.

In these type of decision situations, you will not pay any ECU to modify Person A's payoff.

Information

In a decision situation, each Person is informed regarding the options of the other participants he/she is matched with. The rules are therefore common knowledge. For instance, before choosing how to allocate the 240 ECU, Person A knows which are the possible actions available to Person B and Person C and which information they receive.

Condition announcement

During the experiment, you first receive information regarding your role (i.e., Person B or Person C) and the cost of your choice (i.e., Cost or no Cost) as shown below (Figure D12). Thereafter, you will be presented with several decision situations where your role and the cost of your choice remain constant. You will be informed when your role and/or the cost of your decision change again.

Figure D12: Condition announcement.

You are informed about your role and the cost of your choice for the following decision situations.

For instance, in the example in Figure D12 you are informed that in the next multiple decision situations you will be Person C and that you pay 1 ECU for each 5 ECU by which Person A's payoff is increased or decreased (i.e., Costly decision). Be aware that you will face many decision situations in this experiment and that there will be waiting periods.

Screen example

After seeing the condition announcement, you will face the decision situations. You can see below an example of the screen of a decision situation you will face during the experiment (Figure D13). Please note that for each decision situation, you will be matched with two new participants. This means you will never be exposed to the same participants more than once.

- On the top right part of the screen, you can see the remaining time you have to make

Figure D13: Screen Interface example.

your decision. You have at most 20 seconds to make your decision and click on the “Confirm” button. If you do not make a decision within this time limit you will automatically move to the next decision situation.

- In the centre of the screen, the image with the stylized humans summarizes the features of the decision situation you are facing. This picture is a reminder of the condition announcement you saw before starting the decision situations. You are informed about your role represented by a blue human (i.e., Person B or Person C) and about the cost of your decision (i.e., cost or no-cost). You will be presented with several decision situations where your role and the cost of your decision remain constant. You will be informed when your role and/or the cost of your decision vary.
- Above the picture, a two-letter ID associated to the Person A you are matched with in that decision situation is displayed. This ID changes in each decision situation, since you are always matched with a different Person A.
- Below the picture, you learn about Person A' decision to distribute his/her tokens with Person B. Please pay particular attention to this because it might vary across decision situations.
- Your decision consists of moving a slider to decrease or increase Person A' payoff. If you move the cursor to the left, you will decrease Person A's payoff. If you move the cursor to the right, you will increase Person A' payoff. You can move the cursor in the slider or click on the button on the left and on the right. You can use up to 40 ECU of your own

to modify Person A's payoff. If you do not move the cursor or click on any button, you leave Person A's payoff unchanged.

- On the bottom of the screen, you are informed about your payoff and Person A's payoff. When you move the slider, this payoffs will automatically update.
- You need to click on Confirm to submit your decision.

Your identity

Your identity and the identity of all other participants is secret. You will never be asked to reveal it to the other participants during the course of the experiment or after it. Your name is recorded only at the end of the experiment to pay you. The other participants will not be able to link your identity to any of the decisions you make. In order to keep your decisions private, please do not reveal your choices to any other participant. All the interactions are anonymous and none of the participants can communicate or influence the choices of the others.

Matching

Importantly, in this experiment, you will never face the same participant more than once. Thus, you should consider each decision you make as completely independent from the other decisions: in each decision situation, you will be matched with different other participants. The actions of these participants have been recorded in a previous experimental session.

Payment

For each experimental session, you receive a show up fee of €7.5. In addition, in each experimental session, one of the decision situations you faced will be randomly selected for payout. You and the other two Persons who participated in the selected decision situation will be paid according to Person A's and your choices. Please note that if you did not make a decision within the time limit for the selected decision situation that counts for payout, you receive €0 while the other two persons will be paid according to the initial ECU allocation. All your earnings, including the €7.5 participation fees, will be transferred to your bank account at the end of the three experimental sessions. Your earnings will be transferred within one week from the end of the experiment.

Note: Recall, for each participant in this experiment, each ECU will be converted to money at a rate of 1 ECU to €0.10.

This is the end of the instructions. You can now answer the comprehension questions. If you have any questions please raise your hand and wait for the experimenter.

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Impact

In this section, I elaborate on the scientific and societal impact the knowledge generated in this dissertation may have.

