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Property rights determine who owns what. Trade is very difficult if it is unclear who owns what or if property rights are not enforced. For this reason, many scholars argue that property rights and their enforcement are essential to economic prosperity. A distinction can be made between a legal and psychological approach to property rights. A legal approach to property rights considers how the rules of property rights are codified in law while a psychological approach focuses on how humans tend to think about property rights intuitively.

The two approaches seem to diverge if more unconventional goods are considered. This thesis consists of four studies that investigate how consumers perceive unconventional goods in different contexts. The aim of these four studies combined is to gain a better understanding of consumers' perception of property rights, which not only furthers relevant theories but also provides practical recommendations to policy-makers and managers.

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Anouar El Haji

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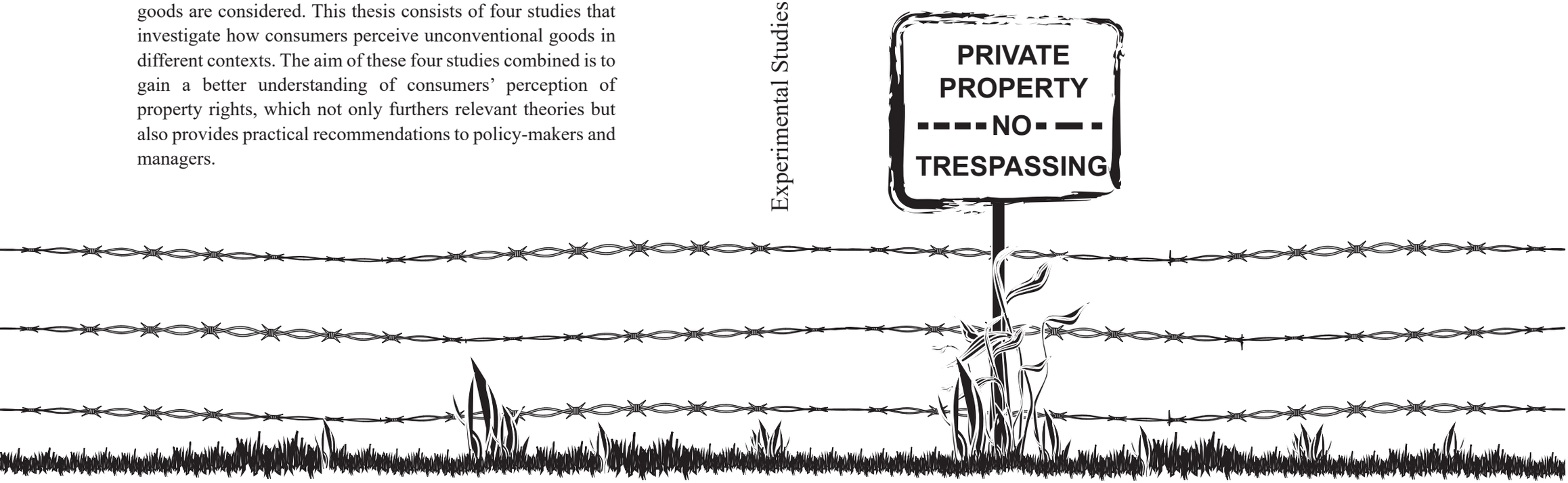

Experimental studies on the psychology of property rights

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possible explanations of the phenomenon at hand. The fruits of this collaboration are presented in chapter four. The fifth chapter is the result of my collaboration with Sander Onderstal whose positive and can-do attitude motivated me immensely. Sander's deep knowledge of mechanism design helped me gain a better understanding of how economic theory can be used to improve people's lives.

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Table of Contents

List of Tables ..... **ix**

List of Figures ..... **x**

1. Introduction **1**

1.1. Property rights 1
1.2. A Basic Taxonomy of Goods 3
1.3. The Psychology of Property Rights 6
1.4. Methodology 8
1.5. Thesis Overview 9

2. The Moral Distinction Between Theft and Piracy **15**

2.1. Introduction 15
2.2. Theoretical framework 17
2.3. Experiment 1: Moral evaluation of piracy and theft 25
2.4. Experiment 2: Likelihood of cheating 29
2.5. Experiment 3: Tangibility versus rivalry 34
2.6. Experiment 4: Foregone gains versus rivalry 38
2.7. Discussion 42

3. Theft and Piracy: Incentivized Experiments **48**

3.1. Introduction 48
3.2. Theoretical framework 50
3.3. Study 1: Exchange Game 56
3.4. Study 2: Dictator Game 62
3.5. Discussion 71
3.6. Appendix: Experimental Instructions Exchange Game 75
3.7. Appendix: Experimental Instructions Dictator Game 76

4. Dilution Illusion 77

4.1. INTRODUCTION 77
4.2. LITERATURE REVIEW 79
4.3. EXPERIMENTAL DESIGN 86
4.4. THEORETICAL PREDICTIONS 95
4.5. RESULTS 100
4.6. DISCUSSION 109
4.7. APPENDIX: INSTRUCTIONS 115

5. Trading Places 118

5.1. INTRODUCTION 118
5.2. THEORETICAL FRAMEWORK 126
5.3. EXPERIMENTAL DESIGN AND HYPOTHESES 132
5.4. RESULTS 138
5.5. CONCLUSION 156
5.6. APPENDIX: PROOFS OF PROPOSITIONS 162
5.7. APPENDIX: EXPERIMENTAL INSTRUCTIONS 167

6. Discussion and Implications 174

6.1. THEORETICAL CONTRIBUTIONS 174
6.2. MANAGERIAL IMPLICATIONS 180

Summary 185

Samenvatting 189

References 194

List of Tables

Table 1.1: *A taxonomy of goods* 3
Table 2.1: *Tangibility, rivalry and appropriation type* 21
Table 3.1: *Monetary value of possessions depending on the Buyer's decision* ... 59
Table 3.2: *Determinants of perceived ownership after making a decision* 62
Table 3.3: *Final distribution of tokens and payoffs Dictators and Receivers* 65
Table 3.4: *Overview* 66
Table 4.1: *Donors' choice set* 89
Table 4.2: *Descriptives of initial offers* 102
Table 4.3: *Descriptives of final offers* 105
Table 5.1: *Numerical example for the rules of the server-initiated auction* 127
Table 5.2: *Numerical example for the rules of the customer-initiated auction* . 129
Table 5.3: *Experimental design and number of participants* 133
Table 5.4: *Descriptive statistics* 140
Table 5.5: *Average efficiency gains* 143
Table 5.6: *Estimation of efficiency gains* 145
Table 5.7: *Estimations of bids in the server-initiated auction* 147
Table 5.8: *Regressions explaining bids in the customer initiated auction* 151
Table 5.9: *Estimations of likelihood voting for server-initiated auction* 154

List of Figures

Figure 2.1: *Moral evaluation of theft and piracy*.....28
Figure 2.2: *Willingness to pay and cheating rate* 33
Figure 2.3: *Moral evaluation of theft and piracy*.....37
Figure 2.4: *Perceived moral acceptability, rivalry and foregone gains* 41
Figure 3.1: *Perceived shared ownership* 61
Figure 3.2: *Cumulative distribution of Dictators' appropriation*.....67
Figure 3.3: *Mean appropriation rate per price range* 69
Figure 3.4: *Mean actual and expected appropriation rate* 70
Figure 4.1: *Visualization token distribution*.....92
Figure 4.2: *Confirmation dialog box* 93
Figure 4.3: *Cumulative distribution of donors' initial offers*.....100
Figure 4.4: Mean initial and final offer per treatment and CRT score 108
Figure 5.1: *Average bids in the server-initiated auction by position and arrival process* 149
Figure 5.2: *Defenders' bids in the customer-initiated auction by arrival process* 152
Figure 5.3: *Attackers' bids in the customer-initiated auction by arrival process* 153

1. Introduction

"The right to sell is one of the rights of property."
— Thomas Jefferson to Handsome Lake, 1802.

1.1. Property rights

Property rights determine what a person can and cannot do with respect to a delineated piece of property. The existence of property rights allows for welfare improving exchanges because buyers and sellers know who is getting what at the end. Because the existence of property rights is a necessary condition for exchange to occur, the degree to which property rights are defined and enforced is considered one of the main predictors of economic welfare (De Soto 2000). Well-defined property rights ensure that the likelihood of conflict is minimized, which decreases the cost of doing business (Demsetz 1967). Thus, the presence of a well-functioning system of property rights increases the likelihood that a welfare enhancing exchange occurs, which in turn contributes to the growth of an economy.

A distinction can be made between a legal and psychological approach to property rights. The legal approach focuses on the judicial system, which provides a normative view of how property rights should be defined and enforced. This approach aims to develop a legal framework to improve the law's ability to use property rights to the benefit of the public at large (Demsetz 1964). The psychological approach, however, focuses on how consumers tend to perceive property rights intuitively (Stake 2004). The aim of the psychological approach is to produce and develop theories

that reveal how consumers intuitively perceive property rights. This approach often requires the application of empirical methods to measure how consumers think and behave towards property rights. This thesis adopts the psychological approach.

In most cases consumers' perceptions of property right conform to codified law. The simplest scenario is that one person, say Bob, is the owner of a single well-defined physical good, a book. In this case there is little room for any misunderstanding. For example, to take away Bob's book without his consent is considered theft, which is illegal and psychologically considered immoral. It does not matter whether Bob still values the book; the mere fact that Bob cannot make use of the book anymore, to which he did not consent, constitutes a breach of his property rights and is almost universally perceived as such (Green and Kugler 2010). However, perceptions of property rights start to differ considerably from the legal interpretation of property rights once other types of goods are involved. Notoriously, perceptions of intellectual property rights differ often differ considerably from what the law prescribes (Nunes *et al.* 2004). Specifically, consumers are morally less concerned about violations of intellectual property rights compared to the legal measures that are put in place to protect intellectual property (Logsdon, Thompson and Reid 1994). This thesis focuses on nontrivial types of goods, such as intellectual property, to investigate how consumers tend to perceive property rights in general and how this might differ from a legal perspective.

1.2. A Basic Taxonomy of Goods

To determine what types of goods can be considered nontrivial, a taxonomy of goods is needed.

We adopt a basic taxonomy of goods based on two characteristics: (1) rivalry and (2) tangibility (Table 1.1). The first characteristic, rivalry, is a concept adopted from economics (Mankiw 2009). The degree of rivalry determines to what extent multiple consumers are able to enjoy the same good at the same time. Thus, only one person at a time can enjoy a perfectly rivalrous good. For example, a book is a perfectly rivalrous good because only one person at a time is able to read from it. In contrast, a large number of people can make use of a park, which is an example of a nonrivalrous good. In economics the distinction between rivalrous and nonrivalrous good is often used to determine whether a good can be considered a public good (Kroll, Cherry and Shogren 2007; Schlager and Ostrom 1992). Theoretically, an unlimited number of consumers can make use of the same good at the same time if it is perfectly nonrivalrous. Information goods are a prototypical example of a perfectly nonrivalrous good.

Table 1.1: ***A taxonomy of goods***

		Rivalry	
		Rivalrous	*Nonrivalrous*
Tangibility	*Tangible*	Books	Park
	Intangible	Reservation spots	Information

The second characteristic, tangibility, is a concept adopted from consumer psychology (Peck, Barger and Webb 2013). The degree of tangibility determines to what extent the good has a physical presence and, thus, can be touched. Peck *et al.* (2013) argue that tangibility increases perceived ownership because tangibility provides a sense of control over the object, even if tangibility is only imagined. In the literature there is an implied misunderstanding that intangible goods are necessarily nonrivalrous (Lysonski and Durvasula 2008). However, it is possible that an intangible good is rivalrous. A ubiquitous example is a reserved spot on a waiting list. Only a single person at the time can take a single spot on the list but the spot itself is not a tangible good.

The taxonomy provides a map of how the main chapters of this thesis relate to each other.

Chapter 2 provides a more detailed discussion about the complete taxonomy within the context of understanding how consumers tend to perceive theft and piracy. Chapter 3 concentrates on the distinction between rivalrous and nonrivalrous goods. Chapter 4 investigates how framing a rivalrous good as a nonrivalrous good can affect moral decision-making. Chapter 5 focuses on how consumers are inclined to exchange an intangible rivalrous good, a queue position, and to what extent consumers make a moral distinction between exchange mechanisms.

Even though information goods are nonrivalrous of nature, the number of consumers that are in fact able to consume the same good at the same time depends on the state of the art. For example,

initially, a song could only be heard by a small number of consumers if they were physically present at a venue. Afterward, a song could be stored on easy-to-distribute mediums, such as CDs, to allow a large number of consumers to enjoy the same song. These mediums constitute in essence a tangible and rivalrous representation of an otherwise intangible and nonrivalrous goods. As a result, the number of available mediums determined the potential reach. However, the Internet made it possible to transfer information goods easily without using any medium, which explicitly exposes the nonrivalrous nature of information goods. Numerous studies suggest that this development resulted in an increase of intellectual property right violations, also known as digital piracy (e.g., Bhattacharjee, Gopal and Sanders 2003).

Nunes *et al.* (2004) suggest an alternative taxonomy based on the cost structure of goods to understand consumers' perceptions of property rights. They argue that consumers are more likely to respect property rights of a good with high variable costs because consumers prefer to compensate seller for costs that can be directly attributed to a single unit (i.e., variable costs). Similarly, consumers are less willing to pay for goods with low variable costs even if the fixed costs are high, which is often the case for information goods. Nunes *et al.* (2004) argue that refusal to compensate variable costs is perceived as harming the seller because it causes a loss to the seller.

We posit, however, that the taxonomy based on rivalry and tangibility is theoretically more tractable. First, costs are historical and vary over time. Thus, the ratio of fixed and variable costs is not constant and not inherent to the good itself while rivalry and

tangibility are integral and stable properties. Second, consumers would only care about costs if they bought directly from the producer, which is often not the case. Nunes *et al.*'s (2004) framework implies that gifted goods are far more likely to be stolen considering the cost incurred by the current owner is zero. Rivalry and tangibility do not depend on the current owner of the good. Third, fixed and variable costs are often not known and can be inferred only partially through inspection. Rivalry and tangibility can be determined easily for any good. Furthermore, the degree of rivalry determines to what extent an owner can lose possession, which is closer to the concept of loss as understood in prospect theory compared to the notion of financial losses (Brenner *et al.* 2007).

1.3. The Psychology of Property Rights

A recurring theme throughout this thesis is the relevancy of prospect theory to gain a better understanding of consumers' perceptions of property rights (Kahneman and Tversky 1979). A central element of prospect theory is the notion that losses weigh more than gains to determine the attractiveness of options, also known as loss aversion. There is strong evidence that options that are framed in terms of losses are less attractive than options that are framed as gains, even if the outcome between the two types of options is exactly the same (Kühberger 1998). Loss aversion is extensively applied to explain a broad range of patterns in individual decision-making. More recent studies suggest that consumers also take into account to what extent others might experience loss aversion (e.g., Andersson *et al.* 2014).

Gintis (2007) argues that loss aversion reveals that humans are predisposed to recognize and respect property rights. Specifically, he points to the endowment effect as a strong indication that humans have an intuitive sense of property rights. The endowment effect is the empirically supported hypothesis that owned goods are valued more than non-owned goods. In a classic study Kahneman, Knetsch and Thaler (1990) show that the willingness to pay for obtaining a coffee mug is lower than the willingness to accept to sell the same coffee mug. This observation contradicts with standard economic theory, which predicts that there is no difference between willingness to pay and willingness to accept because the amount of value that can be derived does not change if ownership changes. In other words, the mere fact of being an owner of a good increases the perceived value of that good (Beggan 1992).

Three of the four studies reported in this thesis (Chapter 2, 3 and 4) focus on consumers' tendency to violate property rights of others. The aim of this approach is not to study violations of property rights *per se* but to determine under which circumstances consumers are more or less likely to violate property rights, which in turn uncovers how consumers tend to perceive property rights. Standard economic theory provides a baseline prediction of the likelihood of property rights violations (Becker 1968). This approach assumes a perfectly self-regarding consumer who would only respect property rights if the deterrence is sufficiently strong. Thus, such a consumer is assumed to trade-off, on the one hand, the value of violating property rights and, on the other hand, the probability of being caught and the magnitude of the punishment if

caught. This implies that in the absence of deterrence this consumer would not hesitate to violate property rights for self-gain.

1.4. Methodology

The studies reported in this thesis concentrate on corner cases in terms of property rights. The use of corner cases is an oft-applied technique in the study of morality because these cases force participants to reveal their moral preferences on nonobvious issues, which in turn furthers our understanding of human moral decision-making. Arguably the most influential corner case in the study of moral decision-making is the so-called trolley problem (Foot 1967). The trolley problem consists of the hypothetical scenario in which five persons are standing on a train track. A train is heading towards the five persons but it is possible to divert the train to a sidetrack by hitting a switch. However, on this sidetrack there is another person standing. The moral dilemma is whether it is morally justified to hit the switch, which prevents the death of five persons but does lead to the death of another person who otherwise would not have been killed.

Empirical studies show that a majority of respondents consider it morally permissible to pull the lever (Lanteri, Chelini, and Rizzello 2008). Although the scenario is extremely unlikely to ever occur in reality, numerous studies have compared reactions to variations of the trolley problem to uncover patterns of intuitive moral decision-making (Mikhail 2007). For example, a famous alternative scenario of the trolley problem is in which there is no sidetrack and instead it is possible to stop the train by pushing someone, who is assumed

to be overweight, from a bridge on the track. The impact of the train would kill this person but also stop the train, which prevents the death of the five persons. Even though there is no difference in outcome between the standard variation and the bridge variation, studies show that an overwhelming majority considers pushing a person from the bridge to save five lives morally impermissible (Lanteri *et al.* 2008).

This discrepancy reveals that moral decision-making is more than weighing the possible outcomes; it also matters under which conditions an outcome came about. Greene *et al.* (2009) theorize that the moral distinction arises from the fact that in the 'switch' scenario the intent is to redirect the train, which has the side effect of killing another person while in the 'bridge' scenario the intent is to use a person as a means to stop the train. Interestingly, this explanation is not intuitive considering that respondents seem unable to formulate a justification that matches the found pattern (Cushman *et al.* 2006). Similarly, this thesis emulates the above approach to identify deeper insights about how consumers tend to perceive property rights.

1.5. Thesis Overview

Chapter 2 focuses on the moral distinction between theft and piracy. Previous studies suggest that consumers are morally less concerned about piracy compared to theft (Nunes *et al.* 2004). The aim of this study is twofold. First, Chapter 2 explores whether a moral distinction between theft and piracy exists. Second, Chapter 2 aims to determine which factors adequately explain this

distinction. Chapter 2 consists of four vignette experiments. The goal of the first experiment is to establish to what extent a moral distinction between theft and piracy exists. The second experiment aims to establish whether consumers are more likely to pirate than to steal. The third and fourth experiment aim to disentangle to what extent rivalry and tangibility can explain the moral distinction between theft and piracy.

Chapter 2 is based on the paper titled 'Explaining the Moral Distinction between Theft and Piracy: Second-Person Loss Aversion' and the co-authors are Gert-Jan Munneke and Maurits van der Molen.[1] Gert-Jan Munneke and I designed the studies. Gert-Jan Munneke collected the data. I analyzed the data and wrote the paper. Maurits van der Molen provided supervision.

Chapter 3 further scrutinizes the moral distinction between theft and piracy based on the main findings of the studies reported in Chapter 2. One of the main conclusions of Chapter 2 is that rivalry determines to a great extent whether a violation of property rights is considered immoral. However, the studies in Chapter 2 consist of presenting hypothetical scenarios to the participant as an objective observer. Chapter 3 presents two economic experiments in which participants were provided the opportunity to steal or pirate. Thus, participants could actually monetarily gain from stealing or pirating and in those cases victims were actually monetarily disadvantaged. In the first experiment participants were only able to steal or pirate a single good. The second experiment extends to number of goods

[1] El Haji, A., Munneke, G.J. & Van der Molen, M.W. (2016). Explaining the Moral Distinction between Theft and Piracy: Second-Person Loss Aversion.

that can be stolen or pirated to ten and we manipulate the prices to vary the monetary incentive to steal or pirate. The experiments reported in Chapter 3 also introduce a novel method to compare theft and piracy without changing the payoff structure. As a result, the difference between theft and piracy is a matter of changing frames, which allows drawing conclusions about why consumers are more averse to theft than to piracy.

Chapter 3 is based on the paper titled 'The Moral Distinction between Theft and Piracy: An Experimental Study' and the co-author is prof. dr. Mark Leenders. Mark Leenders and I designed the studies. I conducted the experiments, analyzed the data and wrote the paper. Mark Leenders provided supervision.[2]

Chapter 4 investigates to what extent the aversion to theft is sensitive to changes in the nominal representation of goods. Previous studies, including Chapter 2 and 3, show that consumers are averse to stealing rivalrous goods (e.g., Oxoby and Spraggon 2008). However, it is unclear what precisely triggers this aversion. A distinction can be made between the nominal and real representation of a good. The distinction between the nominal and real representation is extensively studied in the context of money illusion. Money illusion is the psychological tendency to take into account the nominal value of money. For example, Shafir *et al.* (1997) show that consumers prefer receiving a 5% raise with 4% inflation to receiving a 2% raise without any inflation, while the latter option in real terms is more attractive. Thus, consumers tend

[2] El Haji, A. & Leenders, M.A.A.M. (2016). The Moral Distinction between Theft and Piracy: An Experimental Study.

to maximize the nominal amount even if this leads to a less attractive outcome in real terms. Chapter 4 explores to what extent the degree of theft can be mitigated or magnified by disentangling the nominal representation of goods from the representation in real terms. Particularly, we investigate to what extent the degree of theft increases if it is possible to steal without affecting the potential victim nominally, which is dubbed the dilution illusion. Furthermore, we explore whether susceptibility to the dilution illusion is associated with cognitive ability.

Chapter 4 is based on the paper titled 'Dilution Illusion' and the co-author is dr. Aljaž Ule. Aljaž Ule and I designed the experiment.[3] I conducted the experiment, analyzed the data and wrote the paper. Aljaž Ule provided supervision. Financial support from the University of Amsterdam Research Priority Area in Behavioral Economics is gratefully acknowledged.

Chapter 5 studies how the introduction of property rights in a queue can affect trading behavior and fairness perceptions. Queues arise if consumers are required to wait before being served and tend to become longer as demand exceeds supply even more (Kumar, Kalwani and Dada 1997). Queues can be prevented if the monetary price for the service is sufficiently high. However, in many cases prices cannot be changed or even introduced due to practical or ethical reasons. Consumers waiting in line are in essence paying with their time on top of the monetary price for the service (Kleinrock 1967). This leads to an inefficient allocation of services because the value of time is not the same for everyone.

[3] El Haji, A. & Ule, A. (2016). Dilution Illusion.

Theoretically, this inefficiency can be reduced if property rights are applied to the positions in queue (Gershkov and Schweinzer 2010). This would allow the queued consumers to trade positions, which would allow consumers with a high time value to pay for moving forward in the queue and consumers with a low time value receive money to move back in the queue. A position in the queue is an example of a rivalrous but intangible good.

The study in Chapter 5 investigates empirically how consumers respond to the ability to trade places in a queue. Specifically, two auction mechanisms are compared: (1) a server-initiated auction (SIA) and (2) a customer-initiated auction (CIA). The SIA mechanism requires every consumer to place a bid on a position, including the incumbent consumer, and the proceeds are distributed equally among the bidders. Thus, under the SIA mechanism, incumbents are not entitled to 'their' position in the queue and do not receive the full amount for selling `their` position. However, under the CIA mechanism property rights are exogenously enforced. Consumers can trade positions with the person in front of them. However, the person in front is not forced to sell and receives the full amount if sold. This experimental design makes it possible to study whether biases related to property ownership, such as the endowment effect (Kahneman *et al.* 1990) and the sunk cost effect (Arkes and Blumer 1985), are present and whether the exogenous enforcement of property rights affects bidding behavior.

Chapter 5 is based on the paper titled 'Trading Places: An Experimental Comparison of Reallocation Mechanisms for Priority

Queuing' and the co-author is dr. Sander Onderstal.[4] Sander Onderstal and I designed the experiment. I conducted the experiment and analyzed the data. Sander Onderstal and I wrote the paper. Sander Onderstal provided supervision. Financial support from the University of Amsterdam Research Priority Area in Behavioral Economics is gratefully acknowledged.

Chapter 6 provides an overview of the main findings of the studies reported in this thesis. Furthermore, we discuss how the studies combined contribute to the literature. Chapter 6 ends with an overview of the managerial implications of this thesis.

[4] El Haji, A. & Onderstal, A.M. (2016). Trading Places: An Experimental Comparison of Reallocation Mechanisms for Priority Queuing.

2. The Moral Distinction between Theft and Piracy

2.1. Introduction

Consumers' tendency to pirate is a major societal concern. Piracy can be defined as copying or sharing copyrighted content without the owner's consent. The Business Software Alliance (2012) finds that 57% of computer users self-reported that they pirate. Despite legal and public communication campaigns to deter consumers from pirating, there is little indication that the piracy rate has dropped. Measures to prevent piracy seem to be of little effect (Sinha, Machado and Sellman 2010). Firms seem to implicitly accept that piracy is difficult to eradicate and that efforts to prevent it are futile (Bhattacharjee, Gopal and Sanders 2003). Although piracy is widespread and continues to constitute a major challenge for firms and governments (Lessig 2004), it is still unclear why consumers are much more prone to engage in piracy than theft.

Extant research on consumer piracy has focused primarily on factors that can be associated with the decision to pirate or not (e.g., Hennig-Thurau, Henning and Sattler 2007; Levin, Dato-on and Rhee 2004; McCorkle *et al.* 2012; Sinha and Mandel 2008; Watson, Zizzo, and Fleming 2015). However, these studies do not separate factors that are also associated with the theft of physical objects. For example, a higher probability of being caught decreases the likelihood of piracy (Sinha and Mandel 2008), but this relationship also exists for physical goods (Antia *et al.* 2006). For a clearer understanding of why piracy is prevalent while theft is

not, it is pertinent to explicitly compare these two closely related types of criminal behavior.

This research aims to understand to what extent a moral distinction between theft and piracy exists, and which factors adequately explain the distinction. We argue that extending prospect theory to how consumers evaluate outcomes that affect others can provide a succinct explanation of the moral distinction between theft and piracy. Standard prospect theory posits that humans are more sensitive to losses than to gains (Kahneman and Tversky 1979). We argue that consumers are not only relatively more sensitive to causing losses to themselves but also to others. Specifically, consumers are expected to be averse to causing *possessive* losses even if this loss is a gain to the consumer. We dub this tendency second-person loss aversion (SPLA).