1 Scientific impact

During my PhD, I had multiple opportunities to discuss and showcase the results of this dissertation in many different contexts. Keeping true to the interdisciplinary nature of this dissertation, I presented the results of the empirical chapters in conferences in different fields such as Neuroeconomics, Behavioral and Experimental Economics and Social Psychology. I attended conferences and seminars in a wide variety of locations across the globe, such as Germany, The Netherlands, Sweden, Norway, China and United States. I considered this as an important way of communicating the results of my research to the scientific community and other interested researchers while also keeping check of the quality of the scientific work I produced according to academic standards.

In addition, early on in my PhD, I became aware of the replicability crisis, which called into question the validity of scientific findings produced across many different social sciences. As a researcher, I attempt to attend to the recent changes in academic standards and make efforts to abide by them. In that sense, I tried to follow as much as possible the recent Open Science movement aiming to make scientific research reproducible and accessible to both academics and the lay public. For reasons of good scientific practice and conduct, hypothesis and an analysis plan for chapter 5 were pre-registered and can be found in the database of the Center for Open Science (<https://osf.io/pg7yc>). Moreover, results of chapter 2 were published as a preprint to facilitate timely dissemination among the scientific community. It is my goal to also share the datasets used in the empirical chapters of this dissertation as well as the statistical analysis I conducted in open data repositories, supporting other researchers in using my work to either reproduce it or to conduct further scientific investigations. I also aim to publish my research as much as possible in open access journals, such that it can be accessible to a wider public of researchers and other interested individuals or institutions. Furthermore, during my PhD, I joined the organization *FORRT*, which advocates for the integration of open and reproducible science in high education. This organization aims to support the teaching and mentoring of open science tenets in high education while raising awareness of the pedagogical implications and challenges of teaching open and reproducible science (for more information, see <https://forrt.org/>). The attempt to raise awareness in the scientific community to the

issue of teaching open science led to a working paper which I co-authored (FORRT, 2019).

Finally, all the empirical chapters of this dissertation are being submitted to scientific journals for publication after peer-review scrutiny. I believe these chapters can provide significant contributions to different scientific fields engaged in the exploration of the impact of inequality and unfairness on social and consumer behavior. For example, results of **chapter 2** suggest that there may be some similarities in how individuals perceive inequality in opportunity and outcomes. These results hopefully can inspire further research investigating inequality in opportunity and its potential similarities and differences from how inequality in outcomes is perceived. **Chapter 3** investigates the influence of unequal opportunities on preferences for outcome redistribution. Interestingly, results suggest individuals may not think of outcome redistribution as a legitimate way to compensate inequality in opportunity. These findings contribute to the literature on redistributive behavior and call for further research unraveling what individuals might consider as a fair compensation for unequal opportunities. **Chapter 4** adds to the literature on consumer behavior by showing how individuals' perceptions of society can have detrimental effects on their consumption behaviors. Lastly, **Chapter 5** contributes to the literature on the neuroscience of (un)fairness by providing a systematic and comprehensive investigation of the involvement of two regions of the prefrontal cortex in reciprocating behavior in contexts of (un)fairness. Results challenge some previous interpretations for the role of the right dorsolateral prefrontal cortex and medial prefrontal cortex on punishing unfair behavior and reveal interesting similarities and differences in the engagement of the prefrontal cortex in reciprocating fair and unfair behavior.

2 Social impact

In addition to the scientific relevance of this dissertation, I believe some of its findings can also be of relevance to behavioral scientists working on policy-making. For this reason, during my PhD I have participated in conferences and workshops that fostered an exchange between the scientific community and behavioral science practitioners.

Although the empirical chapters of this dissertation are not policy papers, an extrapolation of the results might be insightful for policy-making. For example, results of **chapter 2** could suggest that making the cause of inequality in opportunity salient to individuals may elicit perceptions of how (un)fair that inequality is. Findings of **chapter 3** reveal that redistributing outcomes may not be seen as the optimal strategy in rectifying unequal opportunities. An extrapolation of this result may suggest that policies aimed at redistributing opportunities to offset inequality in opportunity may have more success in galvanizing public support. Lastly, **chapter 4** demonstrates that perceptions of high economic mobility by the poor can encourage conspicuous

consumption. This points to the need of policies aimed at correcting individuals' misperceptions about society which could lead to further poverty and inequality.

More importantly, I hope the empirical chapters of this dissertation can argue for the relevance of studying and understanding how inequality affects behavior and how individuals react in situations of unfairness. In the long-run, comprehending the negative effects of living in an unequal world to human behavior and psychological motivations might steer governments and institutions in their actions to reduce economic inequality and opportunity gaps while trying to better human well-being.