Considering theft always involves dispossessing owners while piracy does not dispossess the owner of the focal good, a moral distinction between the two types of criminal behavior is predicted in which piracy is evaluated less negatively than theft. Although piracy does result in losses in form of foregone gains, studies show that this type of loss weighs less than possessive losses (Brenner *et al.* 2007; Kahneman, Knetsch and Thaler 1991). An implication of the existence of SPLA is that the likelihood of piracy is predicted to be high if perceived value is also high because there is no increase in possessive losses to offset the attractiveness. On the other hand, however, the likelihood of theft is expected to be low if perceived value is high because a higher perceived value translates to a greater magnitude of possessive losses. Although on the surface the tangibility of the focal good seems to be a distinguishing

characteristic between stolen and pirated goods, SPLA predicts that this distinction is not relevant.

2.2. Theoretical framework

2.2.1. Piracy

Research on piracy primarily aims to understand why consumers pirate (Watson *et al.* 2015). For example, Hennig-Thurau *et al.* (2007) study why consumers share pirated movies while Levin *et al.* (2004), McCorkle *et al.* (2012), and Sinha and Mandel (2008) focus on the determinants of sharing pirated music. Unfortunately, these studies do not explain why piracy is more prevalent than other types of deviant consumer behavior. This would require an explicit comparison between piracy and related criminal behavior. Piracy has often been compared with theft or even categorized as such (Goodenough and Decker 2008). But there is little evidence of whether consumers have a different moral attitude toward piracy than toward theft, and whether this translates into a moral gap between the propensity to pirate and the propensity to steal.

Standard economic theory predicts that the likelihood of criminal behavior is a function of three variables: 1) value of the focal good, 2) probability of being caught, and 3) the magnitude of the punishment if caught (Becker 1968; Mazar *et al.* 2008). The standard economic prediction is, therefore, that the likelihood of piracy and theft are equal if these three variables are equal as well. It can be argued that piracy is more prevalent because the probability of being caught and the magnitude of the punishment are both lower than in the case of theft. This would imply that

consumers do not morally differentiate between theft and piracy, and that mere economic considerations determine the likelihood of theft and piracy. However, some studies suggest that consumers do differentiate morally between theft and piracy and that this moral distinction should partially explains why piracy is more prevalent than theft (e.g., Cockrill and Goode 2012; Nunes *et al.* 2004). The distinction is also reflected in the codified law of various countries, where violations of intellectual property rights are considered less severe than violations of physical property rights (Yu 2011). To be able to pinpoint the source of a moral distinction between the two forms of larceny, it is pertinent to identify the differences between theft and piracy.

Both theft and piracy constitute expropriating a good without the owner's consent. If the good is for sale, theft or piracy occurs if the consumer refuses to pay. The economic consequences of both theft and piracy are similar. Namely, the legitimate owner loses the possibility to sell the good at a profit to the perpetrator, which is also known as foregone gains (Thaler 1980). However, a notable and observable difference between theft and piracy is the nature of the focal good. Theft applies to physical goods, such chairs and books, while piracy applies to information goods, such as music, imagery, and texts. Thus, a moral distinction between theft and piracy is bound to stem from a difference in the type of goods involved. We identify two characteristics that differ between physical goods and information goods: 'rivalry' and 'tangibility'.

2.2.2. Rivalry and tangibility

'Rivalry' is a basic notion within economics and can be defined as the extent to which joint consumption or possession of a single good is possible. More precisely, the number of consumers being able to consume the same good at the same time without affecting individual consumption experience determines the degree of rivalry. Only one consumer at a time ($N = 1$) can consume a perfectly rivalrous good. For example, the comfort of a chair is enjoyed by at most one consumer. A perfectly *non*-rivalrous good can be enjoyed by an unlimited number of consumers ($N = \infty$). The content of a news article, for example, can be shared and read widely without affecting the quality of the article. However, many goods are neither perfectly rivalrous nor perfectly non-rivalrous ($1 < N < \infty$). Trains, for example, are able to accommodate more than one person to provide the same good until the train gets too crowded to be able to provide a seat for an additional traveler.

The notion of rivalry provides a more precise understanding of the distinction between the types of good associated with theft and piracy. It can be argued that theft only pertains to goods that are (almost) perfectly rivalrous (e.g., cars, jewelry), while piracy only relates to perfectly non-rivalrous goods (e.g., information goods). As a result, theft always has as a consequence that it dispossesses the current user because rivalrous goods can only be expropriated by inflicting a possessive loss to the victim. Even though in the case of piracy there is a victim, this victim does not experience a possessive loss. Thus, the moral distinction between theft and piracy might originate from the extent to which each act causes a possessive loss to the victim.

Another difference between physical and information goods is tangibility. Physical goods are inherently tangible and information goods are inherently intangible. Peck and Shu (2009) show that touching an object increases the perceived ownership of that object, which in turn increases the perceived value. As tangibility implies that the product can be controlled physically – and physical control is associated with a higher degree of perceived ownership – consumers tend to have stronger feelings of entitlement toward tangible goods (Pierce, Kostova and Dirks 2003). Tangibility also signals that the producer had to incur costs to produce the good, which increases the perceived value (Nunes *et al.* 2004). The psychological effect of tangibility on product evaluation and perceived ownership is also observable when the ability to touch a good is only imagined (d'Astous and Kamau 2010; Peck, Barger and Webb 2013).

Besides rivalry, tangibility might contribute to the moral distinction between theft and piracy. Peck and Shu (2009) argue that tangibility facilitates establishing ownership as non-owners deem it feasible that someone else, arguably the rightful owner, already had the focal tangible product in her possession. This moral conclusion might deter consumers from appropriating tangible goods. As information goods are inherently intangible, it is much more difficult to signal the possibility of ownership. Therefore, information goods are more likely to be perceived as having no owner at all, which in turn decreases the moral barrier to refuse paying for information goods.

Rivalry and tangibility are distinct characteristics of any consumable good. Theft is arguably often associated with rivalrous

and tangible goods. In contrast, appropriating non-rivalrous intangible goods (e.g., downloading music) is usually not considered to be theft. Legally, taking the train without paying for a ticket is considered evasion, and copying a book without the publisher's consent is categorized as infringement. An archetypical pirated good is both non-rivalrous and intangible (Table 2.1). It is unknown to what extent each characteristic (i.e., tangibility and rivalry) contributes to the moral distinction between theft and piracy. We draw from prospect theory to address this research gap.

Table 2.1: ***Tangibility, rivalry and appropriation type***

		Rivalry	
		Rivalrous	*Non-rivalrous*
Tangibility	*Tangible*	Chairs (Theft)	Public transportation (Evasion)
	Intangible	Domain names (Theft)	E-books (Piracy)

Notes. For each possible combination a prototypical example is provided. The term for appropriating the type of good without the owner's consent is in parentheses.

2.2.3. Second-person loss aversion

Prospect theory states that losses weigh more than gains in individual decision-making (Kahneman and Tversky 1979). Prospect theory was initially applied to risky choices to explain anomalies such as the observation that consumers tend to reject profitable lotteries that have as a possible outcome a salient loss. Research on loss aversion primarily focused on how possible outcomes for the self are evaluated. There is a growing body of

evidence demonstrating that loss aversion applies not only to situations in which the self is potentially affected but also when others are (Andersson *et al.* 2015; Polman 2012; Nunes *et al.* 2004). We make a distinction between first-person loss aversion (FPLA) and second-person loss aversion (SPLA). FPLA conforms to the standard interpretation of loss aversion; decision-makers give more weight to one's own losses than one's own gains. SPLA, however, takes into account how choices impact one's own gains and losses *and* the impact on the gains and losses of others.

A difference between FPLA and SPLA is the nature of the aversion. Camerer (2005) argues that FPLA is an emotional reaction, more precisely, a fear of incurring losses to onself. As SPLA takes into account a second person, emotions such as empathy are likely involved (Crockett *et al.* 2014). A possible consequence is that, besides choice behavior, SPLA implicates moral considerations (Baron 1995; Liberman, Idson and Higgins 2005; Van Beest *et al.* 2005; Zhou and Wu 2011). Kahneman, Knetsch and Thaler (1986) show that the effect of loss aversion can be captured in terms of fairness. They show that cutting the wages of workers is considered unfair even if it is legally allowed and is the optimal choice, given market conditions. However, the outcome is considered fair if it can be obtained by making sure that the percentage wage increase is lower than the inflation rate. Their findings strongly suggest that loss aversion affects moral considerations once the possible impact on other people is taken into account.

SPLA is conceptually different from an aversion to harm others. The aversion to harm others is a well-established moral human

preference to avoid hurting others (Haidt 2007). SPLA differs in two respects from harm aversion. First, SPLA explicitly compares the outcome for the self with the outcome for the other while harm aversion focuses solely on the outcome for the other. Particularly, this research focuses on the scenario that a gain to the self might lead to a loss to a second person. Second, SPLA focuses on losses and gains of possessions as understood in the literature on loss aversion (Brenner *et al.* 2007). Harm aversion, however, focuses solely at possible negative outcomes for others and the negative outcome might also include physical harm, which is beyond the scope of loss aversion.

SPLA might provide a novel explanation of why a moral distinction between theft and piracy likely exists, which in turn can explain why piracy is more likely to occur than theft. A core assumption is that consumers stand to gain from acquiring a good through either theft or piracy. Amoral consumers would be indifferent between stealing and pirating if the perceived gain from doing so, together with the probability of being caught and the extent of the punishment if caught, are the same in both cases. In contract, moral consumers might perceive the impact on the victim. Under SPLA, moral consumers will refrain from piracy or theft if the perceived loss to the victim outweighs the gain (Van Beest *et al.* 2005). It is unclear, however, whether the perceived loss to the victim of piracy is of the same magnitude as in the case of theft. This depends on the consumers' perception of what constitutes a loss.

We identify two types of losses that can arise if a good is appropriated without being paid for. The first type of loss is the

loss of the possibility to profit, which constitutes foregone gains. Foregone gains are gains that would have materialized if the good had been paid for. Foregone gains are caused both in the case of theft and in the case of piracy. When the Recording Industry Association of America and the Motion Picture Association of America argue that piracy is equivalent to theft, they base this moral equivalence on the fact that both acts result in foregone gains (Yu 2011). The second type of loss is losing possession of the good itself. Recent evidence strongly suggests that consumers care more about the loss of possession than foregone gains (Brenner *et al.* 2007; Dommer and Swaminathan 2013). Brenner *et al.* (2007) show in two studies that consumers are more averse to a loss of possession than a loss in terms of valence. Novemsky and Kahneman (2005) show that the unintentional loss of possession, especially in the case of theft, induces a stronger effect of loss aversion.

2.2.4. Overview of experiments

Four experiments were designed to investigate to what extent SPLA provides an explanation of the moral distinction between theft and piracy. Experiment 1 establishes whether a moral distinction between theft and piracy does indeed exist. Experiment 2 shows the extent to which the nature of the good (physical or digital) affects the likelihood of piracy and theft. Experiments 1 and 2 compare piracy and theft without disentangling the specific causes of a moral distinction. Experiments 3 and 4 explore three possible explanatory variables: rivalry, tangibility, and the presence of foregone gains. Experiment 3 aims to compare to what extent tangibility and rivalry contribute to explaining the distinction. In

Experiment 4 rivalry is separated from the presence of foregone gains. Based on SPLA we predict that rivalry is the strongest contributor of the moral distinction between theft and piracy because rivalry makes possessive losses possible.

2.3. Experiment 1: Moral evaluation of piracy and theft

Experiment 1 is designed to test whether consumers morally dissociate between piracy and theft. We argue that due to SPLA theft is considered less fair than piracy. Participants are asked to indicate to what extent they agree with a negative or positive moral evaluation of either piracy or theft. Acts that are considered unambiguously immoral have a high level of agreement with a negative moral evaluation and a low level of agreement with a positive moral evaluation. As theft implies imposing a possessive loss on the victim, we predict that theft falls squarely in this category (Kahneman *et al.* 1986). Although piracy also imposes losses on the victim, these losses are not possessive losses. We therefore predict that the moral evaluation of piracy is distinct from theft in the sense that piracy is not considered unambiguously immoral.

2.3.1. Method

Sixteen paid students (M_{age} = 23, SD = 4.28) participated in a 2 (action: theft, piracy) x 2 (moral evaluation: positive, negative) within-subject design. Participants were recruited using announcement boards available across campus.

We obtained moral attitudes toward piracy and theft using a questionnaire containing statements with either a positive or negative moral evaluation of the action. For example, a negative moral evaluation of theft could be stated as "I think that punishment for theft is a good thing" and a positive moral evaluation of piracy could be stated as "The prevalence of piracy is a good development." Each sentence is either constructed with the words theft or piracy and the moral evaluation is either positive or negative.

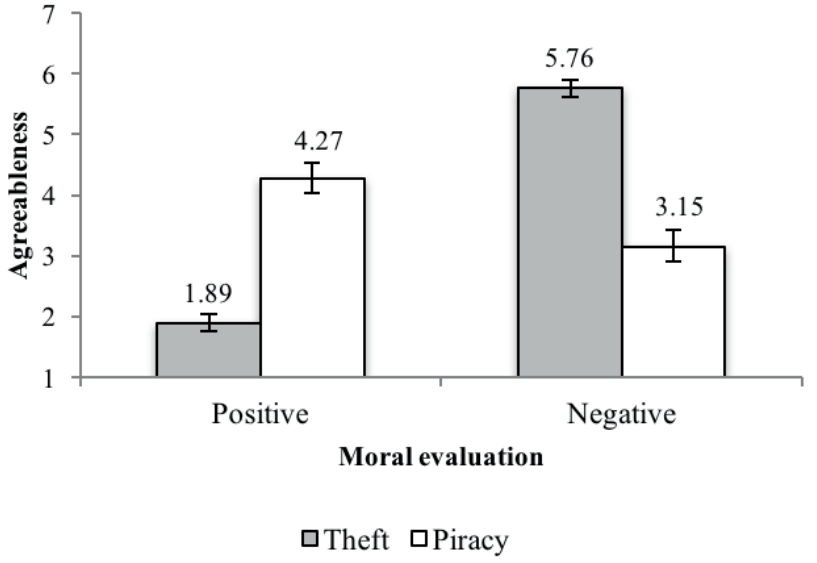
The format of these statements is adopted from Van Berkum *et al.* (2009) who used similar statements but with different actions to obtain moral attitudes. Each of the four conditions has 40 statements and the order of presentation was randomized. Thus, the total number of statements is Theft (2) x Piracy (2) x Valence (2) x Number (40) = 320. The statements were displayed on a computer screen. After presenting each statement participants were asked to report on the extent to which they agreed with the statement. Participants could indicate their agreeableness on a 7-point Likert scale (1 = "I completely disagree", and 7 = "I completely agree"). To capture the participant's intuitive response, there was a seven-second time limit for the response to each statement. The mean score of the responses in each condition was calculated and used for further analysis. The internal consistency of the statements in all four conditions is high (Cronbach $\alpha > .80$). At the beginning of the experiment participants were provided a general definition of theft and piracy to avoid any confusion about the specific crime (i.e., digital piracy and, thus, not actual violent piracy at sea).

2.3.2. Results

A 2 (action: theft, piracy) x 2 (moral evaluation: positive, negative) repeated measures analysis of variance (ANOVA) revealed a significant main effect of moral evaluation ($F(1,15) = 26.05$, $p < .001$, $\eta_p^2 = .64$) but did not show a significant main effect of type of action ($F(1,15) = 1.50$, $p = .24$, $\eta_p^2 = .09$). As predicted, there was a significant interaction effect between moral evaluation and type of action ($F(1,15) = 81.11$, $p < .001$, $\eta_p^2 = .84$; Figure 1.1). As a robustness check we repeated the analysis for each quartile of responses and we found that each quartile yielded the same outcome.

In line with our hypothesis, participants agreed more with a negative evaluation of theft (M = 5.76, SD = .55) than with a positive evaluation of theft (M = 1.89, SD = .58; paired-samples *t*-test, $M_{diff} = 3.87$, SD = 1.02, $t(15) = 15.18$, $p < .001$). The opposite seems to be true for piracy; participants agreed more with a positive evaluation of piracy (M = 4.27, SD = 1.07) than with a negative evaluation of piracy (M = 3.15, SD = .98; paired-samples *t*-test, $M_{diff} = 1.12$, SD = 1.93, $t(15) = 2.31$, $p = .04$). Furthermore, participants agreed more with a positive moral evaluation of piracy than a positive moral evaluation of theft (paired-samples *t*-test, $M_{diff} = 2.37$, SD = 1.27, $t(15) = 7.48$, $p < .001$). But participants agreed less with a negative moral evaluation of piracy than a negative moral evaluation of theft (paired-samples *t*-test, $M_{diff} = 2.61$, SD = 1.07, $t(15) = 9.75$, $p < .001$).

Figure 2.1: ***Moral evaluation of theft and piracy***



Note. Scale ranges from 1 ("I completely disagree") to 7 ("I completely agree").

2.3.3. Discussion

As predicted, the moral evaluations of theft and piracy differ significantly, which provides support for the existence of a moral distinction between the two. A positive moral evaluation of theft attracts a low level of agreement while a negative moral evaluation of theft is associated with a high level of agreement. Thus, theft is categorized as immoral and this categorization is unambiguous. On the other hand, participants seem to have another attitude towards piracy. Participants agree significantly more with a positive evaluation of piracy than with a negative one. Due to the perception

that theft imposes losses while piracy does not, it was predicted that theft is considered morally worse than piracy. We find that theft is evaluated unambiguously as immoral (*i.e.*, average agreement with a negative moral evaluation is beyond the middle of the scale in Figure 1.1) while piracy is considered moral (*i.e.*, average agreement with a positive moral evaluation is beyond the middle of the scale). However, participants' moral attitude toward piracy is not as strong as it is toward theft – which suggests that piracy is not considered fully moral. Even though piracy deprives victims of the possibility to profit (i.e., foregone gains), this alone does not seem sufficient to render the perception of piracy as immoral.

2.4. Experiment 2: Likelihood of cheating

Experiment 1 provided evidence of the existence of a moral distinction between theft and piracy. Experiment 2 was designed to test the prediction that people are less likely to commit theft than piracy due to an aversion to cause possessive losses to others (Van Beest *et al.* 2005). In Experiment 2 participants were asked to indicate how much they would be willing to pay for either a digital or physical copy of the same good. After providing an amount, participants were given the opportunity to cheat the seller and get the good for free.

Under SPLA the harm of losing a physical good is greater than the harm of copying a digital good. As a result, buyers are inclined to pay more to offset the harm. Therefore, we predict that the willingness to pay for physical goods is higher than for digital goods. Similarly, buyers who are given the opportunity to obtain a good through cheating (digital → piracy; physical → theft) are

expected to take into account the magnitude of the possessive loss. Thus, the likelihood of cheating is predicted to be higher if the focal good is digital.

2.4.1. Method

Three-hundred-and-sixty unpaid students (M_{age} = 23.10, SD = 4.92) participated in a single factor (type of good: physical, digital) between-subjects design. The participants were invited by e-mail to participate in a vignette study. Vignettes are often employed to study moral preferences (Rai and Holyoak 2010).

The vignette in this study starts with the following context, which is the same for both conditions: "Imagine visiting the website of a musician who has just released his first album." To avoid any association that may exist with a real musician, we add: "You have never heard of this musician before. After listening to samples of his album, it becomes clear to you that you enjoy listening to his music." Participants are then informed that they can purchase the album using a Name Your Own Price (NYOP) mechanism, which requires that the price needs to be positive (Kim, Natter and Spann 2009): "Today only it is possible to purchase the album for any positive amount from his website. Anywhere else the price is €20." A reference price is provided to reduce possible price variance (Johnson and Cui 2013).

In the tangible condition it is made clear to the participant that "[a]fter your purchase, you will receive the album on CD by post express on the same day." In the intangible condition it is mentioned that the album will be delivered on the same day "as a

download." Furthermore, to make the victim salient, it is emphasized in both conditions that the musician is the sole recipient of the revenues (Jenni and Loewenstein 1997): "It is made clear on the website that all revenues go to the musician."

After reading the vignette, participants are asked to report the amount they would be willing to pay for the album. It was made clear that the amount has to be positive and, thus, it is not possible to obtain the product by paying nothing. After confirming the amount, participants are informed that an error occurred during the payment procedure due to a glitch. As a result of this glitch, participants are given the opportunity to reduce their provided amount to zero, which is violation of the NYOP mechanism. Thus, participants who change the amount to zero cheat the seller, considering it was not possible to get the album for free. Cheating in the physical condition amounts to theft, while in the digital condition cheating can be interpreted as an act of piracy.

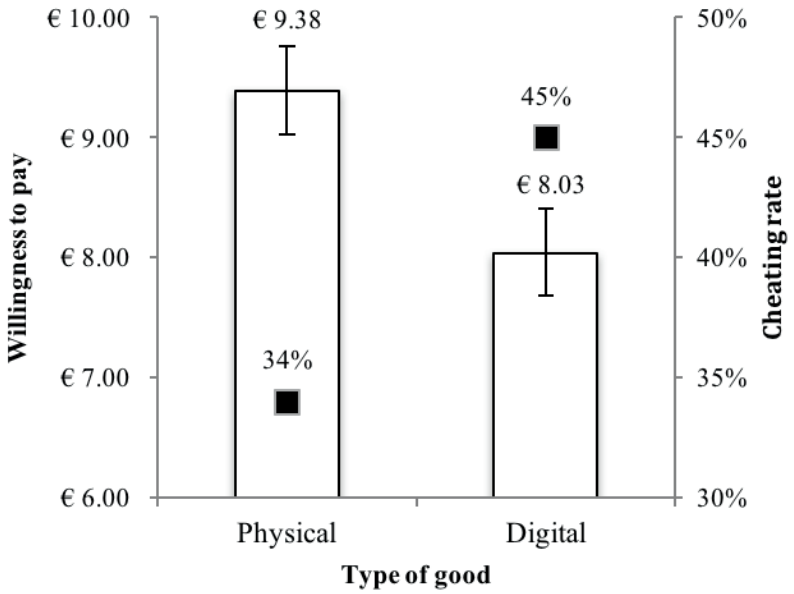
2.4.2. Results

The willingness to pay for a physical copy of the album (M = 9.38, SD = 5.07, Median = 10.00) was significantly higher than for a digital copy of the album (M = 8.03, SD = 4.72, Median = 8.00; ($F(1,358) = 6.78$, $p = .01$, $\eta_p^2 = .02$). To ascertain that this difference does not depend on a preference for physical mediums, we assessed which medium participants prefer to be able to control for this effect. Sixty-six percent indicated that in general they preferred the physical version (Binomial, $p < 0.01$). After controlling for this preference, a comparison of the means still

revealed that the willingness to pay is significantly higher if the copy is physical ($F(1,357) = 6.41$, $p = .01$, $\eta_p^2 = .02$).

Cheating is significantly more likely if the album is digital (45%) compared to a physical copy (34%; $\chi^2 = 4.36$, $p < .05$). We controlled for willingness to pay in a logistic regression. More specifically, including an interaction variable (price × digital copy) in the logistic regression revealed a significant interaction effect ($\beta = .10$, S.E. = .05, $\chi^2 = 4.10$, $p < .05$). This effect indicates that a higher willingness to pay is correlated with a higher likelihood of cheating if the copy is digital. In contrast, a higher willingness to pay is correlated with a lower likelihood of cheating if the copy is physical ($\beta = -.09$, S.E. = .04, $\chi^2 = 7.23$, $p < .01$).

Figure 2.2: ***Willingness to pay and cheating rate***



Notes. Bars represent average willingness to pay for each medium. Black rectangles represent the relative frequency of participants who chose to cheat for each medium.

2.4.3. Discussion

Willingness to pay for the physical version is significantly higher than for the digital version of the same good. Considering that the context between the two situations was the same, the difference can be attributed to a difference in medium type. Interestingly, the willingness to pay is inversely related to the cheating rate. Further analysis shows this effect is only true for the physical version whereas the effect is inversed for the digital version. The current pattern of findings constitutes strong evidence in support of an

explanation based on SPLA. The finding that participants are willing to pay to more to compensate the seller if the perceived loss of selling is greater as well is in line with SPLA. Buying the physical version of the album results in a possessive loss and as a result consumers are willing to pay more to compensate for this loss. Similarly, the finding that relatively fewer participants are prepared to cheat if the medium is physical reveals that in this case cheating is considered more harmful than if if the medium is digital.

2.5. Experiment 3: Tangibility versus rivalry

The previous experiments provide evidence that the moral acceptability of theft is lower compared to piracy (Experiment 1) and that theft is less likely to occur than piracy (Experiment 2). We argue that this distinction results from SPLA, which consists of an aversion to cause possessive losses to others. In Experiment 2, however, tangibility and rivalry are confounded. Specifically, the good that could be pirated in Experiment 2 was either non-rivalrous and intangible or rivalrous and tangible. In Experiment 3 these factors are disentangled. We predict that rivalry matters more for the moral acceptability of either theft or piracy than tangibility. Specifically, the theft or piracy of rivalrous goods is predicted to be less acceptable than that of non-rivalrous goods. The reason is that a victim only experiences a possessive loss if the good is rivalrous. Tangibility might also affect the moral acceptability of pirating or stealing a good (Peck and Shu 2009). However, this effect is expected to be smaller than the effect of rivalry on the moral acceptability of theft and piracy because it is assumed that

tangibility can only amplify existing considerations due changes in saliency while rivalry acts as a trigger of moral considerations.

2.5.1. Method

Two-hundred-and-seven unpaid students (M_{age} = 20, SD = 1.79) participated during class in a 2 (Tangibility: tangible, intangible) x 2 (Rivalry: rival, non-rival) within-subject design.

In this experiment participants were presented with four vignettes of which the order was randomized. Each vignette starts with the following context: "A music store sells a physical and a digital version of a music album that is only available in this shop. The price for both versions is the same." Then the focal good, which is either tangible or intangible, is introduced: "Jan and Marie are interested in the *physical/digital* edition. They do not know each other. Marie buys a *physical/digital* edition." To elicit moral outrage Jan robs Marie: "Jan *takes/downloads* the album that Marie just bought and runs out of the store." The vignette ends with information on whether Marie is still able to get a copy for herself, which is an operationalization of rivalry: "The store owner has *no* more copies. Jan was fully aware of this. Marie *will therefore receive a free/can therefore not receive* a replacement product. Jan foresaw this." If Marie is able to receive a replacement then the stolen good can be considered non-rivalrous considering that Marie was not deprived as a result of theft or piracy. However, if Marie is unable to receive a replacement then the stolen album is rivalrous because Marie was deprived as a result of either theft or piracy. It is always emphasized that Jan foresaw whether a replacement was

available to clarify Jan's foreknowledge of the moral consequences of his action.

After each vignette, participants evaluated the moral severity of Jan's action with a visual analogue scale. The right end of the scale indicates that Jan's action is completely acceptable and the left end represents Jan's action as being completely unacceptable.

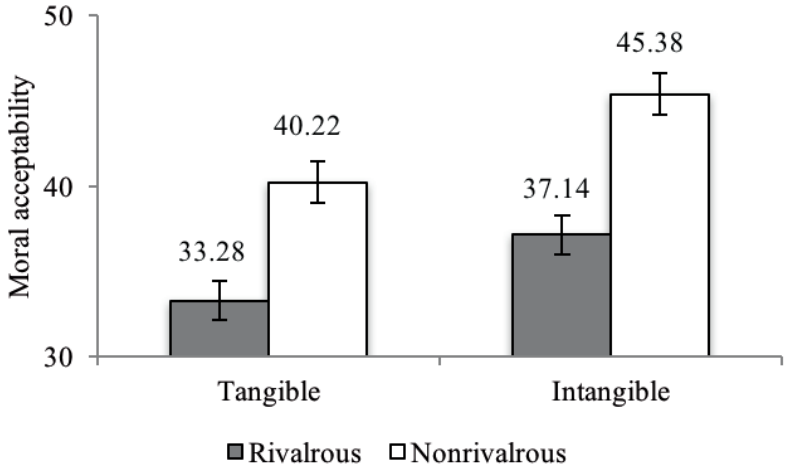
2.5.2. Results

A 2 (tangibility: tangible, intangible) x 2 (rivalry: rival, non-rival) repeated measures analysis of variance (ANOVA) yielded significant main effects of tangibility ($F(1,204) = 37.52$, $p < .001$, $\eta_p^2 = .16$) and rivalry ($F(1,204) = 90.12$, $p < .001$, $\eta_p^2 = .31$). The interaction between tangibility and rivalry was not significant ($F(1,204) = 1.08$, $p = .30$, $\eta_p^2 = .01$). Note that the effect size of rivalry is almost twice the effect size of tangibility, indicating that rivalry accounts for considerably more of the variance in moral acceptability than tangibility.

As predicted, participants were more likely to report Jan's behavior as being less acceptable if it deprived the victim of obtaining the music album ($M_{rival} = 35.25$ versus $M_{nonrival} = 42.76$; paired-samples *t*-test, $M_{diff} = 7.51$, $SD = 12.55$, $t(205) = 8.61$, $p < .001$). This effect occurred for both types of goods (digital: paired-samples *t*-test, $M_{diff} = 8.30$, $SD = 13.96$, $t(205) = 8.53$, $p < .001$; physical: paired-samples *t*-test, $M_{diff} = 7.02$, $SD = 15.70$, $t(205) = 6.42$, $p < .001$).

Stealing a intangible digital music album was considered more acceptable than stealing a tangible physical music album ($M_{physical}$ = 36.73 versus $M_{digital}$ = 41.27; paired-samples *t*-test, M_{diff} = 4.54, SD = 10.63, $t(205) = 6.14$, $p < .001$). The effect of tangibility can be found while considering the rivalrous ($M_{physical}$ = 33.28 versus $M_{digital}$ = 37.07; paired-samples *t*-test, M_{diff} = 3.79, SD = 12.59, $t(205) = 4.32$, $p < .001$) and non-rivalrous ($M_{physical}$ = 40.28 versus $M_{digital}$ = 45.38; paired-samples *t*-test, M_{diff} = 5.10, SD = 14.37, $t(205) = 5.09$, $p < .001$) treatments separately.

Figure 2.3: ***Moral evaluation of theft and piracy***



Note. Scale ranges from 0 ("Completely unacceptable, just as wrong as murder") to 100 ("Completely acceptable, there is nothing wrong with this behavior").

2.5.3. Discussion

Stealing or pirating rivalrous goods is considered less acceptable compared to doing the same with non-rivalrous goods. Obtaining a rivalrous good implies, by definition, that someone else loses possession of the good, which does not happen if the good is nonrivalrous. The observed link between rivalry and moral acceptability is in line with the notion that an aversion to causing possessive losses underpins the moral distinction between theft and piracy. Earlier studies show that imposing losses on others is considered more unfair than obtaining the same outcome without imposing losses (e.g., Kahneman *et al.* 1986). Furthermore, we find that the theft or piracy of intangible goods is more acceptable compared to stealing or pirating tangible goods. This supports earlier studies that find a relationship between tangibility and perceived ownership (Kamleitner and Feuchtl 2015; Peck and Shu 2009; Peck *et al.* 2013). Importantly, the effect of tangibility is much less pronounced than the effect of rivalry. This result underscores the relative importance of SPLA in explaining the moral distinction between theft and piracy.

2.6. Experiment 4: Foregone gains versus rivalry

In the previous experiment, there were two possible victims: Marie and the storeowner. In the rivalrous condition, the storeowner is unable to compensate Marie and, thus, Marie is the victim because she is monetarily worse off. In the non-rivalrous treatments Marie was not worse off in the end because the storeowner compensated her loss by providing a replacement. However, in this case the

storeowner has one fewer copy to sell profitably to someone else. This results in so-called foregone gains. Foregone gains are gains that could have been generated in the future but are not. Experiment 4 aims to separate the effect of rivalry from the effect of foregone gains.

Kahneman *et al.* (1991) argue that "out-of-pocket" losses, which affect current possessions, are considered more painful than foregone gains and that this distinction is revealed in fairness considerations. More recent studies show that the strongest type of "out-of-pocket" losses refers to possessive losses (Brenner *et al.* 2007; Dommer and Swaminathan 2013). A possessive loss can be defined as the deprivation of access to a good, which can be considered theft if the deprived person is also the owner. Considering that possessive losses can only occur if the good is rivalrous, we expect that rivalry is more pronounced than foregone gains in determining the moral acceptability of theft and piracy.

2.6.1. Method

Sixty-three unpaid students (M_{age} = 18.75, SD = 1.51) participated during class in a 2 (rivalry: rivalrous, nonrivalrous) x 2 (foregone gains: absent, present) within-subjects design.

Similar to the previous experiment, the participants were presented with four different vignettes in randomized order. Each vignette starts with the following context: "Jan needs a license code for using a computer program." We varied whether Jan is aware of options to purchase a license code: "He *knows/does not know* where to purchase a license code." Jan cannot cause foregone gains

if he is not aware of any channels through which to purchase a license code. However, if Jan is aware of a way to obtain a license code, he is causing the seller of the computer program to incur foregone gains.

All vignettes continue with the fact that "Jan finds on the internet a license code generator for the software program." The generated code is either rivalrous or non-rivalrous. A rivalrous code would deprive someone else: "The license code generator generates only codes of paying users. As a result Jan would deny someone access to the program." But a non-rivalrous code does not deprive anyone because the code is unused: "The license code generator generates only codes that nobody has. As a result Jan would not deny anyone access to the program." In all vignettes Jan commits piracy by generating a code: "Jan generated a license code and enters it."

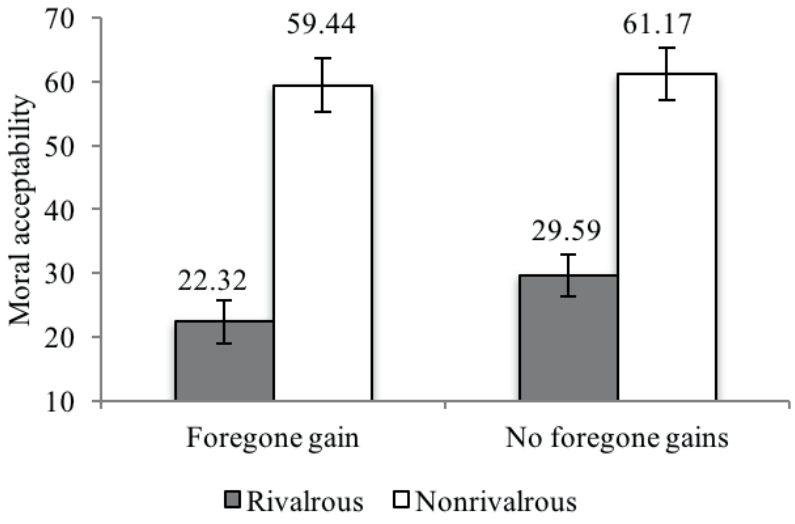
Again similar to the previous experiment, after each vignette participants are asked to evaluate the moral severity of Jan's action. We again employed a visual analogue scale on which participants could indicate their perceived moral severity. The left end of the scale represents Jan's action as being completely unacceptable (0) and the right end of the scale indicates that Jan's action is completely acceptable (100).

2.6.2. Results

A 2 (rivalry: rivalrous, non-rivalrous) x 2 (foregone gains: absent, present) repeated measures analysis of variance (ANOVA) revealed a significant main effect of rivalry ($F(1,62) = 47.84$, $p < .001$, $\eta_p^2 = .44$) and the presence of foregone gains ($F(1,62) = 7.19$,

p = .009, η_p^2 = .10). The interaction effect, however, between rivalry and the presence of foregone gains was not significant ($F(1,62) = 1.53$, $p = .22$, $\eta_p^2 = .02$). Participants find Jan's behavior significantly more unacceptable if generating a license code deprives someone else, irrespective of the presence of foregone gains (foregone gains absent, paired-samples t-test, $M_{diff} = 31.59$, SD = 43.96, $t(62) = 5.70$, $p < .001$; foregone gains present, paired-samples t-test, $M_{diff} = 37.13$, SD = 42.51, $t(62) = 6.93$, $p < .001$).

Figure 2.4: ***Perceived moral acceptability, rivalry and foregone gains***



Note. Scale ranges from 0 ("Completely unacceptable") to 100 ("Completely acceptable").

2.6.3. Discussion

Piracy of a rivalrous good is considered much less acceptable than the piracy of a non-rivalrous good. In the experiment the only difference between the rivalrous and non-rivalrous treatment is whether another person is deprived access to making use of a software package. In contrast to Experiment 3, the possessive loss in this experiment is not physical as the victim did not physically lose possession of any good. Loss of access is sufficient to trigger a large effect on the moral acceptability of piracy.

We also find that the presence of foregone gains significantly decreases the acceptability of piracy. Earlier studies show that foregone gains are often ignored or underweighted in individual decision-making (Frederick *et al.* 2009; Kahneman *et al.* 1991). Furthermore, this study confirms the hypothesis that rivalry matters more for the moral acceptability of piracy than foregone gains. Although the effect size of foregone gains is smaller than that of rivalry, it does reveal that foregone gains are not completely ignored in determining the moral acceptability of piracy.

2.7. Discussion

Piracy is a major public policy issue that has received little attention in the literature. Extant research on piracy focuses primarily on the determinants of piracy behavior without providing an empirical comparison with the often-related criminal offence of theft (e.g., Hennig-Thurau *et al.* 2007). Te current study examines to what extent the moral acceptability of theft and piracy differ and whether extending loss aversion can provide a novel explanation of

this distinction. An aversion to causing losses to others even if this is a gain to the focal person, which we dubbed second-person loss aversion, is an underexplored extension of prospect theory (Andersson *et al.* 2015; Polman 2012). Four experiments were designed to examine the existence of a moral distinction based on SPLA and explore alternative explanations.

Experiment 1 shows that theft is considered unambiguously morally unacceptable while the moral perception of piracy is more ambiguous. This provides support for the hypothesis that a moral distinction between theft and piracy exists. Experiment 2 reveals that this moral distinction also affects choice behavior. We find that the likelihood of piracy is significantly higher than that of theft. Furthermore, Experiment 2 also confirms our prediction that a higher willingness to pay results in a lower likelihood of theft but in a higher likelihood of piracy. Experiments 3 and 4 provide evidence that the moral distinction is primarily caused by an aversion to causing possessive losses to others. Possessive losses only occur if the good is rivalrous. Experiment 3 shows that rivalry matters more than tangibility in determining the moral acceptability of theft and piracy. In Experiment 4 the effect of rivalry was compared with the effect of foregone gains. Again, we find that rivalry dominates the moral perceptions of piracy. Collectively, the four experiments provide strong evidence of the existence of a moral distinction between theft and piracy and that SPLA underpins this distinction.

The current pattern of results makes at least three contributions. First, we show that comparing piracy with theft provides a better theoretical understanding of piracy behavior. The empirical

literature on piracy has focused primarily on identifying variables that are associated with piracy behavior. This research strategy resulted in a large number of variables associated with piracy behavior (Hennig-Thurau, Henning and Sattler 2007; Levin, Dato-on and Rhee 2004; McCorkle *et al.* 2012; Sinha and Mandel 2008). Although some studies also included variables that are specific to piracy (e.g., moral attitude toward piracy), the theoretical relevance of piracy is underdeveloped. The current study contributes to a theoretically more rigorous understanding of piracy behavior by focusing on determinants that are idiosyncratic to piracy (Nunes *et al.* 2004). To this end, piracy is compared with theft to identify factors that constitute the source of the moral distinction between the two behaviors.

Second, we demonstrate the relative importance of rivalry in explaining the moral distinction between theft and piracy. Earlier studies on piracy often only make a distinction between physical and digital goods (e.g., Hennig-Thurau *et al.* 2007). A more precise taxonomy of goods is possible by disentangling rivalry and tangibility. Rivalry and tangibility often overlap and sometimes the terms are used interchangeably, which has led to confusion in the literature (Lysonski and Durvasula 2008). This confusion results from observations indicating that most rivalrous goods are tangible and most intangible goods are non-rivalrous, which are often categorized as physical and digital respectively. However, rivalrous goods are not necessarily tangible and neither are intangible goods necessarily non-rivalrous. For example, internet domain names (e.g., google.com) are rivalrous and intangible. From a legal point of view, U.S. courts have clarified that the appropriation of

intangible rivalrous goods can be considered theft rather than a form of piracy even though these goods are categorized as digital goods (Henning 2013). This conclusion is counterintuitive considering that in the legal literature a defining characteristic of piracy is intangibility (Arias 2007). Empirically, we find that rivalry weighs considerably more than tangibility in determining the moral acceptability of theft and piracy.

Third, our application of loss aversion highlights the theoretical implications of prospect theory to moral decision-making. Research on loss aversion has primarily focused on how potential losses to oneself affect decision-making (Kahneman and Tversky 1979). Although early studies on loss aversion suggest that there is a relationship between loss aversion and moral considerations (e.g., Kahneman *et al.* 1986), few studies explored the nature of this relationship and its implications further until more recently (Andersson *et al.* 2015; Polman 2012). Developing the concept of loss aversion to include gains and losses caused to others (SPLA) provides a novel explanation of the existence of a moral distinction between theft and piracy. Rivalry as a characteristic within this context matters to moral considerations because it determines whether owners are dispossessed in case of theft or piracy. Earlier studies show that people are indeed averse to causing losses to others even if they can do so profitably, which provide support for SPLA (e.g., Van Beest *et al.* 2005). The current research builds on this literature by providing evidence that SPLA can shape moral perceptions and economic decision-making. SPLA predicts that consumers are less likely to steal than to pirate because stealing deprives another person of access even though this loss is a gain to

the perpetrator. We indeed find that theft and piracy elicit different attitudes and that this can be attributed to SPLA.

A possible limitation of this study is the use of vignettes. Experiment 2, 3 and 4 consists of participants responding to hypothetical scenarios that are not common in the field. Studies on moral decision-making often rely on such scenarios (Rai and Holyoak 2010). To overcome this limitation future research might aim to provide experimental evidence of SPLA from the field. A number of field experiments already provide evidence for the existence of FPLA (e.g., Ganzach and Karsahi 1995). Considering that theft and piracy often occur in considerably different contexts, it is difficult to imagine a field experiment, at least with a natural setting, which can test the existence of SPLA in the context of criminal behavior. Nevertheless, alternative methods, such as framed field experimentation, might provide the prerequisite conditions to test SPLA in the field (Harrison and List 2004).

Our findings have managerial implications for policy-makers and practitioners who aim to mitigate piracy. A common tactic to deter consumers from committing piracy is to morally equate piracy with theft. For example, the Motion Picture Association argued in a public service announcement that "[d]ownloading pirated films is stealing, stealing is against the law" (Loughlan 2007). We find that consumers make a clear moral distinction between theft and piracy. This moral distinction is rooted in how consumers perceive losses that are caused as a result of their actions. Our research provides evidence that possessive losses weigh more than foregone gains. As piracy only causes foregone gains it is more difficult to convince consumers of the immorality of piracy. Therefore, our research

suggests that public relationship strategies that involve the moral equivalence between theft and piracy are ineffective. A more viable strategy would be to create artificial scarcity to render a non-rivalrous good a rivalrous good. Consumers are less likely to commit piracy if they are aware that someone else will be deprived of her copy as a result.

3. Theft and Piracy: Incentivized Experiments

3.1. Introduction

Consumers' lack of compliance with intellectual property rights is a contentious topic of debate among researchers, policy-makers, and managers (Mazar and Ariely 2006). Modern economies increasingly rely on intellectual property (IP) and there is evidence that the enforcement of IP rights stimulates economic growth (Gould and Gruben 1996). Notwithstanding enforcement efforts, there is broad evidence that the piracy of IP is still rampant. For example, the global software piracy rate increased from 38% in 2007 to 43% in 2013 (Business Software Alliance 2014).

To discourage piracy, organizations like the Recording Industry Association of America (RIAA) and the Motion Picture Association of America (MPAA) emphasize that piracy is a form of theft. Ubiquitous anti-piracy public service announcements aim to morally equate piracy with theft. In 2004 the MPAA initiated an advertisement campaign on many DVDs with the message that "downloading pirated films is stealing" and indistinguishable from stealing "a handbag," "a car" or "a mobile phone." However, studies suggest that piracy is far more prevalent than theft (e.g., Goodenough and Decker 2008).

Various explanations have been put forth to understand why people are more likely to commit piracy than theft. Economic incentives might explain the notable gap between the piracy rate and the theft rate. Arguably, weak deterrence makes piracy more attractive than theft (Becker 1968). However, economic deterrence alone might be

insufficient to explain unlawful behavior (Gneezy and Rustichini 2000). There is evidence that people are averse to committing theft, even if the probability of being caught is zero (Gächter and Riedl 2005; List 2007; Oxoby and Spraggon 2008). Furthermore, Green and Kugler (2010) find that most people consider theft significantly more blameworthy than piracy. Together these studies imply that there is a moral distinction between theft and piracy.

In this study, we propose that loss aversion might explain the moral distinction between theft and piracy. A number of studies argue that there is a link between theft aversion and loss aversion (Blumenthal 2010; Gintis 2007; Stake 2004). However, the standard interpretation of loss aversion considers only the losses and gains of the decision-maker, where losses weigh more than gain (Kahneman and Tversky 1979). Instead, we argue that extending loss aversion to take into account the gains and losses of others provides a novel theoretical framework to explain the moral distinction. We hypothesize that theft aversion depends on whether the resource is rivalrous in its use or not. Because IP is *non*-rivalrous, its use does not prevent others from using it as well. Both legal and illegal downloading does not result in copyright content owners losing their property. Therefore, the moral impediment to steal might not exist for IP, which explains why many consider piracy morally permissible (Nunes, Hsee, and Weber 2004).

The use of economic experiments to study piracy is scarce, if not nonexistent. Most studies on piracy either depend on non-incentivized survey responses or country-level data. In this study two framed economic experiments were conducted to study the moral distinction between theft and piracy. Although economic

experiments that elicit theft have been conducted before (e.g., List 2007; Oxoby and Spraggon 2008) the study of piracy in economic experiments is new.

3.2. Theoretical framework

3.2.1. The moral distinction between theft and piracy

The standard economic explanation of illegal behavior presupposes a self-regarding person who rationally considers, on the one hand, the value of an illegally obtained good and, on the other hand, the probability of getting caught and the penalty in case of getting caught (Becker 1968; Conner and Rumelt 1991). This amoral person would prefer to commit an illegal behavior if the expected utility of the good exceeds the expected cost of getting caught. Arguably, theft is rare because the probability of getting caught is high and the penalty for theft is universally stringent. In other words, there is a strong judicial deterrence against committing theft. In the case of piracy the incentives to prevent it differ. Technological innovations, such as peer-to-peer networking, have made it much easier to obtain and share intellectual property anonymously, which makes it difficult to catch violators of intellectual property laws. Furthermore, the judicial consequences of violating IP laws are often controversial, unclear or only weakly enforced (Marron and Steel 2000). These economic factors contribute to the attractiveness of committing piracy. Thus, from an economic point of view theft is less prevalent than piracy due to differences in the strength of deterrence.

Economic incentives alone might not explain why piracy is more prevalent than theft. Theft might still be a less attractive option than piracy even if the economic environment is kept the same. More precisely, moral considerations might inhibit illegal behavior even in the absence of any deterrence. For example, Green and Kugler (2010) show in a vignette study that pirating an electronic book is considered significantly less blameworthy than stealing a physical one. They note that the intuitive perception of IP rights differs distinctly from codified law while this does not seem to be the case for physical property. Due to this moral distinction, even if the economic incentives to steal and pirate were equal, it is likely that piracy would still be more prevalent than theft. However, no experimental study to date has explored this hypothesis in an incentivized environment.

3.2.2. Theft aversion

A number of economic experiments provide strong evidence that humans are theft averse even if stealing is monetarily optimal. Theft aversion can be defined as the aversion to deprive others of their property. This implies that people are inclined to respect property even if no legal mechanisms exist to enforce property-respecting behavior. For example, Levitt (2006) reports how in a natural field setting the sale of bagels and donuts can be sustainable with payment rates above 85% for many years without the requirement of any human oversight. Also, in settings in which the allocation of property rights is unclear, people are inclined to act on ownership information. Gächter and Riedl (2005) show, in a bargaining situation in which neither party has a strategic advantage, that participants are sensitive to claims of ownership in

favor of the claimants. Theoretical work that draws from evolutionary biology supports the possibility of theft aversion as a human predisposition (Eswaran and Neary 2014; Gintis 2007).

A common experimental setting to study social preferences, and more recently people's respect for property rights, is the Dictator Game (DG). In the DG two participants, a Dictator and a Receiver, are paired (Forsythe *et al*. 1994). The pair are usually endowed with an amount of money, usually $10. As the labels suggest, only the Dictator can decide how the wealth is divided. A perfectly self-regarding Dictator is predicted to appropriate the full endowment, thus leaving the Receiver with nothing. However, the observed average appropriation rate is around 70%, which is significantly lower than the predicted 100% (Engel 2011). This result is usually interpreted as evidence of the existence of altruistic preferences because Dictators are unable to gain materially from giving money to Receivers (Hoffman, McCabe and Smith 1996; Eckel and Grossman 1996). However, introducing property rights in the DG can alter the Dictators' behavior dramatically. Cherry, Frykblom and Shogren (2002) show that the appropriation rate in the DG can move close to 100% if Dictators are required to exert effort to earn the full endowment and anonymity is guaranteed. On the surface this result seems to support standard economic theory, which assumes perfectly self-regarding actors. Indeed, Cherry *et al*. (2002) argue that creating entitlements provides Dictators with a moral justification to 'appropriate' the full endowment. A more nuanced interpretation is that people are not predisposed to give money away to others with whom they are not familiar, especially if they consider the money to be theirs (Bardsley 2008).

Theft aversion can arise in situations in which Dictators are offered the opportunity to take money that is owned by the Receiver. In this case, standard theory predicts that Dictators will fully appropriate the endowment for themselves if Dictators are not punished for doing so. However, theft-averse Dictators are expected to leave the money to Receivers. List (2007) lets Receivers exert effort before playing the DG to make them earn the endowment that is controlled by the Dictator. In the treatment without an earned endowment, 44% of the Dictators appropriated the full amount. This number decreased to 19% in the treatment in which Receivers exerted effort to earn the endowment. This finding strongly supports the existence of theft aversion. Oxoby and Spraggon (2008) show that the effect is even more pronounced if Receivers' efficacy in an effort task determines the size of the endowment, which emphasizes the causal link between Receivers' actions and the endowment.

3.2.3. Second-Person Loss Aversion

We argue that theft aversion is a specific manifestation of loss aversion, which in turn can explain why theft aversion is unable to prevent piracy behavior. Loss aversion is a tendency in individual decision-making to weigh losses more than gains (Kahneman and Tversky 1979). Loss aversion is widely studied and has been used to explain a broad set of anomalies, such as the inclination to value owned goods more than if these were unowned, also known as the endowment effect (Knetsch 1989).

The effects of loss aversion are primarily studied in the context in which the decision-maker can only affect her own payoffs.

However, recent studies suggest that people also experience loss aversion if they decide for others (Andersson *et al.* 2015; Polman 2012). As a result, a distinction should be made between First-Person Loss Aversion (FPLA) and Second-Person Loss Aversion (SPLA). FPLA refers to the standard context of loss aversion in which an individual decides on possible outcomes for herself. SPLA extends FPLA in the sense that the focal person not only considers the consequences of her decision on her own outcome in terms of gains and losses but also on the outcome of others. Andersson *et al.* (2015) and Polman (2012) provide evidence of the existence of SPLA and both show that the losses of others weigh less than one's own losses.

SPLA might be able to explain the existence of theft aversion. Committing theft results in a gain for oneself *and, at the same time,* a loss to another person. If losses to others weigh more than gains for oneself then the behavioral prediction of SPLA is that decision-makers would refrain from theft. FPLA cannot explain theft aversion because it would only consider gains and losses to oneself. Indeed, a strict interpretation of FPLA would imply that theft is always the optimal decision if the probability of experiencing losses is zero. Thus, extending FPLA with SPLA would provide a tractable explanation of the existence of theft aversion. Interestingly, Nunes *et al.* (2004) also argue that loss aversion can explain why piracy is more prevalent than theft. However, they identify losses as incurring variable costs to produce the goods, which are lower for non-rivalrous goods.

3.2.4. Rivalry

We argue that SPLA mitigates the theft of physical goods but not piracy. In the case of theft of physical goods, the victim loses both the focal good and the opportunity to profit by selling the good. However, in the case of piracy, the victim only loses the opportunity to profit from the perpetrator, assuming that the perpetrator does not share the pirated good with others. Piracy does not deprive the victim of the good itself. The underlying reason for this distinction is the rivalrous nature of the good. Rivalry determines to what extent joint consumption is possible. This means that if a rivalrous good is in use, another person *cannot* use it too. The only way to make use of a rivalrous good without the owner's consent is by excluding the owner, which is one of the defining characteristics of theft. While intellectual property can be used without making it impossible for the owner to use it as well.