Summary

This dissertation investigates how inequality and unfairness impact our decisions when interacting directly or indirectly with others. **Chapter 2** explores individuals' perceptions of unequal distributions of opportunities and shows that the source of inequality in opportunity has an important effect on individuals' judgments of fairness, rendering some inequalities in chances more unacceptable than others. Moreover, the fairness of inequality in opportunity is directly related to how much control individuals have over the opportunities they receive. This result points to the fact that individual responsibility is an important factor when judging the fairness of inequality of opportunity. Interestingly, however, the positive correlation between fairness and control is not found when opportunities are unevenly allocated due to luck. When luck is the source generating unequal opportunities, it is considered to allow little control, but to be fair, whereas previous literature has reported it to be unfair when it leads to unequal outcomes. This suggests the existence of some inconsistencies when evaluating the source of inequality of opportunity and outcome.

Chapter 3 investigates whether individuals rectify inequality in opportunity by redistributing outcomes. Results show that opportunities influence how individuals think of redistributing outcomes, such that the more opportunities one has, the less they are willing to redistribute outcomes. In addition, while both involved and non-involved individuals seem to perceive differences in fairness and control between varied sources of inequality of opportunity, this assessment does not necessarily translate into different redistribution patterns. Results suggest that individuals might not see redistribution of outcomes as a legitimate compensation for inequality in opportunity.

Chapter 4 demonstrates that perceptions of high economic mobility by low-income consumers lead to higher willingness to engage in consumption of goods that convey status to others. This effect is not present when income can be directly observed, suggesting that low-income consumers use status consumption to signal their socioeconomic status when economic mobility is considered to be high. Finally, we find that while the effect of perceived economic mobility on conspicuous consumption is not affected by perceptions of inequality, it is underlined by the legitimization of inequality. Perceptions of high economic mobility lead individuals to consider unequal outcomes as fair for being the result of one's hard work and effort. In this context, observers are likely to consider ownership of status goods as a reliable sign of one's position in the socioeconomic ladder, which ultimately encourages low-income consumers to display status by consuming such goods.

Finally, **chapter 5** explores the neurobiological bases of individuals' reactions to fair-

ness and unfairness. Results indicate that the prefrontal cortex influence reciprocation of fairness and unfairness differently. While the right dorsolateral prefrontal cortex (R dlPFC) and medial prefrontal cortex (mPFC) are broadly involved in overriding self-centered processing to facilitate the retaliation of unfairness, these same brain regions are crucial to inhibit both selfishness and reciprocity motivations when deciding how to reward fairness.

Curriculum Vitae

Leticia Rettore Micheli was born in Rio de Janeiro, Brazil, on 22nd June 1988. She grew up in Belo Horizonte and graduated from high school in 2005. From 2007 to 2011, Leticia studied Psychology at the Federal University of Minas Gerais. During her undergraduate studies, she joined the Developmental Neuropsychology research group, where she worked as student assistant from 2009 to 2011. In 2011, Leticia spent a semester studying at Bologna University, Italy, and did a research internship at the Kynematics research group.

In 2012, Leticia moved to The Netherlands to pursue a research master in Cognitive Neuroscience at Radboud University Nijmegen. As part of her masters, she did a research internship at the Decision Neuroscience Laboratory at the Donders Institute for Brain, Cognition and Behaviour investigating the neural mechanisms of cooperation under the supervision of Prof. Dr. Alan Sanfey and Dr. Mirre Stallen. Upon graduation, Leticia worked for a year as a research assistant at the Decision Neuroscience Laboratory collaborating on a research project on the neural mechanisms of scarcity.

In 2015, Leticia started her PhD at Maastricht University. She worked with Prof. Dr. Caroline Goukens, Prof. Dr. Arno Riedl and Dr. Kelly Geyskens on the effects of inequality and unfairness on social and consumer decision-making. Her research was presented in several national and international conferences and she published in interdisciplinary journals such as PNAS and Scientific Reports. During her PhD, Leticia taught courses in Marketing at the bachelor level, such as Consumer Behavior, and supervised the thesis of several master and bachelor students.

As of August 2020, she joined the Emmy Noether group 'More than meet the eyes' at the Institute of Psychology at Leibniz University Hannover as a post-doctoral fellow. In October 2021, she moved together with the group to the Institute of Psychology at Würzburg University.