Stake (2004) and Goodenough and Decker (2008) argue that our sense for property has evolved to coordinate the distribution of resources efficiently and to avoid conflicts that might harm the proliferation of the species. However, such conflicts could only arise in goods that are rivalrous (Maynard Smith and Price 1973). Even though theft and piracy both result in losses to the victim, the losses are qualitatively distinct, which explains why SPLA is able to mitigate theft but not piracy. Brenner *et al.* (2007) make a distinction between valence losses and possessive losses. A valence loss can be defined as any negative change with respect to a reference point. For example, losing the opportunity to profit is a valence loss. A possessive loss is defined as losing possession of a good, such as in the case of theft. Brenner *et al.* (2007) and

Morewedge *et al.* (2009) show that decision-makers are more sensitive to possessive losses than valence losses. Considering that SPLA is an extension of loss aversion, it can be hypothesized that SPLA is more likely to mitigate theft than piracy.

3.2.5. Two framed incentivized experiments

In Study 1, two participants are paired to create a setting in which the participants can potentially exchange a single good. The good can be purchased or appropriated without the owner's consent. In the rivalrous treatment the good can be stolen and in the non-rivalrous treatment the good can be pirated. The difference between the two treatments is a difference in framing while the incentive structure between the two treatments is identical. Study 2 extends Study 1. In this study, we develop a game design based on a Dictator Game with multiple goods. Dictators are able to appropriate up to 10 goods. We also provide an incentive to Receivers to elicit their beliefs about the Dictator's behavior.

3.3. Study 1: Exchange Game

3.3.1. Sample

Participants ($N = 1026$) were recruited from the online labor market Amazon Mechanical Turk (AMT). The use of online labor markets for economic experiments is now widely recognized as a viable alternative to laboratory experiments (Horton, Rand and Zeckhauser 2011). The main advantages of using an online labor market for experiments are: 1) access to a large population, 2) monetary incentives can depend on the choices that participants

make during the experiment, and 3) anonymity is inherently insured (Charness, Gneezy and Kuhn 2013). Horton *et al*. (2011) replicated well-known experimental games such as the prisoner's dilemma with outcomes that conform to earlier results obtained by laboratory experiments. Amir, Rand, and Gal (2012) show that using small stakes on AMT results in behavior that is consistent with behavior observed in offline laboratory experiments. Potential participants were unable to view the content of the experiment unless they agreed to participate. Participants who viewed the content could not re-enter the experiment, irrespective of whether they had completed the experiment. Participants received a fixed participation fee of \$0.25 if they completed the experiment and received more depending on the decisions made during the experiment. Participants were required to correctly answer questions about the consequences of each decision to receive a payoff.

3.3.2. Experimental Design

Two participants, a Seller and a Buyer, are paired. The Seller is endowed with a good. In the rivalrous treatment (T1) this is visualized as a physical chip and in the non-rivalrous treatment (T2) this is visualized as an intangible character. The Buyer values the good at $v_b = \$0.50$, and the Buyer is endowed with a budget, $b_b = \$0.50$. The Buyer is given the possibility to do nothing, to buy the good for a fixed price, $p = \$0.25$ or to appropriate. In the rivalrous treatment appropriation means to take the good without purchase (theft) while in the non-rivalrous treatment this means to copy the character without purchase (piracy). Note that the non-rivalrous treatment is comparable to the situation in which digital

tokens can be bought to be able to continue playing a game on a mobile phone. A prominent example of such a game is Candy Crush (www.candycrushsaga.com). These tokens have no intrinsic value to the publisher (in the experiment, the Seller) but do have a positive value to the gamer (in the experiment, the Buyer). The publisher is able to make money by selling these tokens at very low marginal costs.

In Table 3.1 an overview is provided of how each decision affects the monetary value of the Seller's and Buyer's possession and efficiency. It is noteworthy that the efficiency for each decision does not change across treatments. Thus, the Exchange Game effectively renders the distinction between rivalrous and non-rivalrous goods to solely a difference in framing, which is necessary to test our hypothesis based on SPLA. We also measured perceived ownership to investigate whether rivalry indeed leads to different perceptions of losses. Specifically, participants indicated who they thought was the owner of the good *after* a decision had been made. We predict that in the rivalrous treatment that Buyers are more likely to consider the good theirs in case of purchase or appropriation compared to Buyers in the non-rivalrous treatment.

Table 3.1: ***Monetary value of possessions depending on the Buyer's decision***

Buyer's decision	*Seller*	*Buyer*	*Efficiency*
Do nothing	$v_s = \$0.00$	$b = \$0.50$	\$0.50
Purchase	$p = \$0.25$	$b - p + v_b = \$0.75$	\$1.00
Appropriate	$v_s = \$0.00$	$b + v_b = \$1.00$	\$1.00

Notes. The second and third columns show respectively how much the Seller and Buyer receive depending on the Buyer's decision in the first column. Appropriation in the rivalrous treatment (T1) means that the Buyer chose to take the chip without purchase (theft) while in the non-rivalrous treatment (T2) this means that the Buyer chose to copy the character without purchase (piracy). Efficiency is defined as the sum of the Seller's and Buyer's monetary value of their possessions.

3.3.3. Results

FINDING 1.1 *Piracy rate is higher than the theft rate.*

The distribution of decisions in the rivalrous treatment is marginally significantly different from the distribution of decisions in the non-rivalrous treatment ($\chi^2(2) = 4.57$, $p = 0.10$). To be able to determine whether piracy is more likely to occur, we define the theft and piracy rate as the percentage of Buyers who choose to steal and pirate respectively. The percentage of Buyers who neither stole nor purchased is not significantly different between the two treatments (Fisher's exact, $p = 0.37$, two-tailed). The theft rate is 45.6% while the piracy rate at 53.3% is 16.9% higher, which is significantly higher (Fisher's exact, $p = 0.05$, one-tailed). This result supports the hypothesis that theft is less attractive than piracy due to an aversion to causing a possessive loss.

FINDING 1.2 *Ownership is more likely perceived to be shared in case of piracy.*

After the Buyer had made a decision, participants were asked to indicate who they consider to be the owner of the good to study how rivalry affects perceptions of losses. For this analysis we focus on Buyers who chose either to purchase or to appropriate and indicated either that they considered the good theirs or shared after making a decision. An overwhelming majority of Buyers fell within this group (81.9%).

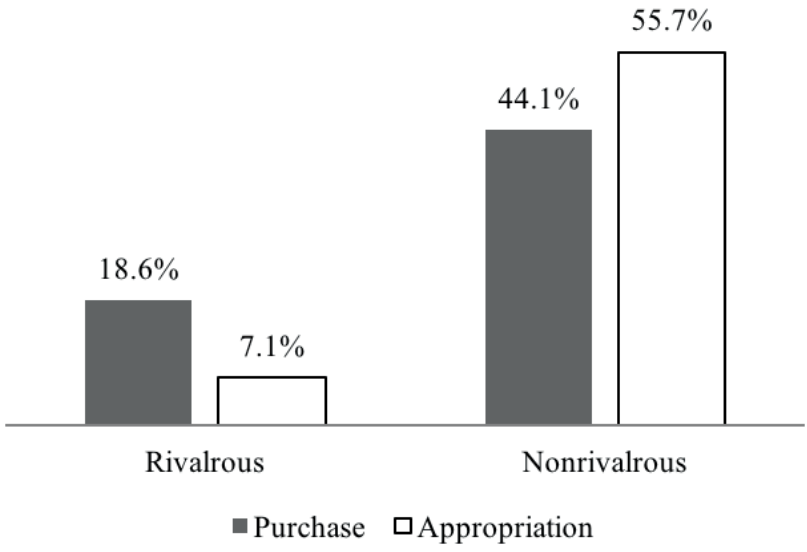
Buyers in the non-rivalrous treatment were significantly more likely to indicate that post hoc ownership is shared compared to Buyers in the rivalrous treatment (Non-rivalrous: 50.4%, Rivalrous: 12.8%; Fisher's exact, $p < 0.01$). This supports the prediction that purchasing or appropriating in the rivalrous treatment results in the perception that ownership shifted from Seller to Buyer, while in the non-rivalrous treatment this is less likely the case. In fact, Buyers in the non-rivalrous treatment are more likely to perceive that the good is shared between themselves and the Seller (Figure 3.1).

FINDING 1.3 *Piracy is associated with the perception that ownership is shared*

We also studied whether the act of appropriating can affect perceptions of ownership. Interestingly, Figure 3.1 suggests that theft increases the likelihood that Buyers consider the good to be theirs while piracy increases the likelihood that Buyers consider the good to be shared. A logistic regression confirms that an interaction effect exists between the appropriation and perceptions of

ownership (Table 3.2). Specifically, Buyers are more likely to believe that the Seller is not the owner anymore if the good is rivalrous, especially if it was stolen. In the non-rivalrous treatment, however, Buyers are significantly more likely to believe that ownership is shared with the Seller and this likelihood is even significantly higher in case of piracy. A possible explanation is that Buyers who pirated were beforehand not convinced that the Seller was the owner. However, it is also possible that Buyers who pirated rationalize their action by convincing themselves or the experimenter that the Seller was not the owner to begin with.

Figure 3.1: ***Perceived shared ownership***



Notes. $N = 420$. Only Buyers that claimed sole or shared ownership after purchase or appropriation were included in this analysis. The percentages represent the relative number of Buyers who indicated that ownership is shared with the Seller after purchase or appropriation.

Table 3.2: ***Determinants of perceived ownership after making a decision***

Independent variables		
Non-rivalrous	1.24 (0.33)	***
Appropriation	-1.09 (0.47)	**
Non-rivalrous × appropriation	1.56 (0.54)	***
(1 = Piracy)		
Constant	-1.48 (0.26)	***
Wald χ^2 (df)	80.70 (3)	***
Log pseudo-likelihood	-225.58	
Nagelkerke's R^2	.24	
N	420	

Notes. Logistic regression. The dependent variable is 1 if the Buyer indicated after making a decision that ownership is shared and is 0 if the Buyer indicated that she is the sole owner. Buyers who chose to do nothing were excluded as there is no transfer of possession in these cases.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

3.4. Study 2: Dictator Game

3.4.1. Experimental Design

The previous study involved a single good per pair and the pricing across treatments was fixed (p = \$0.25). To consider a more realistic setting, Study 2 extends the number of available tokens to 10. This renders Study 2 to the Dictator Game. The pair is endowed with a fixed amount of money. The Dictator (Buyer) decides how

the endowment is divided. The Receiver (Seller) has no say and leaves with whichever amount, if anything, the Dictator allocates to her.

The variant of the Dictator Game that is employed in this study differs from the standard Dictator Game in four respects. The first difference is that the endowment consists of a combination of money and tokens instead of money alone. The second difference is that depending on the treatment tokens can either be taken (rivalrous) or copied (non-rivalrous). Similar to Study 1, the verb 'to appropriate' refers to both taking and copying tokens. The third difference in the framing in all treatments is that the tokens are initially in possession of the Receiver while the money is in possession of the Dictator. The fourth difference is that Dictators are required to purchase tokens that are not appropriated. Despite the above differences, Dictators are faced with a payoff scheme that is the same as in the standard Dictator Game. Thus, a self-regarding Dictator is expected to appropriate all tokens.

Dictators start with a budget of $0.50, which allows them to purchase tokens. Receivers are endowed with 10 tokens without a budget. For Receivers, the value of a token is $0.00 while for Dictators it is $0.05. Dictators are asked to decide how many tokens should be purchased and appropriated. The combined sum of tokens purchased and appropriated is always 10. The price of a token is randomly drawn from the set $0.00, $0.01, $0.02, $0.03, $0.04, and $0.05. The minimum and maximum prices constitute interesting corner cases. If the price is $0.00 Dictators are monetarily indifferent between purchasing and appropriating. Only at this price a self-regarding Dictator is indifferent between all

possible decisions. The other extreme is when the price is $0.05. In this case Dictators do not monetarily gain from purchasing tokens because the value of a token to Dictators is $0.05 as well.

Piracy is operationalized as the number of tokens copied without purchase in the non-rivalrous treatment and theft is operationalized as the number of tokens taken without purchase in the rivalrous treatment. More generally, the appropriation rate (*d*) is defined as the number of tokens copied or taken without purchase. Also note that the monetary payoff does not depend on whether the tokens are rivalrous (Table 3.3). Thus, as in Study 1, the difference between the rivalrous and non-rivalrous treatment is only a difference in framing. Participants were recruited from AMT (N = 1,202). Both Receivers and Dictators were required to correctly answer a question about their understanding of the experiment in order to receive a payoff. To elicit Receivers' beliefs about what Dictators will do, Receivers were eligible to earn $0.10 if they were able to predict the exact appropriation rate of the paired Dictator.

We hypothesize, based on SPLA, that in the rivalrous treatment the appropriation rate is lower than in the non-rivalrous treatment. We also predict that in both treatments a higher price results in a higher appropriation rate. Although it is evident that a higher price provides Dictators with a stronger monetary incentive to appropriate, a higher price also implies that Receivers' economic losses are higher as well. Thus, at a high price Receivers lose in terms of opportunity costs than at a low price. But considering that this loss is not a possessive loss, SPLA is not expected to prevent Dictators from taking this into account, which also known as 'opportunity cost neglect' (Frederick *et al.* 2009).

Our last hypothesis focuses on Receivers' beliefs about what they think Dictators will do. Studies show that people have difficulties when considering the effects of loss aversion on the decision-making of others (Faro and Rottenstreich 2006; Loewenstein and Adler 1995; Van Boven, Dunning and Loewenstein 2000). Considering that SPLA is an extension of loss aversion, it is expected that Receivers will fail to take into account the effect of SPLA in the form of theft aversion. Specifically, we hypothesize that Receivers expect a higher theft rate than the actual theft rate.

Table 3.3: ***Final distribution of tokens and payoffs Dictators and Receivers***

	Tokens in possession		
	Rivalrous	*Non-rivalrous*	*Payoff*
Receiver	0	10	$(10 - d) \times p$
Dictator	10	10	$\$1.00 - (10 - d) \times p$

Notes. In the rivalrous treatment Dictators always obtain all tokens from the partnered Receiver. In the non-rivalrous treatment Dictators are only able to copy and, thus, both Dictators and Receivers are left with 10 tokens each. Receivers' payoff depends on how many tokens are appropriated (d) and the price charged for each token (p). As Dictators always end up with 10 tokens their payoff is \$1.00 (= budget + value of 10 tokens) minus the price paid for purchased tokens $(10 - d) \times p$.

3.4.2. Results

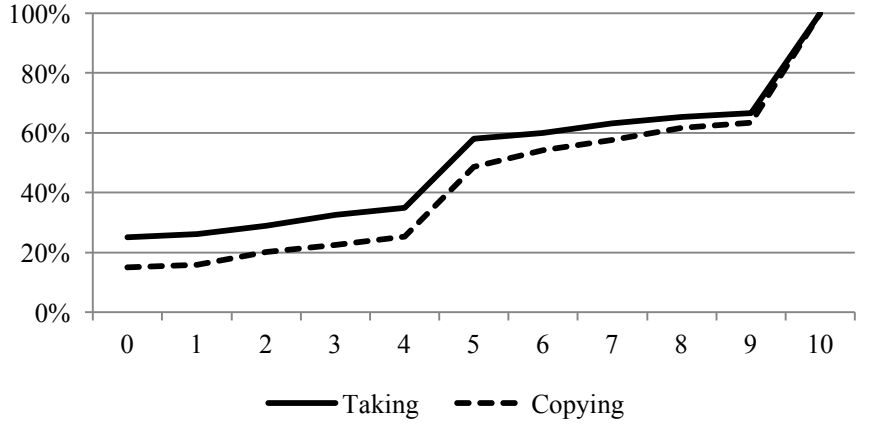
Table 3.4: ***Overview***

	Price range					
	All		< $0.03		≥ $0.03	
Dictator	*N*	Mean (SD)	*N*	Mean (SD)	*N*	Mean (SD)
Appropriation (*d*)						
Rivalrous (theft)	317	5.39 (3.96)	154	4.98 (3.88)	163	5.78 (4.01)
Non-rivalrous (piracy)	284	6.15 (3.62)	124	5.30 (3.70)	160	6.82 (3.42)
Combined	601	5.75 (3.82)	278	5.12 (3.80)	323	6.29 (3.76)
Receiver						
Expected appropriation (d)						
Rivalrous (theft)	317	6.48 (3.51)	154	6.22 (3.66)	163	6.71 (3.36)
Non-rivalrous (piracy)	284	6.47 (3.31)	124	6.31 (3.35)	160	6.60 (3.29)
Combined	601	6.47 (3.42)	278	6.26 (3.52)	323	6.66 (3.32)

FINDING 2.1 *Piracy is more prevalent than theft*

Dictators appropriated, on average, 5.75 tokens (SD = 3.82) (Table 3.4). Dictators appropriated significantly more tokens in the non-rivalrous treatment (6.15) than in the rivalrous treatment (5.39) (Mann-Whitney $U = 40140$, $p = 0.02$, two-tailed). The difference is especially striking if a distinction is made between Dictators who appropriated nothing ($d = 0$) and Dictators who appropriated a positive number of tokens ($d > 0$) (Figure 3.2). In the rivalrous treatment 25.2% of the Dictators appropriated nothing and in the non-rivalrous this is only 15.1%, which is significantly lower (Fisher's exact, $p < 0.01$, one-tailed).

Figure 3.2: ***Cumulative distribution of Dictators' appropriation***

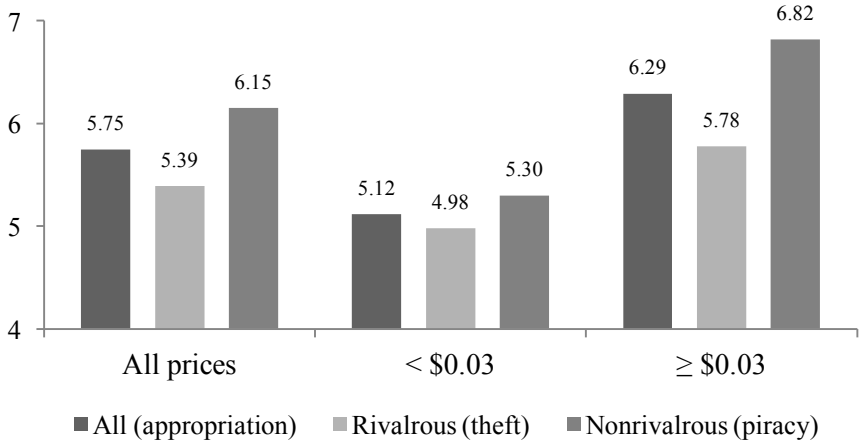


Notes. $N = 601$. Lines represent the cumulative distribution of the Dictators' appropriation rate for the rivalrous (taking) and non-rivalrous treatment (copying). The horizontal axis represents appropriation where 0 stands for nothing stolen or pirated and 10 stands for everything stolen or pirated.

FINDING 2.2 *Price increases appropriation rate*

The appropriation rate seems to increase with a higher price (Figure 3.3). Dictators who are faced with a price of \$0.00 appropriated, on average, 4.34 tokens while Dictators who could purchase at \$0.50 appropriated, on average, 6.41 tokens (Mann-Whitney $U = 2792.5$, $p < 0.01$, two-tailed). In an OLS regression it is estimated that the impact of price on the appropriation rate is, on average, 0.359 tokens more appropriated for every dollar cent increase in price ($F(1) = 14.8$, $p < 0.001$). This coefficient is higher in the rivalrous treatment ($B = 0.253$, $p = 0.06$) but lower in the non-rivalrous treatment ($B = 0.477$, $p < 0.01$). Indeed, in the treatments with a price equal to or lower than \$0.02, there is no significant difference between average theft (4.98) and piracy (5.30) (Mann-Whitney $U = 9045$, $p = 0.43$, two-tailed). While in treatments with a price equal to or higher than \$0.03, average piracy (6.82) is significantly higher than average theft (5.78) (Mann-Whitney $U = 11265$, $p = 0.03$, two-tailed). This result suggests that the magnitude of piracy depends more on how high the price is than it does for theft. In sum, a higher price provides a stronger monetary incentive, which leads to a higher appropriation rate. However, in the rivalrous treatment this effect seems to be mitigated by SPLA. As a result, the difference in the appropriation rate between piracy and theft is largest at a high price.

Figure 3.3: ***Mean appropriation rate per price range***



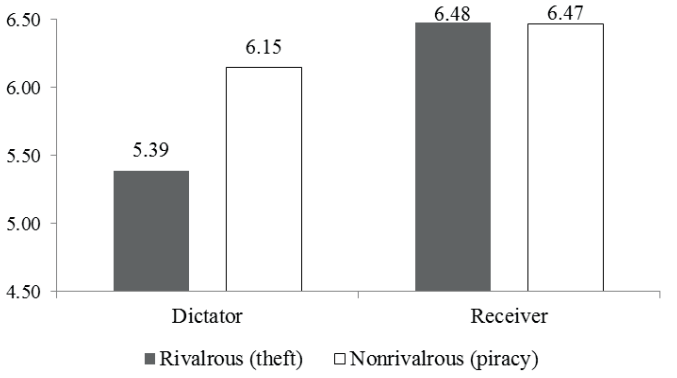
Notes. N = 601. Bars represent the mean Dictators' appropriation, theft, and piracy rate for each price.

FINDING 2.3 *Receivers believe that piracy is as prevalent as theft*

Receivers' beliefs about what their respective Dictator will do were elicited by providing a monetary incentive for correctly predicting her decision. Twenty-six percent of the Receivers predicted the Dictator's exact appropriation rate, which is significantly higher than the likelihood of picking a random prediction (Random choice: 1/11, Binomial test, $p < 0.01$, one-tailed). The correct prediction rate did not differ significantly between the rivalrous and non-rivalrous treatment (Fisher's exact, $p = 0.194$, two-tailed). A logistic regression shows that the token price did not significantly affect the likelihood of a correct prediction ($B = -0.17$, $p = 0.76$). In general, Receivers expected an average appropriation rate of 6.47

tokens while the actual appropriation rate of 5.75 tokens is significantly lower (Mann-Whitney $U = 163052.5$, $p < 0.01$, two-tailed). This result indicates that Receivers seem to overestimate the appropriation rate. If the analysis is restricted to the non-rivalrous treatment only, no significant difference between the predicted (6.47) and actual (6.15) appropriation rate is found (Mann-Whitney $U = 38950.5$, $p = 0.46$, two-tailed). Receivers' overestimation of Dictators' appropriation rate seems primarily to stem from the rivalrous treatment (Figure 3.4). Receivers in this treatment expected, on average, an appropriation rate of 6.48 while the actual rate is 5.39, which is significantly lower (Mann-Whitney $U = 42692.5$, $p < 0.01$, two-tailed). These results indicate that, on average, Receivers held correct beliefs about the extent to which Dictators would commit piracy but incorrect beliefs about the extent of theft. Less theft was committed than Receivers predicted. As hypothesized, a possible explanation is that participants fail to take into account the existence of SPLA and, as a result, overestimate the degree of theft.

Figure 3.4: ***Mean actual and expected appropriation rate***



Notes. N = 1,202. Bars represent the mean appropriation rate for Dictators (left) and the mean expected appropriation rate by Receivers (right).

3.5. Discussion

This study aims to investigate why piracy is arguably more prevalent than theft, even if economic incentives are kept constant. Earlier studies suggest that economic incentives alone are unable to explain the discrepancy (Nunes *et al.* 2004) but lack theoretical underpinning and empirical evidence. Our study reports on two framed incentivized experiments that explore to what extent theft aversion can be explained by SPLA. We argue that theft aversion affects decision-making if the potential victim loses possession of a rivalrous good. To our knowledge this study is the first to consider theft and piracy alongside each other in an economic experiment while earlier studies focused on either theft (e.g., Oxoby and Spraggon 2008) or piracy (e.g., Buchanan and Wilson 2014) separately. Two economic experiments were conducted to explore to what extent our proposed extension of loss aversion can explain the moral distinction. In both experiments we implement a novel payoff scheme that renders the difference between theft and piracy to solely a difference in framing. This allows for a clean comparison of piracy and theft.

We identify four specific contributions of this study. First, this study provides theoretical underpinning as to why a specific form of loss aversion may explain a phenomenon that cannot be explained by economic incentives alone. Our experiments provide evidence in support of the hypothesis that the likelihood of appropriation depends on whether the focal good is rivalrous. This

implies that piracy is more likely to occur than theft even if the economic incentives between the two types of goods are kept constant. Earlier studies on theft aversion focused primarily on the possible appropriation of rivalrous goods (e.g., List 2007; Gächter and Riedl 2005). We contribute to the literature on theft aversion by showing that the aversion is only triggered if the focal good is rivalrous. We provide a novel explanation of this effect by extending loss aversion to SPLA to take into account losses caused to others.

Second, our findings show that rivalry and appropriation can affect perceived ownership. In the first experiment Buyers are more likely to consider a rivalrous good theirs, irrespective of whether the good was purchased or appropriated, compared to Buyers in the non-rivalrous treatment. This result provides empirical support for the assumption that the transfer of rivalrous goods, whether voluntarily or involuntarily, is perceived as a possessive loss. We also find that this effect is more pronounced among Buyers who appropriated. The link between rivalry and possessive losses in the context of loss aversion is unexplored. Our study of this link contributes to the literature on loss aversion that stresses the importance of possessive losses (Brenner *et al.* 2007; Dommer and Swaminathan 2013; Morewedge *et al*. 2009).

Third, we find that increasing prices results in a higher theft and piracy rate. A prominent moral argument against piracy is that piracy inflicts economic losses. In the DG experiment potential economic losses were equal to prices. At the same time, higher prices provide a stronger incentive to appropriate. Considering that an economic loss is not a possessive loss, we observe that the net

effect of higher prices is a higher appropriation rate. A possible explanation is that cognitively it is more difficult to imagine the gravity of an economic loss due its abstract nature, while possessive losses are material. This would be in line with earlier studies that show that decision-makers often fail to take into account similar abstract considerations such as opportunity costs (Frederick *et al.* 2009; Spiller 2011).

Fourth, we show that the inability to anticipate loss aversion extends to SPLA. Earlier studies demonstrated that people are unable to anticipate FPLA in the decision-making by others (Loewenstein and Adler 1995; Van Boven *et al.* 2000). We find that people are also unable to anticipate that others are averse to stealing. This implies that SPLA does not differ from FPLA in this respect and supports the theory that theft aversion is a manifestation of loss aversion. In a managerial setting, this insight can explain why firms marvel over why consumers are reluctant to pay for non-rivalrous goods. As a result, decision-makers should be aware that mitigating piracy requires stronger economic incentives than lowering the likelihood of theft.

More generally, our study contributes to research on loss aversion by extending it to the moral domain. Research on loss aversion has primarily focused on how loses affect the decision-maker. Our study shows that taking into account the losses of others provides a new avenue of research. Further investigations of SPLA might reveal how other types of illegal behavior besides theft and piracy can be explained as well. For example, fare dodging is illegal because it constitutes a refusal to pay for used services such as public transportation. Nevertheless, fare dodging is relatively

common and is often perceived as a minor offence (Groot and Van Den Brink 2010). Similar to piracy, fare dodging does not deprive the victim of any possessions, which prevents SPLA from acting as a moral deterrence.

Our explanation of the prevalence of piracy behavior based on SPLA has clear policy implications. Efforts to convince consumers that piracy is morally equivalent to theft seem futile if SPLA is cognitively hardwired, like FPLA (Tom *et al.* 2007). These efforts constitute a burden on firms and consumers. IP publishers spend time and money on public service announcements, which is unnecessary if such messages are ineffective. Furthermore, consumers are often required to watch or listen to these public service announcements, which increases the time cost of consumption of these media. A more effective communication strategy is probably to emphasize the economic loss that results from piracy. Furthermore, the findings of this study suggest that piracy needs a stronger deterrence than theft. Because piracy lacks the moral deterrence that seems to exist for theft, policy-makers who aim to impede piracy are advised to implement measures that sufficiently deter piracy by adopting a psychological framework that takes into account SPLA.

3.6. Appendix: Experimental Instructions Exchange Game

This is an experiment in decision-making. Your participation is anonymous. In this experiment you will be asked to make a decision and to respond to a number of questions.
Another worker was asked to participate in this experiment as well. This worker received one chip, which is presented below. You receive a budget of $0.50.

The monetary value of this chip for you is $0.50 and for the other worker this is $0.00. The other worker is willing to sell the chip for $0.25. Momentarily, the monetary value of your possessions is $0.50 (the budget) and for the other worker this is $0.00 (the chip). This does not change if you choose to do nothing.

If you purchase the chip, the monetary value of your possessions becomes $0.75 because this is equal to the budget - the paid price + the chip, and for the other worker this becomes $0.25 because this is equal to the paid price - the chip. If you [take/copy] the chip without purchase, the monetary value of your possessions becomes $1.00 because this is equal to the budget + the chip, and for the other worker this becomes $0.00 because this is equal to the chip - the chip.

3.7. Appendix: Experimental Instructions Dictator Game

For this experiment you're matched with another worker. One of you gets the role of X and the other gets the role of Y. This is determined randomly. Y produced ten identical tokens and X receives a budget of $0.50. The value of a single token for X is $0.05 and for Y this is $0.00. X is the only person who can decide. Y cannot decide. Y can earn money by selling tokens. The price of a single token is $[price].

For each token X has to decide whether to purchase it or to [take/copy] it. Y [won't have the token anymore/will still have a copy] of the token if it is purchased or [taken/copied]. Your role is revealed on the next page. At the end of the experiment, the possessions of each person are exchanged for money and granted as a bonus.

Examples
If X decides to purchase all tokens: X will receive $[0.50 – (price×10)] (budget left) + $0.50 (value tokens) = $[1– (price×10)] and Y receives $[price×10] (sales).

If X decides to copy all tokens: X will receive $0.50 (budget left) + $0.50 (value tokens) = $1.00 and Y receives $0.00 (value tokens).

4. Dilution Illusion

4.1. Introduction

Standard economic theory predicts that only the representation in real terms matters. There is, however, evidence that the nominal representation of choices influences decision-making. A prominent example is the distinction between the face value of money and its purchasing power (Fisher 1928). Studies show that people tend to neglect the purchasing power of money in favor of focusing on the nominal representation of money, which is also known as money illusion (Shafir, Diamond and Tversky 1997). This bias is also found in non-monetary and probabilistic contexts (Burson *et al.* 2009; Hsee *et al.* 2003; Kirkpatrick and Epstein 1992). The overarching conclusion of these studies is that the nominal representation of choices biases decision-making.

Extant research on framing effects due to changes in the nominal representations has focused primarily on *individual* decision-making (Hsee and Hastie 2006). It is unclear, however, to what extent the nominal representation of choices can also affect *interpersonal* decision-making. There are situations in which it is possible to disadvantage or advantage another person in real terms but not nominally, and vice versa. For example, it is possible to appropriate value from a shareholder without affecting the number of shares held by this shareholder through issuance of new shares, which dilutes the value of a single share (Johnson *et al.* 2009). The monetary value of a single share can vary because the number of shares can be increased or decreased but this does not affect the value of the shares combined. Theoretically, a shareholder can

appropriate value from another shareholder through either (1) theft or (2) dilution with the same outcome in real terms. Thus, a distinction can be made between nominal appropriation (theft) and real appropriation (dilution).

There is convincing evidence that people are averse to stealing, even if the probability of being caught is zero (Engel 2011; Gächter and Riedl 2005; Hoffman *et al.* 1994; Levitt 2006; List 2007; Oxoby & Spraggon 2008). Empirical research on theft aversion has mainly focused on providing evidence for its existence (e.g., List 2007) and how ownership can be established to induce theft aversion (e.g., Oxoby & Spraggon 2008). It is implicitly assumed that theft aversion is an aversion to appropriating from others in real terms. However, extant research on theft aversion confounds theft as nominal appropriation of possessions *and* appropriation in real terms. This chapter disentangles real appropriation from nominal appropriation to study to what extent theft aversion depends on this distinction.

We present an experiment that is based on the dictator game. In the standard implementation of the game two participants are paired, the donor (also known as the dictator) and the recipient, and endowed with a fixed sum of money. The donor can decide how much to divide the endowment between herself and the recipient. In our variation the endowment consists of shares and the monetary value of a single share depends on the total number of shares. In our baseline treatment donors are unable to change the number of shares, which corresponds to the standard implementation (Engel 2011). In the Dilution treatment, however, donors can only expropriate value from the recipient by issuing new shares to

themselves. Thus, in the Dilution treatment nominal appropriation is not possible. We find that donors are more selfish in the Dilution treatment than in the baseline treatment, which we dub the dilution illusion. In the Destruction treatment, donors can only expropriate value from the recipient by destroying shares of the recipient. Here we find the opposite effect that donors are less selfish in the Destruction treatment. Combined, our findings provide evidence that theft aversion is moderated by the nominal representation of the distribution of mediums. Our formal analysis shows that this is consistent with an aversion to inequality in nominal distributions. To the best of our knowledge, this study is the first to explore the decision-making biases arising from the nominal representation of value in an incentivized social context.

4.2. Literature review

Standard economic theory assumes that people make choices in such a way that it maximizes perceived value. We adhere to the economic definition of value, which is the maximum amount the decision-maker is willing and able to give up to obtain a good. In the literature money is often used as a measure of value for the sake of simplicity and comparability. As a result, choices in studies are usually framed in terms of a currency and its distribution. However, the value of money is subject to change over time, often in the form of inflation. This results in that over time the value of a given unit decreases. Thus, in nominal terms nothing changed but in real terms money becomes less valuable.

This change poses an arithmetical challenge to decision-makers who need to choose from options that involve both the present and the future. To be able to compare this type of choice sets in real terms it is often necessary to calculate the monetary value of these choices at a single point in time. For example, assuming an inflation rate of 100%, the value of $100 in one year is equal to the value of $50 today ($\frac{\$100}{1+100\%}$). To meet the standard economic assumption of value maximization it is predicted that decision-makers always choose the optimal choice in real terms and are able to ignore the nominal denomination of value. However, there is strong evidence that people are prone to take into account the nominal denomination of choices, which also known as *money illusion* (Shafir *et al.* 1997).

Money illusion is the tendency to make choices such that the nominal amount is maximized, even if this leads to suboptimal choices in real terms. Shafir *et al.* (1997) find, for example, that respondents prefer receiving a 5% raise with 4% inflation to receiving a 2% raise without any inflation. A simple calculation shows that the latter is actually optimal in real terms (5% - 4% = +1% < +2%). Shafir *et al.* (1997) argue that money illusion occurs due to the inherent saliency of value denominations, simplicity of comparing nominal choices and the fact that in many cases the nominal terms are highly correlated with real terms. More recent studies show that money illusion is such a robust bias that it can be observed at the aggregate market level, which can explain rigid prices in labor, asset and housing markets (Fehr and Tyran 2001; Fehr and Tyran 2005; He and Zhou 2014; Noussair, Richter, and Tyran 2012).

A phenomenon that is conceptually similar to money illusion is the ratio bias, which also known as the denominator neglect. In a classic study Kirkpatrick and Epstein (1992) find that participants prefer a lottery with a 10 in 100 odds over a lottery with a 1 in 10 odds even though the objective odds of these two lotteries are exactly the same ($\frac{10}{100} = \frac{1}{10}$). Dale *et al.* (2007) show that the ratio bias can also be found if the lottery with the greater nominator is actually the lottery with a lower probability of winning ($\frac{28}{100}$ versus $\frac{3}{10}$). The ratio bias is similar to money illusion because both biases result from weighing the nominator more that standard economic theory would predict. The main difference is the context: ratio bias is applies to probabilities while money illusion applies to inflation rates. Chen *et al.* (2012) argue, however, that the ratio bias and money illusion are of the same nature.

The psychological effect that accounts for money illusion can also occur in situations in which money is not used as a denominator. A broader bias, which also encompasses money illusion, is *medium maximization* (Hsee *et al.* 2003). Medium maximization can be defined as the preference to maximize the amount of a medium instead of only taking into account how much value the medium represents. Hsee *et al.* (2003) argue that anything that is used to obtain value is in essence a medium. They provide the example of a frequent flyer who accumulates miles (medium 1: miles) as part of the airline's loyalty program. These miles can be exchanged for booking a flight with a sizeable discount (medium 2: flight). The flight is booked to a destination to enjoy a holiday (medium 3: holiday), which brings about happiness and, thus, value. In this

example medium maximization occurs if, for example, the flyer prefers to collect more miles even though she knows that she's not planning to exchange these for something valuable.

The study of medium maximization, specifically that of money illusion, has been predominately restricted to situations in which choices did not have consequences to others or only hypothetically (Hsee *et al.* 2009; Shafir *et al.* 1997). However, there are many situations in which multiple persons are affected because the underlying value of a medium might be distributed among multiple 'shareholders'. For example, in 2006 the Reserve Bank of Zimbabwe decided to significantly increase the money supply to pay a sovereign debt. As a result, the value of a single Zimbabwean dollar was diluted to share the value with the newly issued supply of money. This led to a sharp increase in the inflation rate (Hanke and Kwok 2009). The population at large was disadvantaged because the purchasing power of the Zimbabwean dollar decreased drastically. An alternative strategy for the government of Zimbabwe would have been to payoff its debt by increasing taxes. This would mean that the population of Zimbabwe would be affected nominally and in real terms. The outcome, however, would have been the same. But due to a difference in framing, the ability to expropriate value by diluting the value of money might lead to more selfish decision-making than if value expropriation could only take place through taking the medium as well.

We argue that decision-makers are more likely to expropriate value from others if the victims are not affected nominally, which we dub the dilution illusion. The dilution illusion is an illusion in the sense that diluting the value of a single unit of a medium appears as if

victims are not deprived of anything while, in fact, their possessions are becoming less valuable. In the case of theft, victims are deprived of their possessions and, thus, also the value that those possessions carry. A perfectly self-regarding individual will commit theft if the probability of being caught is zero (Becker 1968). However, studies provide strong evidence in support for the existence of an aversion to stealing (Gächter and Riedl 2005; Hoffman *et al.* 1994; Levitt 2006; List 2007; Oxoby and Spraggon 2008). This implies that even if the probability of being caught is zero, people are prone to self-enforce the norm against stealing. To study to what extent the possibility to dilute leads to more expropriation than the possibility the steal, it is necessary that the ratio of nominal units and the monetary value of a unit is able to vary.

Disentangling this ratio can clarify to what extent the aversion to theft is actually an aversion to *nominal* expropriation. For example, imagine a fund with only two shareholders, Alice and Bob, and each person holds two shares (4 shares = 100% of the fund). To expropriate 25% of the fund's value, Alice can either steal or dilute Bob's shares. Alice stealing one share from Bob ($\frac{2+1}{4} = 75\%$) has the same effect in real terms as issuing four more shares to herself ($\frac{2+4}{4+4} = 75\%$). In the case of theft, Bob is affected nominally because to transfer value from Bob to Alice, Alice has to dispossess Bob from one share. In the case of dilution, however, Alice does not have to dispossess Bob to transfer value to herself; issuing more shares decreases the value of a single share. The dilution illusion entails that Alice with the ability to dilute is predicted to

expropriate more value than Alice with the ability to steal. Because the difference between the two situations is a nominal difference, the difference constitutes a difference in framing only.

In the above scenario Alice can only affect the number of shares she possesses. Besides creating new shares, Alice could also destroy her own shares. This would effectively transfer value from Alice to Bob. For example, if Alice destroys a single share of her own, then her stake decreases from $\frac{2}{4}$ to $\frac{2-1}{4-1} = \frac{1}{3}$ while Bob's stake increases from $\frac{2}{4}$ to $\frac{2}{4-1} = \frac{2}{3}$. Interestingly, if Alice is only able to affect the number of shares held by Bob, destroying Bob's shares is the only method for Alice to transfer value to herself. For example, if Alice destroys one of Bob's shares, then the value of her possessions increases from $\frac{2}{4}$ to $\frac{2}{4-1} = \frac{2}{3}$ while the total value of Bob's shares decrease from $\frac{2}{4}$ to $\frac{2-1}{4-1} = \frac{1}{3}$. Thus, the situation in which Alice issues two new shares to herself is in real terms equivalent to Alice destroying one of Bob's shares ($v_A = \frac{2+2}{4+2} = \frac{2}{4-1} = \frac{2}{3}$). Although these two outcomes in real terms are identical, the framings are opposable. Indeed, the scenario in which Alice can only affect the shares of Bob might induce an effect that is the opposite of the dilution illusion, which we call the ruin illusion. Ruin illusion is the tendency to expropriate *less* value due to an aversion to nominal expropriation.

The scenario with Alice and Bob can be mapped unto to the dictator game (DG), which has been studied extensively to explore the nature of social preferences (Forsythe *et al.* 1994). Namely, in

the DG two participants are paired, a donor and a recipient, and are endowed with a sum of money. Only the donor is allowed to decide how the endowment is distributed between the two, which is called the offer. A self-regarding donor is expected to always expropriate the complete endowment. However, a large of body of replications and variations of the DG show that donors on average offer a proportion of the endowment that is well above zero (Engel 2011).

There is strong evidence that donors expropriate even less if the framing suggests that recipients are entitled to a part of the endowment (Hoffman *et al.* 1994; List 2007). For example, donors who are informed that the recipient earned the endowment, offer on average more to the recipient than donors who are not provided any information about the distribution of property rights (Oxoby and Spraggon 2008). Donors' tendency to expropriate less if framing attributes property rights to the recipient can be described as a form of theft aversion. Theft aversion can be defined as an aversion to expropriating in real terms. However, extant research on theft aversion does not disentangle the nominal representation of the endowment from the representation in real terms. Thus, it is still unclear to what extent theft aversion depends on the nominal representation of the endowment's distribution between the donor and the recipient. Standard economic theory predicts that theft aversion is independent of the nominal representation and, thus should not affect decision-making.

We hypothesize that the nominal representation does moderate theft aversion. Specifically, we predict that donors will expropriate more if expropriation does not affect the recipient nominally but does make the donor better off (*dilution illusion*). Similarly, we

predict that donors will expropriate less if expropriation affects the recipient negatively in nominal terms without the donor being better off nominally (*ruin illusion*). Destroying shares does not increase the number of shares held by Alice while regular theft increases both the value of the shares held by Alice and the *number* of shares held.

The strength of the illusions might be moderated by the decision-maker's ability to see through the veil of mediums. As in the case of inflation, the real effect can be calculated or easily estimated using simple arithmetical operations. Thus, a higher cognitive ability might mitigate the effect of the dilution illusion. Studies show that a higher cognitive ability reduces susceptibility to framing effects (Oechssler, Roider and Schmitz 2009; Stanovich and West 1998). LeBoeuf and Shafir (2003) find evidence that people who think about themselves that they think more deeply about problems are less susceptible to common framing effects. They argue that this can be explained by a general preference for consistent decision-making, which in turn mitigates framing effects because these would lead to inconsistent choices. More relevant, there is evidence for the notion that a higher cognitive ability decreases the susceptibility to the ratio bias (Pacini and Epstein 1999; Stanovich and West 2008). We hypothesize that participants with a higher cognitive ability are less sensitive to changes in the nominal representation.

4.3. Experimental design

The experiment was conducted on Amazon Mechanical Turk (Horton, Rand and Zeckhauser 2011). The experiment consists of a

variation of the dictator game (DG), which we dub the Shareholders Game (SG). In the DG and SG two participants, a donor and a recipient, are paired and endowed with a sum of money. Only the donor can decide on how the endowment will be divided. This decision is called an offer. An offer of 0% means that the donor is allocating the full endowment to herself while an offer of 100% means that the donor is allocating everything to the recipient. The standard framing of the DG is that the dividable endowment simply consists of money. Accordingly, in the DG the donor chooses how much money to offer to the recipient. Instead of money, in the SG the pairs are endowed with tokens, which are shares of the endowment and, thus, function as a medium. The monetary value of all tokens combined is fixed and, thus, does not depend on the total number of tokens. As a result the monetary value of a single token varies and is defined as the monetary value of the endowment divided by the total number of tokens. At the end of the experiment, participants receive the monetary value of the tokens.

In the SG the initial number of endowed tokens is 120. The donor and the recipient are initially allocated 60 tokens each. Dependent on the treatment donors can affect the number of tokens of held by both, the recipient only or herself only. Another difference between the DG and the SG is that in the SG there is a distinction between the total endowment and the dividable endowment. Tokens represent the total endowment but the donor can only affect the distribution of the *dividable* endowment. More precisely, donors and recipients always receive at least 1/10 of the total endowment each. This distinction is technically necessary to allow for

comparing donors' offers between treatments. For reasons of consistency and clarity, an offer is presented in this study as a percentage of the dividable endowment, which is 10/12 of the total endowment (Table 4.1).

Table 4.1: ***Donors' choice set***

TAKING	Donor Tokens	110	100	90	80	70	60	50	40	30	20	10
	Recipient Tokens	10	20	30	40	50	60	70	80	90	100	110
DILUTION	Donor Tokens	660	300	180	120	84	60	43	30	20	12	5
	Recipient Tokens	60	60	60	60	60	60	60	60	60	60	60
DESTRUCTION	Donor Tokens	60	60	60	60	60	60	60	60	60	60	60
	Recipient Tokens	5	12	20	30	43	60	84	120	180	300	660
	Label	A	B	C	D	E	F	G	H	I	J	K
	Donor Money	$2.20	$2.00	$1.80	$1.60	$1.40	$1.20	$1.00	$0.80	$0.60	$0.40	$0.20
	Recipient Money	$0.20	$0.40	$0.60	$0.80	$1.00	$1.20	$1.40	$1.60	$1.80	$2.00	$2.20
	Offer	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Notes. Donors can choose from eleven offers and each column represents an offer. The standard framing of an offer is in terms of percentages. For example, an offer of 10% means that 10% of the divisible endowment is offered to the recipient. In the experiment this corresponds to a value transfer of $0.80 from the recipient to the donor. In each treatment an offer corresponds to a nominal change in the number of tokens. In the Taking treatment offers below 50% implies that tokens are transferred from the recipient to the donor and offers above 50% are transfers from the donor to the recipient. Note that the transfer of value with each offer is the same across treatments. Destroying 17 or 55 tokens results in an absolute real change of $0.198 and $1.015 respectively, instead of $0.20 and $1.00. In the experiment these amounts are rounded off to match the payoff that corresponds to that offer in the other treatments.

We manipulate donors' ability to affect the number of tokens. In the Taking treatment the total number of tokens cannot be changed. Donors can only transfer tokens. Thus, the only way for donors to disadvantage the paired recipient is by taking tokens. For example, an offer of 20% corresponds to transferring 30 tokens from the recipient to oneself. Considering that the total number of tokens cannot change in the Taking treatment, the value of a single token is constant. This treatment corresponds to the taking framing of a DG (Dreber *et al.* 2013).

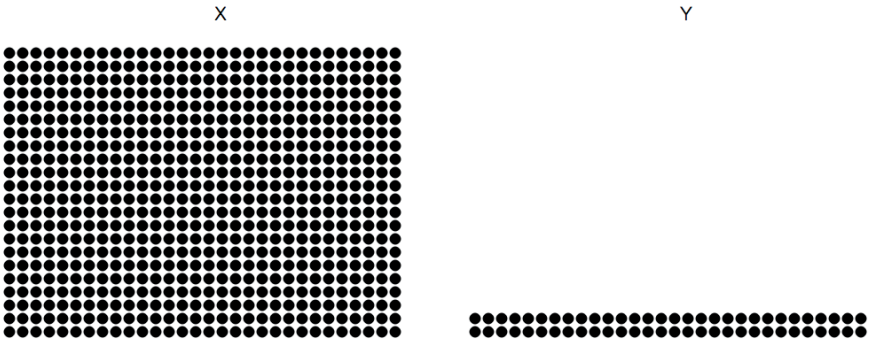
In the Dilution treatment the donor cannot affect the number of tokens held by the recipient. However, the donor can increase or decrease the number of tokens held. Increasing the number of tokens dilutes the value of a single token while decreasing this amount increases the value of a single token. For example, an offer of 20% corresponds to creating 120 tokens, which are allocated to the donor. Considering that in this case the donor will have 120+60

= 180 tokens and the recipient 60 tokens, the donor in essence expropriates to herself $\frac{180}{180+60} = \frac{3}{4}$ of the total endowment (80% of the dividable endowment). Donors can advantage recipients by destroying their own tokens. As a result the value of a single token increases as the total endowment is divided by fewer tokens.

In the Destruction treatment donors cannot change the number of tokens they possess but they can change the number of tokens held by the recipient. In this treatment a donor can only disadvantage the recipient by destroying tokens held by the recipient. This results in fewer tokens, which increases the value of a single token and is monetarily advantageous to the donor. To advantage the recipient, donors can increase the number of tokens held by the recipient, which would dilute the total value of the tokens held by donors.

In Table 4.1 an overview of the donor's choice set for each treatment is provided. Even though the donor's choice set differs considerably in nominal terms across treatments, in real terms the choice sets are identical. Thus, any behavioral difference between treatments can be attributed only to the nominal framing. All participants were required to answer a question that tests their understanding of the experiment. Only participants who answered this question correctly were paired and included in the sample. 66% of all participants provided a correct answer. Participants who provided an incorrect answer did not receive any feedback that they provided the incorrect answer to prevent discovering the correct answer through trial-and-error.

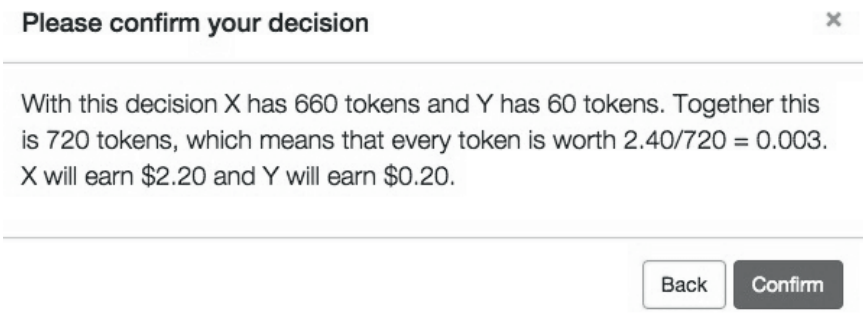
Figure 4.1: ***Visualization token distribution***



Note. Visualization of the distribution of tokens in the Dilution treatment for the offer 0%. In this case the donor has 660 tokens and the recipient has 60 tokens.

In the next screen donors were shown a visualization of the token distribution (Figure 4.1). Donors were free to select any possible offer to view how it would impact the distribution of tokens between the two parties. After selecting an offer, donors could submit their definitive choice. Donors were not made aware beforehand that submission triggers the appearance of a dialog box with more information about their offer and the possibility to reconsider their offer. The dialog box provides information about the distribution of the tokens, the monetary value of a single token and the monetary distribution that results from the submitted offer (Figure 4.2). This procedure allows for measuring the intuitive response of donors, which is the initial offer, and provides insight about to what extent informational feedback about the distribution in real terms affects decision-making. Furthermore, this design avoids any biases that might result from donors' reluctance to calculate the real consequences (Feldman and Ruffle 2015).

Figure 4.2: ***Confirmation dialog box***



Notes. After submitting an offer, donors are asked to confirm their decision in a dialog box. The dialog box provides information about the precise distribution of tokens, the monetary value of a single token and the precise distribution of monetary value.

We also manipulated the order of the scale to take into in case it matters in which order we offer the options. Pairs were either allocated to a treatment in which the first offer starts with 0% or to a treatment in which the first offer starts with 100%. We find that the distribution of donors' offer is not significantly different if the order of the offer scale is descending compared to ascending (Mann-Whitney, U = 17704.0, p = 0.54). At the level of the individual treatments, we find that the scale order does not affect the distribution offers in the Taking and Destruction treatment (p > 0.90) but in the Dilution treatment offers tend to be higher if the scale is descending (p = 0.07). Due to the lack of any significant order effects, the observations of the two order groups have been combined for subsequent analysis.

Recipients received the same instructions as donors and were shown the same screens. The only difference is that the submitted

recipient's offer is not implemented but reflects what the recipient beliefs what the paired donor will choose. To elicit recipients' beliefs about what the donor will offer, recipients could earn a bonus of $0.20 if they correctly predicted what their paired donor offered. 34.2% of the recipients predicted the exact offer, and this is 45.2% if you include predicted offers with a deviation of not more than 10 percentage points from the actual offer.

In the next screen recipients are asked to evaluate to what extent they like or dislike the donor's offer. We implement a novel measure that avoids strategic interaction but requires effort to signal a certain response. The scale starts at zero, which is shown prominently in the middle of the screen. Participants can click on the red button to decrement this amount by one or on the green button to increment the amount by one. It is not possible to increase or decrease automatically by holding the button or using the keyboard. Every increase or decrease requires a click, which necessitates little but some physical effort. The minimum amount is -500 and the maximum amount is 500. Even though the chosen value is not communicated to the donor and nor does it affect the monetary outcome of the experiment, the measure allows recipients to emit a costly signal of their subjective evaluation of the donor's offer. Donors were also presented the same measure but were asked to indicate to what extent they think the recipient likes or dislikes the offer.

Before the end of the experiment both recipients and donors were asked to answer three questions to measure cognitive ability. Following Oechssler *et al.* (2009), we implement the Cognitive Reflection Test (CRT) to be able to study the moderating effect of

cognitive ability on framing effects. The CRT aims to measure to what degree participants are conscientious, reflective and thoughtful in their thinking (Frederick 2005). There is evidence that CRT is a reliable predictor of susceptibility to framing effects and biases (Toplak, West and Stanovich 2011). The first of the three CRT questions provides the following logical challenge: "A bat and a ball cost $1.10. The bat costs $1.00 more than the ball. How much does the ball cost (in cents)?" Participants who only think superficially about this question are likely to provide 10 cents as the correct answer. The correct answer is actually 5 cents, which requires cognitive effort to determine. Goodman, Cryder and Cheema (2013) show that participants in Amazon Mechanical Turk do not score significantly different on the CRT compared to "community" participants. Of all participants, including those who did not provide a correct answer to the control question, 28% answered correctly to all three CRT items. This percentage is 48% if only the included sample is considered. These are categorized as participants with a high CRT score.

4.4. Theoretical predictions

A standard economic assumption is that individuals maximize their private wealth. Moreover, they are assumed to evaluate their wealth by the real value of their possessions. But these assumptions are not always supported in practice, which is illustrated by experimental evidence. Only some individuals are selfish but many appear to regard the consequences of their own decisions for other individuals' wealth (Forsythe *et al.* 1994). And as we discuss above, money illusion has been shown to have tangible impact on economic efficiency.

Here we show that pro-social tastes combined with money illusion may lead to dilution illusion in our experiment. For this we will assume that our participants may hold other-regarding preferences over the *nominal* allocation of tokens rather than over the real division of monetary value. That social preferences may be sensitive to an ex-ante distribution of tokens rather than an ex-post distribution of value. Roth and Murnighan (1982) show that people prefer equal divisions of lottery tickets even when the resulting division of winnings is unequal in any event.

In all our treatments an allocation (s,t) of s tokens for the donor and t tokens for the recipient results in the division (x,y) of a fixed prize value v, where $x = sv/(s+t)$ is the donor's share and $y = tv/(s+t)$ is the recipient's share of the prize. A donor sensitive to real value computes her utility from the distribution (x,y) and a donor sensitive to nominal value computes her utility from the distribution (s,t). A selfish donor will assign the highest utility to the distribution that gives her the highest earning x or the highest number of tokens s, respectively. In our experiment this is always achieved by the 0% offer, with exception of the destruction treatment where the nominal amount of own tokens is fixed.

This changes when we consider other-regarding individuals who may be willing to share the prize, and may exhibit dilution illusion when the relative nominal differences between s and t differ from the corresponding relative real differences between x and y. To illustrate how dilution illusion may affect decisions we consider the simple model of inequity aversion proposed by Fehr and Schmidt (1999). A donor with parameters of 'envy' α and 'guilt' β, where α

$\geq \beta \geq 0$, evaluates a distribution (x,y) of value by $u(x,y) = x - \beta(x-y)$ when she earns more than her recipient, $x \geq y$; and by $u(x,y) = x - \alpha(y-x)$ when she earns less. Her utility therefore increases in her own earning and decreases in the difference between the earnings. Fehr and Schmidt (1999) show that behavior in a number of economic games can be reasonably described by this model assuming that 40% of the participants are very inequity averse with $\beta = 0.6$, a further 30% are selfish with $\beta = 0$, and the remaining 30% hold an intermediate guilt parameter $\beta \in (0,0.6)$.

An inequity averse individual in a dictator game prefers the equal division of earnings whenever her $\beta > 0.5$ and otherwise prefers the selfish division. To see this, note first that according to the inequity aversion model a donor will never choose a distribution of tokens or monetary payoffs where she earns less than the recipient. She would always prefer the even division, which gives her more and simultaneously reduces the difference in either tokens or monetary earnings. A rational donor therefore considers only the divisions where she earns at least as much as the recipient. Her utility is then given by $u(x,y) = x - \beta(x-y)$ which in a dictator game with a fixed prize value v we may rewrite $u(x,y) = u(x, v-x) = x - \beta(2x-v) = x(1-2\beta) + \beta v$. This increases in x whenever $\beta < 0.5$ and decreases in x whenever $\beta > 0.5$. A donor with high guilt β will therefore choose the lowest x such that $x > y$, and that leads to the even division. A donor with low guilt will choose the highest possible x, offering 0% to the recipient. If all our participants consider the division in real values then, based on the above distribution of guilt, we should in all our treatments see about a half of them making the selfish offer 0%.

Consider now a nominal value sensitive donor with utility $u(s,t) = s - \beta(s-t)$. Again this donor will never choose a distribution of tokens or monetary payoffs where she earns fewer tokens than the recipient. In the taking treatment the real and nominal distributions coincide in relative terms, and again a donor chooses an even division when $\beta > 0.5$. In contrast, in the Dilution treatment any such donor would add as many tokens as possible to her own account and thus offer 0%, but in the Destruction treatment only a self-regarding donor (with $\beta = 0$) will destroy the tokens in the recipient's account to offer 0%. To see this, note that in the Dilution treatment the utility can be rewritten as $u(s,t) = u(t+c,t) = t + c - \beta c = t + c(1-\beta)$ where t is fixed and the donor chooses the number c of tokens to create for herself. This utility increases in c for all reasonable guilt parameters and all donors prefer to create as many tokens as possible, resulting in a 0% offer to the recipient. In the Destruction treatment the utility can be rewritten as $u(s,t) = u(s,s-d) = s - \beta d$ where s is fixed and the donor chooses the number d of recipient's tokens to destroy. This utility decreases in d for all donors except those with $\beta = 0$, that is, the self-regarding donors who are indifferent between the offers. All other-regarding donors choose $d = 0$ and offer the even division of earnings.

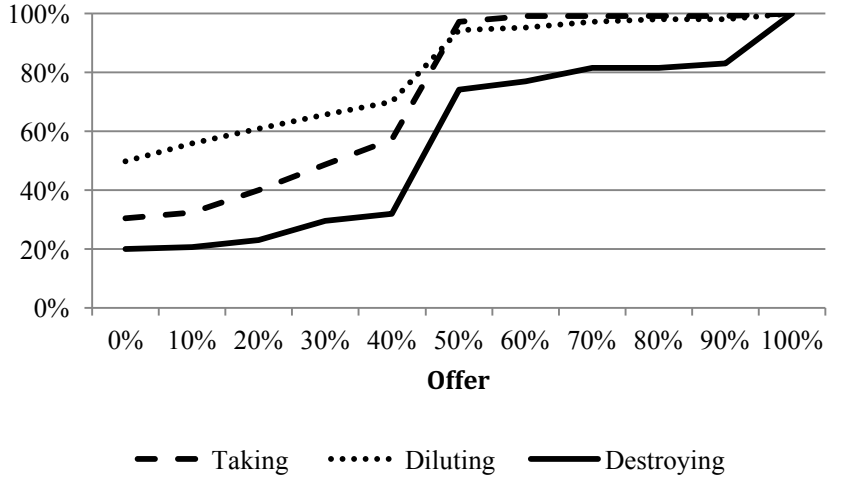
In summary, a donor with a high guilt parameter $\beta = 0.6$ and sensitive to the nominal allocation will evenly divide the tokens and earnings in the Taking treatment, but maximize its own tokens in the Dilution treatment, giving 0% to the recipient. This donor would effectively be subject to the dilution illusion. Similarly, a nominally sensitive donor with a low but positive guilt aversion

will give 0% to the recipients in both the Taking and the Dilution treatments but will share evenly in the Destruction treatment.

Recent models of social preferences imply that prosocials participants might be more affected by dilution illusion. For instance, the model in Charness and Rabin (2002), with the corresponding parameter estimates, predicts that a subject sensitive to the nominal allocation of tokens is eight times more likely to offer 0% in the Dilution treatment than in the taking treatment (with the predicted probabilities of selfish offers being 88% and 12% respectively). Again, no difference is predicted for participants whose preferences depend on the real distribution of monetary value.

4.5. Results

Figure 4.3: ***Cumulative distribution of donors' initial offers***



Notes. $N = 383$. Donors' initial offer.

FINDING 1 *Initial offers are lower in the Dilution treatment than in the Taking treatment*

The distribution of initial offers in the Taking treatment differs from the distribution of initial offers in the Dilution treatment (Figure 4.3). The median initial offer in the Taking treatment (40%) is considerably higher than the median initial offer in the Dilution treatment (10%). Further analysis reveals that donors' initial offers are on average 28% lower in the Dilution treatment than in the Taking treatment (Mann-Whitney, $U = 6025.00$, $p = 0.005$). Also the percentage of donors who considered initially the lowest offer is significantly higher in the Dilution treatment than in the Taking

treatment ($\chi^2(2) = 28.00$, $p < 0.001$). Furthermore, the percentage of donors who initially offered an equal split in real terms is significantly lower in the Dilution treatment than in Taking treatment ($\chi^2(2) = 11.21$, $p = 0.004$). In sum, the option to dilute the recipient lowers donors' offers. The results are in line with our theoretical predictions assuming that a third of donors consider the nominal rather than the real distribution. These findings strongly support the hypothesis for the existence of the dilution illusion. Furthermore, we find that recipients' expected initial offer is on average lower in the Dilution treatment than in the Taking treatment (Mann-Whitney, $U = 4828.0$, $p < 0.001$).

Table 4.2: ***Descriptives of initial offers***

	Mean offer (SD)	Median offer	Offer 0%	Offer < 50%	Offer 50%	Offer > 50%	*N*
donor							
Taking	29.8% (0.23)	40%	30.5%	57.1%	40.0%	2.9%	105
Dilution	21.5% (0.26)	10%	49.7%	69.9%	24.5%	5.6%	143
Destruction	47.8% (0.32)	50%	20.0%	31.9%	42.2%	26.9%	135
Recipient							
Taking	36.2% (0.24)	50%	24.8%	42.9%	48.6%	8.6%	105
Dilution	20.7% (0.28)	0%	55.2%	74.8%	18.2%	7.0%	143
Destruction	45.1% (0.31)	50%	17.8%	35.6%	40.7%	23.7%	135

Notes. $N = 383$. The numbers shown for the recipient pertains to their initial *expected* offer.

FINDING 2 *Compared to initial offers, the dilution illusion is less pronounced in the final offers*

After showing donors that their initial offer is not definitive and providing information about the monetary consequences of this offer, donors were offered the possibility to reconsider their offer as many times as they wished. Donors in the Dilution treatment considered more offers than in the Taking treatment (M_{taking} = 1.2 versus $M_{diluting}$ = 1.8, Mann-Whitney, U = 6210.50, p = 0.001). Note that 73.6% of the donors did not reconsider their initial offer and, thus, submitted their initial offer as their final offer. This percentage, however, differs significantly between treatments (Taking: 88.6%, Dilution: 72.0%, Destruction: 63.7%, $\chi^2(2)$ = 19.11, $p < 0.001$). Relatively more donors submitted their initial offer in the Taking treatment compared to donors in the Taking and Destruction treatments combined (Taking: 88.6%, Dilution and Destruction: 68.0%, $\chi^2(2) = 16.63$, $p < 0.001$). Thus, donors in the Dilution and Destruction treatments were more likely to recalibrate their offer once they were made aware of the consequences in monetary terms. This implies that at least for some donors, the initial offer is based on intuitive decision-making and, thus, donors refrain from manually or mentally calculating the monetary consequences of their choice.

A Wilcoxon Signed-Ranks Paired Difference Test reveals that in general donors' initial offer is significantly higher than the final offer (Z = 3.00, p = 0.003). We find, however, that the distribution of the difference between the initial and final offer differs significantly between treatments (Kruskal-Wallis, $\chi^2(2) = 24.81$, $p <$

0.001). In the Dilution treatment donors tend to offer 2.2 percentage points more in the final offer while in the Destruction treatment the final offer is 10.9 percentage points lower than in the initial offer (Table 4.2).

Even after providing the possibility to donors to reconsider their offer, differences in the final offer between treatments remain. Specifically, the distribution of final offers differs significantly between treatments (Kruskal-Wallis, $\chi^2(2) = 14.99$, $p < 0.001$). The proportion of donors who offered nothing also differs significantly between treatments ($\chi^2(2) = 9.68$, $p < 0.01$). Thus, even after providing donors the opportunity to reconsider their offer while revealing information about the monetary distribution of their offer, they were still susceptible to the dilution illusion.

On average, final offers in de Dilution treatment were 16% lower than in the Taking treatment (Mann-Whitney, U = 6678, $p = 0.12$). The proportion of donors who offered nothing is 38% higher in the Dilution treatment than in the Taking treatment ($\chi^2(1) = 3.88$, $p = 0.049$). These findings marginally support the existence of the dilution illusion considering donors were more selfish in the Dilution treatment than in the Taking treatment but not significantly so.

Table 4.3: ***Descriptives of final offers***

	Mean offer (SD)	Mean change from initial to final offer (SD)	Median offer	Offer 0%	Offer < 50%	Offer 50%	Offer > 50%	*N*
donor								
Taking	28.4% (0.22)	−0.01 (0.13)	40%	32.4%	58.1%	41.0%	1.0%	105
Dilution	23.8% (0.25)	+0.02 (0.19)	10%	44.8%	64.3%	32.2%	3.5%	143
Destruction	36.9% (0.29)	−0.11 (0.27)	50%	27.4%	45.2%	42.2%	12.6%	135
Recipient								
Taking	33.8% (0.23)	−0.02 (0.10)	50%	26.7%	46.7%	48.6%	4.8%	105
Dilution	19.1% (0.24)	−0.02 (0.20)	0%	55.2%	73.4%	23.1%	3.5%	143
Destruction	40.0% (0.28)	−0.05 (0.23)	50%	22.2%	36.3%	46.7%	17.0%	135

Notes. $N = 383$. The numbers shown for the recipient pertains to their final *expected* offer.

FINDING 3 *Offers in the Destruction treatment are lower than in the Taking treatment*

Besides predicting the dilution illusion, we also hypothesized the existence of an opposite effect—ruin illusion—if donors can only affect the shares of recipients. We find that the distribution of initial offers in the Taking treatment also seems to differ considerably from the same distribution in the Destruction treatment (Figure 4.3). Indeed, analysis reveals that donors' initial offers are on average 60% higher in the Destruction treatment than in the Taking treatment (Mann-Whitney, U = 4746.50, $p < 0.01$). Remarkably, the percentage of donors who initially offered more than half of the piece in real terms to the donors is significantly higher in the Destruction treatment than in Taking treatment ($\chi^2(2) = 23.59$, $p < 0.01$). Furthermore, donors who offered more to themselves than the recipients were a minority in the Destruction treatment (45.2%), which is significantly lower than in the Taking treatment ($\chi^2(2) = 3.94$, $p = 0.05$). The proportion of donors who gave more to the recipient than to themselves also differs significantly between treatments ($\chi^2(2) = 16.72$, $p < 0.01$). This proportion is much higher in the Destruction treatment than in the other two treatments. These finding strongly support the hypothesis for the existence of the ruin illusion. In the Destruction treatment final offers were 30% higher than in the Taking treatment (Mann-Whitney, U = 7270, $p < 0.01$).

FINDING 4 *Donors with a high CRT score offer less to recipients*

Initial offers of donors with a high CRT score are on average 24% lower than the initial offers made by donors with a low CRT score

(Mann-Whitney, U = 14942.0, $p < 0.01$). The difference is more pronounced in the final offers. Specifically, final offers of donors with a high CRT score are on average 34% lower than the initial offers made by donors with a low CRT score (Mann-Whitney, U = 13903.5, $p < 0.01$). These findings strongly suggest that increased cognitive ability leads to more selfish decision-making.

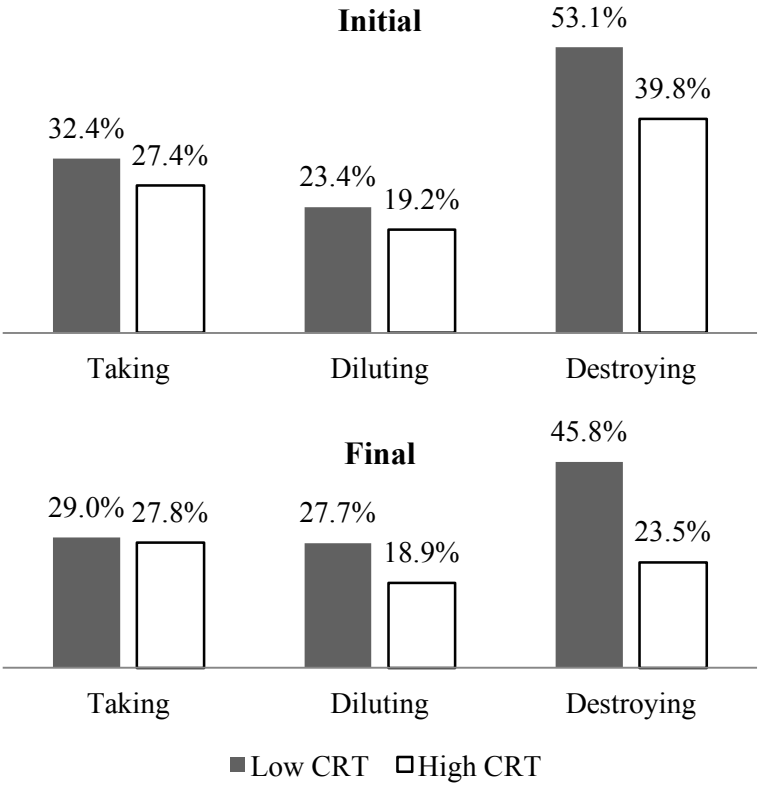
Further analysis reveals that in the Taking treatment cognitive ability does not affect average final offers (Mann-Whitney, U = 1356.0, $p = 0.89$). However, in the Dilution treatment donors with a high CRT score offered on average 31.8% less than donors with a low CRT score (Mann-Whitney, U = 2077.5, $p = 0.05$). In the Destruction treatment donors with a high CRT score offered on average 49% less than donors with a low CRT score (Mann-Whitney, U = 1206.5, $p < 0.001$). Thus, the association between cognitive ability and offers is only found in the two treatments in which the nominal representation can be separated from the distribution in real terms.

FINDING 5 *Offers between treatments are more similar among donors with a high CRT score*

The distribution of initial offers differ significantly between treatments among donors with a low and high CRT score (Low: Kruskal-Wallis, $\chi^2(2) = 44.46$, $p < 0.001$; High: Kruskal-Wallis, $\chi^2(2) = 10.92$, $p = 0.004$). However, the distribution of final offers differs significantly between treatments among donors with a low CRT score (Kruskal-Wallis, $\chi^2(2) = 20.93$, $p < 0.01$) but not among donors with a high CRT score (Kruskal-Wallis, $\chi^2(2) = 3.99$, $p = 0.14$). A Wilcoxon Signed-Ranks Test reveals that initial offers do

not differ significantly from final offers among donors with a low CRT score ($Z = -1.33$, $p = 0.18$). However, among donors with a high CRT score final offers are significantly lower than initial offers ($Z = -2.91$, $p < 0.01$). These findings support the hypothesis that donors with a high CRT score are less likely to suffer from the dilution illusion, especially after receiving feedback.

Figure 4.4: Mean initial and final offer per treatment and CRT score



Note. $N = 383$.

recipients were able to indicate to what extent they liked or disliked the offer made by the donor, which reflects recipients' response to the final offer. Considering that the distribution of this scale is highly skewed (Skewness = 2.65, S.E. of Skewness = 0.125), we dichotomize the responses between negative and nonnegative scores for further analysis. A logistic regression reveals that a lower donors' final offers significantly increases the likelihood that the recipient's response is negative (B = -0.49, S.E. = 0.05, p < 0.01). However, we do not find any evidence that recipients' responses are affected by the Dilution treatment (p = 0.90) or the Destruction treatment (p = 0.16). This strongly suggests that the differences between treatments did not result in a change in recipients' perceptions about the likability of the outcome. Similarly, donors expect on average that a lower final offer significantly increases the likelihood that the recipient's response is negative (B = -1.07, S.E. = 0.10, p < 0.01). A possible explanation of these findings is that the dilution illusion is the result of intuitive decision-making and, thus, not the result of deliberate strategic behavior.

4.6. Discussion

This study investigates to what extent the nominal representation affects interpersonal decision-making. Separate streams of research show that increasing the nominal value of a choice while keeping the real value constant makes that choice more attractive in an

individual decision-making setting (Hsee *et al.* 2003; Kirkpatrick and Epstein 1992; Shafir *et al.* 1997). We find that disentangling the nominal representation of an endowment from its distribution in real terms can also introduce a bias in an interpersonal setting. Specifically, the reported experiment provides strong evidence for the existence of more selfish decision-making if the other is not affected nominally, which we dub the dilution illusion. The inverse effect can be obtained if the nominal endowment of the decision-maker cannot be changed.

We hypothesized that a higher cognitive ability mitigates the effect of disentanglement between the nominal representation and the outcome in real terms. We find, indeed, that the differences across treatment cease to be significantly different among donors with a higher cognitive ability. Interestingly, donors with a higher cognitive ability are more selfish across treatments. This finding conforms to recent studies that show that conscious deliberation increases the likelihood of selfish decision-making (e.g., Rand, Greene and Nowak 2012).

The effect of changing the nominal representation on donors' offers seems quite robust. As part of the experimental design, donors were provided the opportunity to reconsider their initial offers and at the same were provided unambiguous information about the real consequences of their offer. Although we find evidence that donors tend to revise their initial offer if it is presented in real terms, the distribution of final offers still significantly differ between treatments. This shows that removing the burden of mental arithmetic problem-solving is not sufficient to prevent the dilution illusion. Furthermore, note that the endowment in the experiment

can be considered windfall wealth. Studies show that earned wealth, which can be established as such with the use of effort tasks, can magnify perceptions of ownership (Oxoby and Spraggon 2008). Arguably, the found effects might have been more pronounced if participants were required to exert effort to earn their initial endowment.

A relevant question is whether the dilution illusion is in reality strategic behavior or a psychological bias. Donors might reason that recipients care more about the nominal distribution of the endowment than the outcome in real terms. As a result, socially considerate donors might appropriate more in the end because they think that recipients experience less harm due to a lack of nominal harm (Dana, Cain and Dawes 2006). The findings, however, seem to support an explanation based on the existence of a psychological bias. The dilution illusion is less pronounced in the final offers compared to the initial offers. This highlights donors' preference to 'undo' the bias after receiving information about the real consequences of their offer. Furthermore, we find that donors with a higher cognitive ability decide similarly across treatments. Arguably, donors with a higher cognitive ability are more likely to process the presented information accordingly to align the outcome of the experiment with their actual preferences. This is line with previous studies that show that decision-makers with a higher cognitive ability are able to make decisions that are less susceptible to framing effects (LeBoeuf and Shafir 2003) and take into account obfuscating rules (Abeler and Jäger 2015).

We argue that the psychological bias that underpins the dilution illusion is based primarily on perceptions of property rights. To

determine who owns what, decision-makers often rely on the heuristic that the distribution of property rights follows the distribution of possessions (Gächter and Riedl 2005; Reb and Connolly 2007). The found bias arises if possessions, which reflect the nominal distribution, are separated from the underlying value. Because possessions are salient and are used as a heuristic to determine the distribution of property rights, possessions are given more weight than standard economic theory would predict (Brenner *et al.* 2007). Arguably, this bias is difficult to overcome because it is practically difficult to assign property rights to value with using any mediums.

Our findings also contribute to the literature on theft aversion. Studies in this literature show that decision-makers tend to respect claims of moral ownership (Gächter and Riedl 2005). To induce moral ownership participants are required to exert effort to earn an endowment (e.g., List 2007). However, there little evidence that changes in framing alone can change claims of moral ownership. For example, Dreber *et al.* (2013) investigate to what extent changing the framing of transfers, which imply a certain distribution of property rights, affected offers in the DG. Donors can obtain the full endowment by taking the endowment from the recipient assuming that the recipient is the initial holder. In a different framing the same outcome can be obtained if donors give nothing assuming that the donor is the initial holder. Dreber *et al.* (2013) find that framing an offer as giving money to recipients did not result in a different outcome from framing an offer as taking money from recipients. Our study, however, provides evidence that

the degree of theft aversion can be manipulated through disentangling the nominal endowment from the real endowment.

The policy implications of our contributions apply to a broad range of contexts. First, our findings have implications for corporate governance. Johnson *et al.* (2000) describe how in even economically advanced countries controlling shareholders can expropriate value from minority shareholders. They mention that the leading example is share dilution. In these cases majority shareholders issue new shares to themselves while preventing minority shareholders receiving any shares to protect the value of their stake. As a result, value is unjustly expropriated without the consent of shareholders who are not issued any new shares. Interestingly, Johnson *et al.* (2000) argue that the law often insufficiently protects minority shareholders from this type of expropriation, which can hurt the attractiveness of the investment environment. In these cases the law does not provide a sufficient deterrence against exploitive share dilution. Our study shows that the ability to dilute can lead to a higher degree of appropriation. Therefore, our study can provide a basis for policy recommendations that strengthen the protection of minority shareholders to anticipate the effects of dilution illusion.

Second, a subtler example is the effect of dilution illusion in the insurance industry. Profit-maximizing insurance agents do not have an incentive to disclose the implications of inflation on the purchasing power of the maximum amount that can be claimed (Power 1959). Insurance agents can generate a higher profit rate through adjusting parameters such as by advancing the expiration date without affecting the nominal amounts. Our findings suggest

that insurance sales agents are likely to make use of this possibility for self-gain. Requiring agents to present all information in real terms using a single expected inflation rate might nudge agents to offer insurance policies that are more aligned with market prices.

4.7. Appendix: Instructions

In this experiment you will be paired randomly and anonymously with another worker.
Each worker will hold tokens that determine how you will share $2.40 at the end of the experiment. One of the two workers in your pair will be able to change the allocation of tokens.
The worker who can change the allocation is called X. The worker who cannot change the allocation is called Y. There is one X and one Y in your pair.

In your pair you are: Y

X and Y receive each 60 tokens. X can create or destroy her/his own tokens but cannot change the number of tokens for Y. X will choose one of the following options:

	[Taking treatment]	[Dilution treatment]	[Destruction treatment]
a	X takes 50 tokens from Y	X creates 600 tokens for him or herself	X destroys 55 tokens of Y
b	X takes 40 tokens from Y	X creates 240 tokens for him or herself	X destroys 48 tokens of Y
c	X takes 30 tokens from Y	X creates 120 tokens for him or herself	X destroys 40 tokens of Y
d	X takes 20 tokens from Y	X creates 60 tokens for him or herself	X destroys 30 tokens of Y
e	X takes 10 tokens from Y	X creates 24 tokens for him or herself	X destroys 17 tokens of Y
f	X neither takes nor gives tokens to Y	X neither creates nor destroys tokens of him or herself	X neither creates nor destroys tokens of Y
g	X gives 10 tokens to Y	X destroys 17 tokens of him or herself	X creates 24 tokens for Y
h	X gives 20 tokens to Y	X destroys 30 tokens of him or herself	X creates 60 tokens for Y
i	X gives 30 tokens to Y	X destroys 40 tokens of him or herself	X creates 120 tokens for Y
j	X gives 40 tokens to Y	X destroys 48 tokens of him or herself	X creates 240 tokens for Y
k	X gives 50 tokens to Y	X destroys 55 tokens of him or herself	X creates 600 tokens for Y

The final allocations of tokens between X and Y will determine how the $2.40 will be divided. Each token will give the same share of $2.40. To compute the value of each token we will first count the total number of tokens by both X and Y. Then we will divide $2.40 with this total, and this will give us the value of one token. In this way the total value of all tokens together will always be $2.40.

For example, if X has 60 tokens and Y has 60 tokens, then the total number of tokens is 60 + 60 = 120.

Each token is then worth $0.02 = ($2.40 / 120). X has 60 tokens and will then earn 60 * $0.02 = $1.20. Y also has 60 tokens and, thus, earns $1.20.

After the end of the experiment, the tokens are exchanged for money and provided as a bonus for this task.

Control question
It is necessary that you answer the following question correctly to receive any bonus. You will not be informed if you provide an incorrect answer. Make sure you get the right answer the first time.

If the total number of tokens is 240, what is the value of a single token?

- $0.01
- $0.02
- $0.03
- $0.04

5. Trading Places

5.1. Introduction

It is well-known that queues where customers are served on a first-come first-served basis are an inefficient way to ration scarce service time. The reason is that the queuing order does not guarantee that customers with high waiting costs are served before those with low waiting costs. Extant empirical research that explores ways to improve the customer's experience of waiting in a queue focuses primarily on policies that shorten overall waiting time or improve the waiting experience (*e.g.*, Kumar et al. 1997; Pruyn and Smidts 1998). Policies that allow customers with high waiting costs to get ahead for a price might improve the experience for customers who can afford this service but harm the other customers in the queue (Zhou and Soman 2008). In this chapter we explore the possibility of allowing customers to, literally, trade places to increase a queue's efficiency. This would allow customers to get ahead in a queue while compensating other customers for their longer waiting times.

We study the efficiency-enhancing properties of two intuitively appealing auction mechanisms that facilitate customers' trading places using a laboratory experiment. Kleinrock (1967) shows that a queue's efficiency may be restored if customers' positions depend on how much they pay the server. In Kleinrock's model it is assumed that upon arrival each customer pays a 'bribe' to the server. The server places the customer in the queue behind all customers who offered a higher bribe and in front of those who paid a smaller bribe. Assuming that in the steady state customers

use the same bribing function that is strictly increasing in marginal waiting costs, Kleinrock shows that steady-state waiting times are minimized, which results in efficient queues.[5] However, the assumption that customers use the same, strictly increasing bribing function may be a strong one in practice. It may be unrealistic if customers are heterogeneous in dimensions other than only marginal waiting costs (such as risk attitude or beliefs about others' waiting costs). Moreover, results from economic experiments show that, in general, human bidding behavior is 'noisy' so that even in a setting that satisfies Kleinrock's assumptions, inefficiencies are still likely to occur.[6]

In this chapter, we compare two auction mechanisms that could be used to determine the sequence of service to queued customers: the server-initiated auction and the customer-initiated auction. In the server-initiated auction, the server, when idle, invites each queuing customer to submit a bid. The server will then serve the customer who has submitted the highest bid. This customer shares her bid equally among each of the remaining customers in the queue. In the customer-initiated auction, a new arrival can sequentially trade places with customers currently in the queue. The arriving

[5] Lui (1985), Glazer and Hassin (1986), and Afèche and Mendelson (2004) back up Kleinrock's (1967) result by showing that an efficient queue order emerges in a Bayesian-Nash equilibrium in settings where customers incur waiting costs that are linear in waiting time. Hassin (1995) shows this can be achieved with exponential waiting cost functions. Kittsteiner and Moldovanu (2005) generalize the equilibrium analysis, allowing for convex and concave waiting cost functions. See Hassin and Haviv's (2003) book for a discussion of some of this literature.

[6] See Kagel (1995) and Kagel and Levin (forthcoming) for overviews of results from the experimental auctions literature. In most auction formats, inefficiencies arise because participants employ different bidding strategies, even after ample learning opportunities.

customer offers money to the queuing customers, from the back to the front. The current customers indicate simultaneously the minimum amount they are willing to accept. A new arrival trades places with a customer in front of her if and only if the latter is willing to accept her offer. This process stops as soon as the new arrival does not trade places with the customer in front of her.

We focus on the two particular auction mechanisms because both have intuitively appealing properties. First of all, an efficient ordering is feasible for both mechanisms if customers act non-strategically.[7] The server-initiated [customer-initiated] auction implements the selection sort [insertion sort] algorithm that ensures an efficient queuing order if customers consistently submit bids equal to their marginal waiting costs. Moreover, both mechanisms can be straightforwardly used in a dynamic setting where customers arrive while the server is busy. In addition, both mechanisms are budget-balanced from the viewpoint of the customers, in contrast to Kleinrock's (1967) 'bribing mechanism.' As both auction mechanisms have the potential to decrease total waiting costs, they increase the 'pie' compared to a setting where customers cannot trade places. Because all gains-from-trade remain in the customers' hands, entry into the queue is not discouraged, in contrast to a mechanism where customers pay the server to obtain priority.[8] Furthermore, as discussed below, the two auction

[7] A priority queue is an example of a mechanism that cannot guarantee an efficient ordering. While opening a priority queue may improve the efficiency compared to the situation where only the original queue exists, inefficiencies still remain because the two queues may still be ordered inefficiently.

[8] Yang et al. (forthcoming) study mechanisms where queued customers compensate an intermediary for the opportunity to trade positions.

mechanisms are predicted to differ in terms of attractive properties like efficiency and fairness. Finally, comparing the two mechanisms may reveal which mechanism is more attractive for marketing purposes in the sense that a firm offering relatively efficient or relatively fair queues may be more attractive for new potential consumers.

We compare the behavioral properties of the two mechanisms in a laboratory experiment. In contrast to Kleinrock (1967) and most of the theoretical queuing literature, we analyze the mechanisms in a static environment. In this environment there is a fixed and commonly known number of customers waiting in line to be served by the server. The server only opens as soon as all the customers have arrived in the queue.[9] We have chosen this setup for two reasons. First, it is hard, if not impossible, to find analytical results for dynamic processes in a transient state, so that our experimental study would become a fishing expedition without clear testable hypotheses. Second, it is practically impossible to invite so many participants in a laboratory setting to implement a dynamic process that evolves reasonably close to a steady state.

We evaluate the two auction mechanisms along two dimensions: efficiency and perceived fairness. To develop testable hypotheses regarding efficiency, we derive the theoretical properties of the mechanisms in an independent private waiting costs model. In our model, customers face constant marginal waiting costs per unit of

[9] As a consequence, our setting translates into a scheduling problem. Mitra (2001), Wellman et al. (2001), Feng (2008), Kayı and Ramaekers (2010), and Gershkov and Schweinzer (2010) also study auctions mechanisms used for job scheduling.

time. A customer's initial position is independent of her marginal waiting costs. We show that the server-initiated auction has an efficient (Bayesian-Nash) equilibrium, in contrast to the customer-initiated auction. The latter finding is not surprising in light of Myerson and Satterthwaite's (1983) impossibility result which shows that in a large range of settings efficient trade between an incompletely informed buyer and seller is not feasible. In our setting, customers at the front of the initial queue 'own' their position so that trade with late arrivals will not occur as often as efficiency requires. In contrast, users may perceive the customer-initiated auction as a fairer mechanism than the server-initiated auction because only the former grants them ownership rights over their initial position.

To examine the behavioral properties of the two auction mechanisms, we use two novel experimental protocols. Our first protocol implements induced waiting costs. Before bidding in the auctions, participants are privately informed of their own marginal waiting costs. Depending on the number of turns participants have to wait before being served, we subtract the resulting waiting costs from their starting capital. The efficiency gain resulting from the auctions can be readily measured because the induced waiting costs are known to the experimenter. The second protocol involves actual waiting. We used this protocol to determine the order by which participants could leave the laboratory. Participants vote for either of the two auction mechanisms and a majority rule determines which auction is actually implemented. In addition, participants were asked in a questionnaire to rate the auctions in terms of fairness on a seven-point Likert scale.

Besides studying the outcomes of the auction mechanisms, we also check whether psychological biases like endowment and sunk-cost effects have an impact on bidding behavior. We do so by varying the arrival process as part of our experimental design. On the basis of the literature, we conjecture that the endowment effect and the sunk-cost effect can simultaneously affect behavior in a setting where customers can trade places in a queue. The endowment effect occurs when the sheer possession of an object increases a person's value for it. Indeed, significant endowment effects (measured by a willingness-to-accept/willingness-to-pay gap) are observed in many other contexts.[10] Anecdotal evidence suggests that people standing in line feel entitled to their queue position, which in turn could result in an endowment effect.[11] Specifically, if customers feel that they own their current position in the queue, they may be willing to bid a higher amount when their position is up for auction than standard theory predicts.

Someone falls prey to the sunk-cost bias if her decision depends on unrecoverable costs that are economically irrelevant for the

[10] Knetsch (1989) and Kahneman et al. (1990) provide early examples.

[11] Mann (1969) observes queue jumping being discouraged in waiting lines for tickets to watch the "world series" of Australian rules football in Melbourne, Australia. Helweg-Larsen and LoMonaco (2008) find similar responses in a survey among fans of the Irish rock band U2 queuing for concert tickets. Milgram et al. (1986) let confederates impose themselves into queues in train stations and other public locations in New York and report customers' defensive reactions varying from expressing verbal objections to physical actions against the intruders. Oberholzer-Gee (2006) finds many customers willing to let someone jump the queue when offered a monetary compensation. However, when approached for a second time, all "individuals rejected my request, most of them appeared upset, some angry, a few outright hostile, suggesting that it was probably not safe to continue the experiment."

decision at stake.[12] Time spent waiting in a queue is such a sunk cost. Standard economic theory assumes that waiting costs do not affect a customer's willingness-to-pay for queue positions. In the case of a sunk-cost effect, a customer's valuation of queue position depends on how much time she has spent waiting in the queue. The existence of endowment and sunk-cost effects in a queuing setting implies that auctions that allow trading places cannot guarantee that the final queuing order is efficient.

Our main results are the following. First of all, the two auction mechanisms considered do not differ in a statistical meaningful way with respect to the average efficiency gain, irrespective of the arrival protocol. This is surprising in light of our theoretical findings that the server-initiated auction has an efficient equilibrium while the customer-initiated auction does not. In a deeper examination of our data, we do observe differences between the auctions in terms of efficiency gains: Efficiency gains are significantly greater [lower] in the server-initiated auction than in the customer-initiated auction if the initial queuing order is relatively inefficient [efficient]. Neither auction comes close to always reaching an efficient outcome. For the server-initiated auction, this result is rooted in noisy individual bidding behavior that is partly explained by a sunk-cost effect but not by a noticeable endowment effect. Noisy behavior in the server-initiated auction explains why efficiency gains are low and often even negative if the initial queuing order is already relatively efficient. In the

[12] See the seminal paper by Arkes and Blumer (1985). Phillips et al. (1991), Offerman and Potters (2006), Friedman et al. (2007), and Baliga and Ely (2011) present further experimental evidence on the sunk-cost bias.

customer-initiated auction, the queuing order remains relatively inefficient because customers bid more aggressively for their current position than arriving bidders do. In addition, we find evidence of a sunk-cost effect in the customer-initiated auction, which contributes to the auction mechanism's modest efficiency gain. On the positive side, the observed bidding behavior implies that it is unlikely that a customer will trade places if the queue is already in an efficient order. This explains why the customer-initiated auction outperforms the server-initiated auction if the initial queue's order is relatively efficient. Finally, when given the choice between the two auction mechanisms, participants tended to favor the server-initiated auction. This may be partly explained by participants evaluating the server-initiated auction as fairer than the customer-initiated auction.

This chapter speaks to several literatures. First of all, this chapter contributes to the marketing literature in that it studies customers' waiting experience. As far as we know, we are the first to experimentally study priority auctions in a queuing setting. Second, we add to the behavioral operations literature.[13] Several papers within this literature examine queuing processes in the lab. Rapoport *et al.* (2004), Seale et al. (2005), and Stein *et al.* (2007) study participants' decisions as to when to enter a queue, if at all, to test whether participants' arrival times are consistent with Nash equilibrium predictions. Kremer and Debo (2012) examine queue herding in a setting where participants can enter a queue to obtain a good of an uncertain quality. We also contribute to the behavioral

[13] See Bendoly *et al.* (2010) for a recent overview of this literature.

economics literature by examining the endowment effect and the sunk-cost effect in a setting involving queues.

5.2. Theoretical framework

Consider a queuing system where $N \geq 2$ risk-neutral customers, labeled $i = 1, \dots, N$, arrive sequentially in a queue to get served by a server. Each customer is privately informed of her waiting costs per unit of time, which we will denote by c_i. We assume that the c_i's are independently drawn from a differentiable distribution function F on an interval $[\underline{c}, \overline{c}]$, $\overline{c} > \underline{c} \geq 0$, with $F'(c) > 0$ for all $c \in [\underline{c}, \overline{c}]$. The draws are independent of any of the other stochastic processes including the process leading to the initial queue order. Before being served, customers interact in an auction mechanism that allows them to trade places. Interacting in the auctions is assumed not to cost any (additional) time for the customers. Customer i's utility from interacting in the auction is given by

$$U_i = \sum_{\substack{j=1 \\ j \neq i}}^{N} \left(P_{ji} - P_{ij}\right) - c_i w_i$$

where P_{lm} denote payments from customer l to customer m and w_i customer i's total waiting time (i.e., time spent in the queue). We assume customers' service time to be equal to one time unit. Thus, if a customer is the kth to be served, she waits $k - 1$ time units in the queue, $k = 1, \dots, N$. We assume that all customers arrive before the server opens. A customer leaves the system after being served.
We consider two auction mechanisms, the 'server-initiated auction' and the 'customer-initiated auction.' While our environment is

essentially static (all customers arrive before the server opens), we describe both auctions in such a way that they could be straightforwardly applied in a dynamic setting (where customers arrive while the server is busy).

*Server-initiated auction***.** When idle, the server initiates an auction if two or more customers are in the queue. In this auction, each customer in the queue independently submits a bid. The server starts serving the customer who has submitted the highest bid. In the case of a tie, a fair lottery determines which customer gets served. This customer pays each of the r remaining customers a fraction $1/r$ of her bid. The winning bids are revealed to all customers. The losing bids are not revealed. Table 5.1 illustrates the rules of the server-initiated auction on the basis of a numerical example.

Table 5.1: ***Numerical example for the rules of the server-initiated auction***

	First auction			Second auction		
Initial queue order	Bids	Transfers	Queue order	Bids	Transfers	Final queue order
A	18	+82	C			C
B	50	+82	A	15	+42	B
C	164	-164	B	42	-42	A

Notes. Three customers are in the queue when the server becomes idle. In the first auction, all three place a bid. In this case customer C submits the highest bid (164) and moves to position 1. His bid is distributed equally among the other two bidders. In the second auction, customer B places the highest bid (42) and moves to position 2. Customer B pays her bid to customer A.

*Customer-initiated auction***.** Suppose there are $n \geq 1$ customers in the queue when a new customer arrives. The arriving customer is located at the end of the queue. She then trades places with the existing customers on the basis of the following algorithm:

1. $i \equiv n$.
2. Both the arriving customer and the customer directly in front of her independently submit a bid, which is denoted by b_{n+1}^{i} and b_i respectively.
3. If the customer in the queue in front of the arriving customer has submitted a bid $b_i > b_{n+1}^{i}$, the arriving customer remains in her current position and the process ends. Otherwise, go to step 4. (The bids are not revealed to any of the other customers.)
4. The arriving customer pays b_{n+1}^{i} to the customer in front of her. If $i = 1$, she stops. Otherwise, $i \leftarrow i - 1$. Return to step 2.

Table 5.2 contains a numerical example illustrating the rules of the customer-initiated auction.

Table 5.2: ***Numerical example for the rules of the customer-initiated auction***

Initial queue order	First auction		Queue order	Second auction		Final queue order
	Bids	Transfers		Bids	Transfers	
A	76	+158	B			B
B	158	-158	A	100	0	A
			C	50	0	C

Notes. Three customers arrive in the queue. The first auction is initiated when customer B enters the queue. Customers A and B both submit a bid. As customer B places the higher bid, she swaps positions with customer A in return for a payment equal to customer B's bid. A second auction is initiated when customer C arrives. Both customer A, the second in line, and customer C submit a bid. Because the bid of the arriving customer is lower than the bid of the customer in front, there is no swap and, thus, there is no monetary transfer between the two customers.

As soon as the server completes serving one customer, it starts serving another, either the highest bidder (in the server-initiated auction) or the one at the front of the queue (in the customer-initiated auction). Note that both auctions are sequential games with incomplete information. We solve the games using the perfect Bayesian Nash equilibrium (henceforth: equilibrium). We obtain the following results. First of all, the server-initiated auction has a symmetric equilibrium. Let $B_n(c)$ denote the bid for a customer with waiting costs c in the case that n other bidders are in the queue.[14]

[14] Proofs of propositions 1 and 3 and corollary 2 are relegated to the appendix.

PROPOSITION 1. *Let* $c_n^{(1)}$ *represent the highest-order statistic among* n *independent draws from* F, $n = 2,3,\dots,N$. *The following iteratively defined set of bidding functions constitutes an equilibrium of the server-initiated auction:*

$$B_1(c) = \frac{1}{2}E\left\{c_2^{(1)} \middle| c_2^{(1)} \le c\right\}$$

$$B_n(c) = \frac{n}{n+1}E\left\{B_{n-1}\left(c_{n+1}^{(1)}\right) + c_{n+1}^{(1)} \middle| c_{n+1}^{(1)} \le c\right\}, n = 2,3,\dots,N-1.$$

In our experiment, we let the customers draw waiting costs from a uniform distribution. The following proposition establishes the resulting equilibrium.

COROLLARY 1. *Suppose* $F = U[0,\overline{c}]$ *where* $\overline{c} > 0$. *Then*

$$B_n(c) = \frac{nc}{3}, n = 1,2,\dots,N-1$$

constitutes an equilibrium of the server-initiated auction.

Observe that in equilibrium all customers in the queue use the same strictly increasing bidding function for each position the server auctions. As a consequence, the highest bidder is always the customer with the highest waiting costs so that the bidders are served in order of waiting costs. The following result is then immediate.

COROLLARY 2. *The server-initiated auction has an efficient equilibrium.*

In contrast, for the customer-initiated auction, no efficient equilibrium exists. This result follows immediately from the

analysis by Gershkov and Schweinzer (2010) who show that in our setting no efficient individually rational and budget-balanced mechanism exists if individual rationality is with respect to the initial first-come, first-served order.

PROPOSITION 2. *The customer-initiated auction does not have an efficient equilibrium.*

Proof: Follows directly from Proposition 2 in Gershkov and Schweinzer (2010).

Proposition 3 illustrates this result by comparing equilibrium bids for the first position in the queue. It shows that a customer in position 1 at any point in the auction process bids more aggressively than the customer currently in position 2. As a consequence, for a non-zero mass of cost realizations, the arriving customer bids less than the first in line even if the arriving customer has higher marginal waiting costs. So, the two do not trade places, resulting in an inefficient queue order.

PROPOSITION 3. *In any equilibrium of the customer-initiated auction, a customer in position 2 bids strictly less than the customer in position 1 conditional on the two having the same waiting costs* $c > \underline{c}$.

The finding that the customer-initiated auction does not guarantee an efficient queue order is not surprising in light of the Myerson-Satterthwaite (1983) impossibility theorem. The theorem states that no efficient trade is feasible between a seller and a buyer if both are

incompletely informed about each other's value for the good owned by the seller and the range of possible buyer and seller valuations overlap. The impossibility result applies to the customer-initiated auction because the arriving customer is a potential buyer of the position in front of her and the range of values for two customers overlap.

5.3. Experimental design and hypotheses

5.3.1. Experimental design

We ran the computerized laboratory experiments at the Center for Experimental Economics and political Decision making (CREED) of the University of Amsterdam. Each session consisted of four parts. In all parts, participants interacted within groups of the same five participants (no re-matching). In the first part, participants interacted five times in either the server-initiated auction or the customer-initiated auction. In the second part, they interacted five times in the other auction mechanism. In part 3, the participants were asked to vote between the auction mechanisms played in the first two parts. Majority voting determined which of the two auction mechanisms was played in part 4, where we took the votes from all participants in a session together. In part 4, the participants interacted in the chosen auction mechanism and the final queue order determined when the participants could leave the laboratory. Thus, the last part incurred real waiting costs in contrast to induced waiting costs as in the first two parts.

Table 5.3: ***Experimental design and number of participants***

		Arrival time	
		$t = 0$ Simultaneous	$t \sim U[-4,0]$ Sequential
Order of auction mechanisms	Server – Customer	20 (4)	20 (4)
	Customer – Server	30 (6)	25 (5)

Note. Number of groups in parentheses.

We exploit a 2x2 between-subjects design where the treatments vary on two dimensions: the order of the auction mechanisms and the arrival process (see Table 5.3). In all treatments, the server initiates service at time 0 and service time is fixed at 1. Before entering the queue, participants drew their waiting costs per unit of time from the uniform distribution on the integer values from 0 to 100. All draws throughout the experiment were independent of each other and of any of the other stochastic processes. For the sake of comparison between the treatments, we kept the waiting cost draws constant across participant groups. We used the following two arrival processes. The first implements simultaneous arrivals: all customers arrive at time 0 and are put in a queue in random order. The second arrival process is a modification of Stein et al.'s (2007) sequential arrival protocol. All participants draw an arrival time according to the uniform distribution on the time interval $[-4,0]$. Upon arrival, each customer is located at the end of the queue and incurs waiting costs equal to the time she has to wait

until the server initiates service multiplied by her waiting costs per unit of time.
At the end of the experiment, we paid the participants their experimental earnings in the order determined in part 4. We left five minutes between paying each participant in the same participant group. As a consequence, the last student left the experiment 20 minutes after the first. By doing so, we induced actual waiting costs for the participants. Before we paid the participants, we asked them to fill out a questionnaire that included questions about background characteristics such as age, gender, and field of studies. In addition, the participants had to indicate on a seven-point Likert scale to what extent they considered the two auction mechanisms to be fair. Only when all participants in a session had finished the questionnaires did we start paying them.

At the start of the experiment, participants obtained a starting capital equal to 4,000 [3,000] 'francs' in the case of the sequential [simultaneous] arrival process. In all treatments, the exchange rate was 100 francs = €1. Earnings varied between €5.60 and €44.20, with an average of €20.97.[15] We could conclude all sessions within two hours, including the 20 minutes the students at the end of the queue in part 4 had to wait.

5.3.2. Hypotheses

Our experimental design allows us to test several hypotheses. Our main theoretical finding is that the server-initiated auction has an

[15] Participants earned on average €20.93 in the treatments with the simultaneous arrival process and €21.02 in the treatments with the sequential arrival process. There is no significant difference (Mann-Whitney, $U = 1031$, $p = 0.48$).

efficient equilibrium, in contrast to the customer-initiated auction. This result implies the following testable hypothesis.

HYPOTHESIS 1. *The server-initiated auction results in a more efficient outcome than the customer-initiated auction.*

Hypothesis 1 may be rejected if bidding behavior is 'noisy' in the sense that customers do not bid according to the same, strictly increasing bidding function. Consider the extreme case that the initial queue is already in the efficient order. Adding independent noise to the equilibrium bidding functions of the server-initiated auction implies that the actual service order may be inefficient. For the customer-initiated auction, the effect of adding independent noise may be more innocent than for the server-initiated auction when an arriving customer bids less aggressively than customers in front of her so that inefficient trade may be less likely to occur. As a consequence, noisy bidding behavior may imply that for relatively efficient initial queue orders, the customer-initiated auction is at least as efficient as the server-initiated auction so that hypothesis 1 is rejected.

In addition, as discussed in the introduction, the endowment effect and the sunk-cost effect may play a role in auctions that reallocate queuing positions. If an endowment effect is present, the alternative hypothesis is that a customer's bid depends on her initial position in the queue. In the case of a sunk-cost effect, bids may depend on the arrival process because customers sink more costs before they get served in the case of a sequential arrival process than under a simultaneous arrival process. In contrast, the theory is based on the assumption that bidding behavior does not depend on either the

customers' initial positions or the costs customers sink before the server opens, which leads to the following hypotheses.

HYPOTHESIS 2. *A customer's bids in the server-initiated auction do not depend on her initial position in the queue.*

HYPOTHESIS 3. *A customer's bids in the server-initiated auction do not depend on the waiting costs she sinks before the server opens.*

The endowment effect might emerge differently in the customer-initiated auction. A salient difference between the server-initiated auction and customer-initiated auction is the ability to exercise position rights. Although customers in the server-initiated auction are assigned a rivalrous queue position, it is not possible to maintain the position because customers have no ability to defend it. On the contrary, customers in the customer-initiated auctions are assigned positions that can be defended. Customers can defend their position by submitting a very high bid if their position is contested without having to pay this bid. Thus, positions in the customer-initiated auction in terms of possession are 'stickier' than in the server-initiated auction. Reb and Connolly (2007) show that the endowment effect is more pronounced in cases of actual possession than in cases of perceived ownership. Therefore, it is more likely to find an endowment effect in the customer-initiated auction than in the server-initiated auction even though standard economic theory predicts that neither will appear.

The presence of position rights might also affect how sunk-costs affect bidding behavior. Baliga and Ely (2011) note that the sunk-cost effect can result in a willingness-to-pay that is higher or lower

than standard theory predicts. They argue that the sunk-cost effect is rational if decision-makers are assumed to have limited memory. The effect is either negative (the pro-rata effect) or positive (the Concorde effect) depending on how decision-makers use sunk costs as a signal about the future value of the 'project.' In the customer-initiated auction customers might perceive time spent in the queue as the price of obtaining position rights, while in the server-initiated auction customers cannot obtain these rights. Following Baliga and Ely (2011), time spent in the queue might lead to the Concorde effect in the customer-initiated auction and in the server-initiated auction it might lead to pro-rata effect. Both effects would be deviations from standard economic theory.

HYPOTHESIS 4. *A customer's bids in the customer-initiated auction, conditional on her current position and the history of play, do not depend on her initial position.*

HYPOTHESIS 5. *A customer's bids in the customer-initiated auction, conditional on her current position and the history of play, do not depend on the waiting costs she sinks before the server opens.*

Our final hypothesis concerns customers' choice between the two auctions. In part 3 of the experiment we asked the participants to vote for one of the two auctions before they knew their actual position in the queue. Because the theory predicts that the server-initiated auction outperforms the customer-initiated auction in terms of efficiency gain, and because the efficiency gains are shared among the customers, we expect participants to prefer the server-initiated auction.

HYPOTHESIS 6. *The participants will vote for the server-initiated auction rather than the customer-initiated auction.*

5.4. Results

In this section, we present our experimental observations.[16] Table 5.4 provides an overview of the main descriptive statistics. Because both auctions are budget balanced, comparing the participants' payoffs provides a first impression of the auctions' relative efficiency gains. Payoffs are higher in the server-initiated auction than in the customer-initiated auction for both arrival processes, suggesting that efficiency gains are higher in the former, in line with hypothesis 1. In the next section, we will study efficiency gains using a more refined definition. Moreover, in both auctions, bids are significantly higher if customers arrive before the start of the auctions (for both auctions, $p < 0.01$, two-tailed Mann-Whitney). This suggests that hypotheses 3 and 5 should be rejected, which could point to the presence of a sunk-cost bias. We look deeper into this in sections 5.4.2 and 5.4.3.

The descriptive statistics indicate that participants may have economic reasons to prefer the server-initiated auction over the customer-initiated auction. First, their average payoff tends to be higher in the server-initiated auction, albeit not significantly so (simultaneous arrival protocol: $p = 0.22$, sequential arrival protocol:

[16] We find that bids in the first part are on average higher than in the second part. However, this effect is not dependent on the order of the auction mechanisms. Therefore, in our analysis we pool all data in parts 1 and 2. Our results are not qualitatively affected if the order of the auction mechanisms is controlled for.

p = 0.78, two-tailed Mann-Whitney). Moreover, the number of auctions per round is significantly higher in the customer-initiated auction than in the server-initiated auction ($p < 0.01$, two-tailed Wilcoxon Signed Ranks), which suggests that it will take less time to complete the auction process in the case of the server-initiated auction. As a result, the server-initiated auction might be preferred over the customer-initiated auction. However, we do not observe significant differences in terms of the number of auctions played per participant (p = 0.11, two-tailed Wilcoxon Signed Ranks). Moreover, when all customers arrive before the start of the auctions, both the difference between the highest and lowest payoff and the payoff variance are higher in the server-initiated auction (for both comparisons, p = 0.05, two-tailed Mann-Whitney), which suggests that customers might consider the customer-initiated auction more fair. However, if all arrive at the start of the auction, the opposite results obtain, although the differences are not statistically significant (p = 0.71 for the payoff range and p = 0.60 for the payoff variance, two-tailed Mann-Whitney). In section 5.4.4, we report participants' votes for the auction mechanisms as well as how fair they rate the two auction mechanisms.

Table 5.4: ***Descriptive statistics***

	Server-initiated auction		Customer-initiation auction	
	Arrival time		*Arrival time*	
	$t = 0$	$t \sim U[-4,0]$	$t = 0$	$t \sim U[-4,0]$
Bid	82.77	98.77	57.08	65.19
	(64.63)	(78.31)	(45.75)	(56.55)
# auctions per participant	2.80	2.80	2.70	2.64
	(1.67)	(1.67)	(1.03)	(1.01)
# auctions per round	4.00	4.00	6.76	6.60
	(0.00)	(0.00)	(1.98)	(1.91)
Payoff	-87.64	-188.96	-93.78	-190.64
	(110.32)	(180.65)	(126.89)	(177.18)
Payoff Standard Deviation	115.16	185.89	126.99	167.65
	(39.72)	(68.56)	(59.26)	(95.59)
Payoff Minimum	-211.14	-394.67	-254.54	-380.27
	(59.01)	(90.95)	(77.74)	(132.41)
Payoff Maximum	77.96	62.60	58.40	35.87
	(65.22)	(100.18)	(85.43)	(151.04)
Payoff Range	289.10	457.27	312.94	416.13
	(107.10)	(172.71)	(145.56)	(204.08)

Notes. Bid: The average bid per participant per round in francs (n = 950). # *auctions per participant*: The average number of auctions per participant per round (n = 950). # *auctions per round*: The average

number of auctions per round (n = 190). *Payoff*: The average payoff per participant per round in francs (n = 950). *Payoff Variance*: The average standard deviation of the average payoff in a group per round (n = 190). *Payoff Minimum*: The average minimum payoff in a group per round (n = 190). *Payoff Maximum*: The average maximum payoff in a group per round (n = 190). *Payoff Range*: The average range between the minimum and maximum payoff in a group per round (n = 190). Standard deviations are in parentheses.

5.4.1. Efficiency gains

Firstly, we provide an overview of the two auctions' ability to improve the queue's efficiency. Customers enhance the queue's efficiency if a customer trades places with a customer behind her who has higher waiting costs. So, a natural measure of the queue's efficiency gain is the decrease in the sum of the customers' waiting costs after customers have traded places. More precisely, we define an auction's realized efficiency gain ΔE as

$$\Delta E \equiv \frac{W_{start} - W_{end}}{W_{max} - W_{min}}$$

where W_{start} [W_{end}] represents the sum of the customers' waiting costs when served according to the initial [final] queue order. For the sake of comparison between instances, we normalize an auction's efficiency gain by defining it as a fraction of the range of feasible efficiency levels, $W_{max} - W_{min}$, where W_{max} [W_{min}] stands for the highest [lowest] possible total waiting costs, i.e., the sum of the customers' waiting costs in the case that customers are

served in increasing [decreasing] order of waiting costs.[17] Note that an auction's efficiency gain can be negative if the realized waiting costs are higher than the waiting costs that would have emerged if the customers had not traded places.

Table 5.5 shows that both auction mechanisms enhance queue efficiency on average. There were significantly more queues with a positive efficiency gain than a zero or negative efficiency gain in both auction mechanisms (server-initiated auction: Binomial, 62% positive, $p = 0.02$; customer-initiated auction: Binomial, 66% positive, $p < 0.01$). A single sample Wilcoxon Signed Rank test shows that the average realized efficiency gain is significantly greater than zero for both auctions (server-initiated auction: $Z = -5.57$, $p < 0.01$; customer-initiated auction: $Z = -6.06$, $p < 0.01$). Also at the group level, the efficiency gain is significantly greater than zero (server-initiated auction: $Z = -3.82$, $p < 0.01$; customer-initiated auction: $Z = -3.82$, $p < 0.01$).

We only find weak support for hypothesis 1. Table 5.5 shows that on average, the efficiency gain in server-initiated auction is equal to 0.33 while the average efficiency gain in the customer-initiated auction equals 0.28. So, queues using server-initiated auctions experience higher efficiency gains than queues using customer-initiated auctions. However, the difference is not statistically significant ($p = 0.24$, one-sided Mann-Whitney U test).

[17] See, e.g., Goeree and Offerman (2002) for a similar measure of realized efficiency in auctions.

Table 5.5: ***Average efficiency gains***

Auction mechanism	All	Low initial efficiency (< 0.50)		High initial efficiency (≥ 0.50)	
Server-initiated	0.33	0.68		-0.18	
	(0.05)	(0.03)		(.03)	
Customer-initiated	0.28	0.50		-0.06	
	(0.04)	(0.03)		(.02)	
Difference	0.05	0.17	***	-0.12	***
	(0.06)	(0.04)		(.03)	
N (Queues)	190	114		76	

Notes. Numbers represent the average efficiency gain (standard errors are in parentheses).
***/**/* Significant at the 1%/5%/10% level (two-sided Mann-Whitney *U* test)

Further analysis shows that the initial queue efficiency determines to what extent the mechanisms are able to enhance efficiency. In the last two columns of Table 5.5, we distinguish between queues with low and high initial efficiency, where initial efficiency is defined as

$$E_{start} \equiv \frac{W_{start} - W_{min}}{W_{max} - W_{min}}.$$

We find that server-initiated auctions are significantly more effective in increasing queue efficiency than customer-initiated auctions if the initial efficiency is low. In contrast, if the initial efficiency is high, queues using server-initiated auctions result on average in a significantly lower efficiency than queues using customer-initiated auctions. The regressions in Table 5.6 confirm that efficiency gains depend on the type of auction and initial efficiency. Customer-initiated auctions seem to be more rigid than server-initiated auctions, which is advantageous if the initial efficiency is high but impedes efficiency if this is low.

Our finding has the following intuitive explanation. Queues with a low initial efficiency can potentially gain more in terms of efficiency than queues with a high initial efficiency. Also, queues with a high initial efficiency risk decreasing in efficiency in the case of inefficient swaps. Both efficiency gains and efficiency losses are more likely to occur in the server-initiated auction than in the customer-initiated auction. The reason is that in contrast to the server-initiated auction, the customer-initiated auction protects position rights in the sense that the current position holder can retain her own position by submitting a high bid. In queues using the customer-initiated auction changes are expected to be less pronounced because incumbents are likely to block inefficient swaps.

Table 5.6: ***Estimation of efficiency gains***

Variable	*Coefficient (S.E.)*	
Constant	0.59 (0.04)	***
Initial efficiency	-0.65 (0.05)	***
Auction mechanism	0.25 (0.06)	***
(1 = Server-initiated, 0 = Customer-initiated)		
Initial efficiency × Auction mechanism	-0.38 (0.07)	***
F	220.13	***
R^2	0.78	
N	190	

Notes. OLS regressions with standard errors clustered at the group level.
***/**/* Significant at the 1%/5%/10% level

5.4.2. Individual bidding behavior in the server-initiated auction

In this and the next sections, we take a deeper look into individual bidding behavior in the two auction mechanisms to answer the question of why the two auction mechanisms do not differ significantly in terms of average efficiency gain. In this section we focus on the server-initiated auction. Standard economic theory predicts that the auction outcome is efficient because for each position customers bid according to the same bidding functions that are strictly increasing in waiting costs. Table 5.7 presents the results of five regressions on the bids submitted in the server-initiated auction. The estimated coefficients of the interaction term between waiting costs and the number of remaining other bidders are all significantly greater than zero and estimates range from 0.30 to 0.33, which is very close to the predicted value of 1/3 (see Corollary 1). However, the predicted intercept is zero while the

estimated intercepts are all significantly greater than zero, which implies systematic overbidding. More importantly, bidding is very noisy in the sense that the R^2 is only about 0.25. Indeed, participants are not even close to using the same bidding function, which explains why the auctions do not always render efficient queues.

To what extent could an endowment effect explain the noise observed in participants' bidding behavior? According to hypothesis 2, a customer's initial position in the queue should not affect bidding behavior. The hypothesis implies that bids do not correlate with a customer's initial position in the queue. However, Model II in Table 5.7 shows that the initial position significantly affects bidding behavior ($p = 0.03$). Specifically, bids tend be *lower* if the bid is placed on the initial position of the customer, which is quite the opposite of the endowment effect. Thus, this finding allows us to reject hypothesis 2, albeit not in favor of an endowment effect.

Table 5.7: ***Estimations of bids in the server-initiated auction***

	Whole sample			*Sequential arrival process*	
Model	*I*	*II*	*III*	*IV*	*V*
Variable	*Coefficient (S.E.)*	*Coefficient (S.E.)*	*Coefficient (S.E.)*	*Coefficient (S.E.)*	*Coefficient (S.E.)*
Constant	24.69 ***	25.72 ***	24.73 ***	26.44 ***	34.94 ***
	(3.03)	(3.21)	(3.05)	(3.93)	(7.85)
Waiting costs ×	0.30 ***	0.30 ***	0.26 ***	0.33 ***	0.33 ***
# bidders left	(0.01)	(0.03)	(0.03)	(0.04)	(0.04)
Bid on initial		-5.35 **			
position		(0.03)			
Arrival process ×			0.08 *		
# bidders left ×			(0.05)		
Waiting costs					
Arrival time					4.46 **
					(1.85)
F	439.91 ***	221.16 ***	236.76 ***	238.59 ***	123.21 ***
R^2	0.25	0.25	0.26	0.28	0.28
N	1330	1330	1330	630	630

Notes. OLS regressions with standard errors clustered at the group level. Arrival process is a dummy which equals 1 if and only if the observation concerns a sequential arrival process.
***/**/* Significant at the 1%/5%/10% level

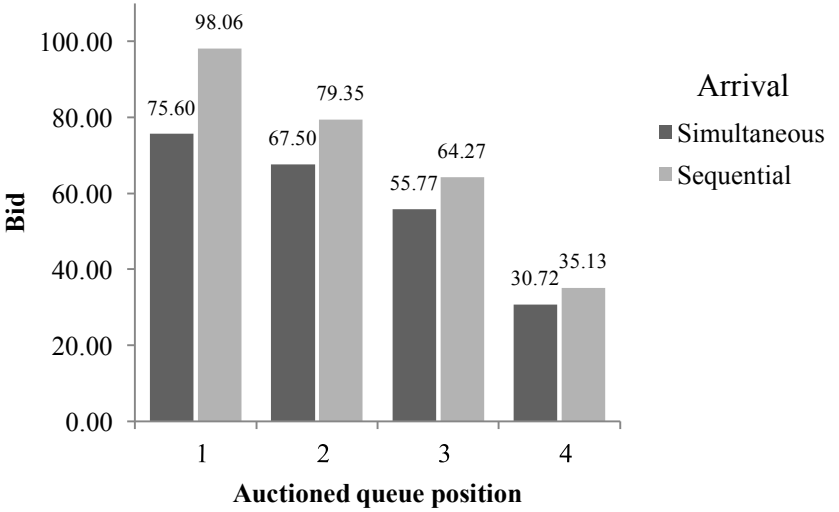
To identify potential sunk-cost effects, we test whether the arrival process affects bidding behavior. According to hypothesis 3, it should not because arrival costs are sunk at the time of bidding. Figure 5.1 suggests that we can reject this hypothesis as bidders submitted significantly higher bids on any position when arriving before the server opens than when all arrived at time 0. For example, in the case of a sequential arrival process, the average bid for the first position is significantly higher (+29.7%) than with a simultaneous arrival process ($p < 0.01$, two-tailed Mann-Whitney U test). Moreover, bids are significantly more likely to be higher than the equilibrium bid when customers arrived sequentially rather than simultaneously (sequential: 68.4%; simultaneous: 58.6%; Fisher's exact, $p < 0.01$). Figure 5.1 indicates that the observed sunk-cost effect is relevant for any of the auctioned positions. The regression analysis in Table 5.7, Model III, confirms that the arrival process has a significant effect on the steepness of the used bidding curves.

To have a further look into the sunk-cost effect, we restrict the sample to only bids in the treatment with a sequential arrival process in Table 5.7. Because arrival time is exogenously determined, it is possible to analyze how the magnitude of sunk costs affects bidding behavior. A sunk-cost effect emerges if participants' bids depend on their arrival time. The estimated coefficient of arrival time is significantly positive (see Table 5.7, Model V), i.e., the more waiting costs a customer sinks, the less aggressively she bids.[18] This finding conforms to Baliga and Ely's (2011) pro-rate effect. However, explained variance as expressed

[18] Recall that arrival time is a negative number in the interval $[-4,0]$. The absolute value of arrival time measures how long a customer has to wait before the server opens.

by the R^2 hardly increases compared to Model IV, which does not correct for arrival time.

Figure 5.1: ***Average bids in the server-initiated auction by position and arrival process***



Note. Numbers represent average bid for each queue position in server-initiated auctions.

5.4.3. Individual bidding behavior in the customer-initiated auction

Similar to bidding behavior in the server-initiated auction, in the customer-initiated auction, the bids are significantly correlated with marginal waiting costs (see Table 5.8). We distinguish between attacking customers and defending customers. An attacking customer is a bidder who initially arrived at the back of the queue and bids to be able to swap with the customer in front of her, whom

we refer to as the defending customer. Inefficiencies emerge in the customer-initiated auction for two reasons. First, we find that attacking customers and defending customers adhere to different bidding strategies. Specifically, defending customers tend to bid consistently higher than attacking customers despite bidding according to a less steep bidding function. Second, only defending customers seem susceptible to a sunk-cost bias, which results in significantly higher bids if customers arrived relatively early. No such effect was found for attacking customers. These findings suggest that the sunk-cost effect is more salient in cases when customers can protect the ownership of their position.

An endowment effect in the customer-initiated auction would result in a higher willingness-to-accept among customers who are defending their initial position than standard economic theory would predict. Consequently, it is expected that the likelihood of an efficient outcome is lower if the auction involves a customer defending her initial position. An outcome is considered efficient if the attacker swaps positions with the defender if and only if the attacker's waiting costs are higher than the defender's. A Logit regression reveals that the likelihood of an efficient outcome is not significantly lower if the defender is defending her initial position (B = -0.06, p = 0.76). Therefore, in line with Hypothesis 4, we do not find evidence for an endowment effect in the customer-initiated auction.

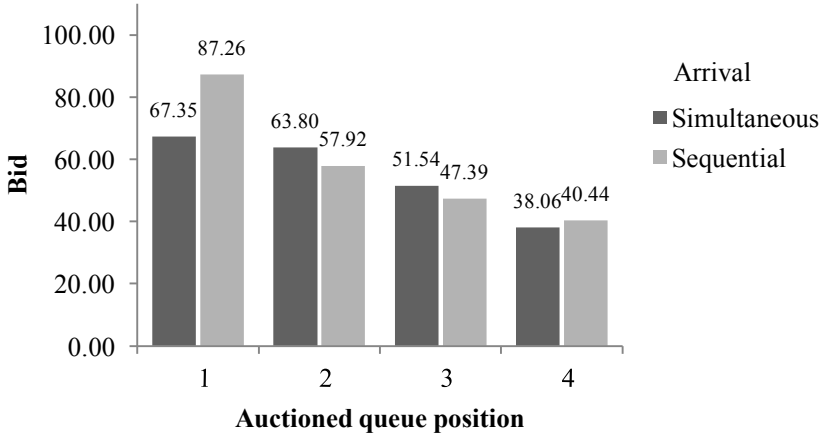
Table 5.8: ***Regressions explaining bids in the customer-initiated auction***

	Defending		*Attacking*	
	Whole sample	*Sequential*	*Whole sample*	*Sequential*
Model	*I*	*II*	*III*	*IV*
Variable	*Coefficient (S.E.)*	*Coefficient (S.E.)*	*Coefficient (S.E.)*	*Coefficient (S.E.)*
Constant	34.01 (7.64)***	21.27 (10.59)**	14.87 (4.53)***	18.03 (7.04)**
Waiting costs	0.53 (0.12)***	0.59 (0.23)**	0.70 (0.07)***	0.65 (0.13)***
Arrival time		-5.74 (2.91)**		-3.02 (3.32)
F	32.80***	7.23***	140.02***	22.36***
R^2	0.05	0.05	0.18	0.13
N	635	297	635	297

Notes. OLS regressions with standard errors clustered at the group level. The dependent variable is the bid.
***/**/* Significant at the 1%/5%/10% level

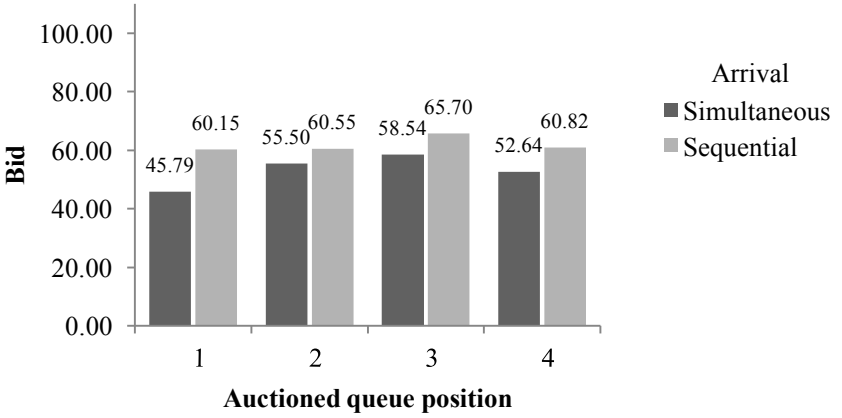
To study potential sunk-cost effects, we now focus on whether the type of arrival process affects bidding behavior in the customer-initiated auction. Figures 5.2 and 5.3 suggest that customers bid more aggressively in the case of a sequential arrival process. Like in the server-initiated auctions, average bids are higher for any of the positions auctioned under a sequential arrival process than under a simultaneous arrival process (Z = -2.47, p = 0.01, Mann-Whitney). In support of the sunk-cost bias and in conflict with hypothesis 5, we find that arrival time significantly affects bidding behavior in the case of a sequential arrival process (Table 5.8, Model II). Bids are increasing in the amount of waiting time before the server opens, which can be interpreted as evidence of the Concorde effect.

Figure 5.2: ***Defenders' bids in the customer-initiated auction by arrival process***



Notes. N = 635. Numbers represent average bid for each queue position in customer-initiated auctions.

Figure 5.3: ***Attackers' bids in the customer-initiated auction by arrival process***



Notes. N = 635. Numbers represent average bid for each queue position in customer-initiated auctions.

5.4.4. Preferred auction mechanism and actual waiting

In the third part of a session, participants were asked to vote for which auction mechanism to play in an experimental protocol that involved actual waiting. 63 percent of all participants voted for implementing the server-initiated auction in the last part of the experiment, which differs statistically significantly from 50 percent ($p < 0.01$, one-tailed binomial test). In fact, in all sessions a majority voted for the server-initiated auction. This finding provides some support to hypothesis 6, which states that customers will vote for the server-initiated auction rather than the customer-initiated auction.

Participants were asked at the end of the experiment to indicate for each auction mechanism to what extent trading positions is 'fair' on a five-point Likert scale. The average score for the server-initiated auction [customer-initiated auction] is 3.36 (SD = 1.07) [2.89 (SD = 1.11)]. The difference is statistically significant (Wilcoxon Signed Rank test, Z = -3.30, $p < 0.01$). Furthermore, participants who considered the server-initiated auction to be strictly more fair than the customer-initiated auction were also more likely to vote for the server-initiated auction (two-tailed Fisher's exact test, p = 0.02). These findings suggest that fairness considerations partially underpin the preference for the server-initiated auction.

Table 5.9: ***Estimations of likelihood voting for server-initiated auction***

Model	*I*	*II*	*III*
Variable	*Estimate (S.E.)*	*Estimate (S.E.)*	*Estimate (S.E.)*
Constant	0.30	-0.13	-0.09
	(0.38)	(0.42)	(0.47)
Gender	0.27	0.23	0.27
(1 = Female)	(0.45)	(0.46)	(0.47)
Payoff difference	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)
Auction order	0.13	0.25	0.17
(1 = Server-initiated first)	(0.45)	(0.46)	(0.47)
Arrival protocol	0.14	-0.01	-0.07
(1 = Sequential)	(0.43)	(0.45)	(0.48)
Fairness		1.09 *	1.16 **
		(0.47) *	(0.49)
Perceived duration			0.11

			(0.48)
χ^2	1.94	7.58	8.14
Nagelkerke's R^2	0.03	0.11	0.11
Percentage correct	63.2%	68.1%	66.7%
N	95	94	94

Notes. Logit regression with standard errors between parentheses. Payoff difference stands for customer's payoff in the server-initiated auction minus her payoff in the customer-initiated auction. Fairness – a dummy variable where 1 stands for perceived fairness of the server-initiated auction – is strictly higher than that of the customer-initiated auction. Perceived duration – a dummy variable where 1 stands for perceived duration that is strictly higher than that of the customer-initiated auction. Similar results are found if perceived fairness and duration are weakly higher (Fairness: $B = 1.56$, $p = 0.01$; Perceived duration: $B = -0.79$, $p = 0.42$). In Model II and III one participant is excluded due to nonresponse. $^{***}/^{**}/^{*}$ Significant at the 1%/5%/10% level

In Table 5.9 the likelihood of voting for the server-initiated auction is estimated. We find that only fairness considerations significantly affect the likelihood of voting for the server-initiated auctions. A participant's vote does not depend in a statistically significant way on differences in earned payoffs in the two auction mechanisms, the order of the auctions or the arrival protocol. The arrival protocol does not have a significant effect on the voting decision either, even though it has an effect on the payoff distribution between the two auction mechanisms as shown in Table 5.4. Participants might also vote for the server-initiated auction because fewer of such auctions are required per round ($M = 4.00$, SD = 0.00) compared to the customer-initiated auction ($M = 6.68$, SD = 1.94). However, perceived duration of a round is not associated

with the likelihood of voting for the server-initiated auction (Table 5.9, Model III).

We also analyze bidding behavior in this last part. According to Corollary 1, the optimal equilibrium bid in the server-initiated auction correlates positively with the number of other remaining customers. We find indeed that, on average, bids decrease by about 9.21 as the number of other bidders decreases ($p < 0.01$). The implied average waiting costs are about €0.28 per five minutes, or €3.32 per hour, which is about 85% of the gross minimum hourly wage for 18-year-old employees at the time of the experiment.

5.5. Conclusion

In this chapter, we have experimentally studied two auction mechanisms that allow customers to trade places in queues. In the server-initiated auction, the server sequentially auctions the right to be served next and pays all customers who remain in the queue an equal share of the winning customer's bid. In the customer-initiated auction, arriving customers iteratively offer money to customers in the queue in order to swap positions. We have used two novel experimental protocols to examine the behavioral properties of both auction mechanisms. One protocol implements induced waiting costs, which allows us to compare the two auction mechanisms in terms of efficiency gains. In the second protocol, participants could trade places in a queue where they had to wait before they could leave the lab. We applied this protocol to determine which auction mechanism participants would prefer in a context that involved actual waiting.

Our most important findings are the following. First of all, on average, the server-initiated auction and the customer-initiated auction perform equally well in terms of efficiency gain. Second, the participants indicated that they found the server-initiated auction a fairer mechanism than the customer-initiated auction. In a way, this result is surprising too, because the customer-initiated auction protects customers' initial positions in contrast to the server-initiated auction. Third, when voting between the two auctions, the participants tended to favor the server-initiated auction.

In both auctions we observe a sunk-cost effect but we find no evidence of an endowment effect. For the customer-initiated auction, the latter result may be surprising because incumbents are able to defend 'their' positions, which might have induced a sense of entitlements that is associated with the endowment effect.[19] A possible explanation of why we are unable to find the endowment effect in either auction mechanism might be due to the fact that positions are intangible or that changing positions can only, at worst, delay access to the focal service but cannot lead to being deprived of access.

The contribution of this study to the extant literature is threefold. To our knowledge, this study is the first to experimentally study priority auctions in a queuing context. Although a large number of papers have studied such auctions theoretically, an empirical

[19] Reb and Connolly (2007) find similar results in another context.

investigation was lacking.[20] As predicted in previous studies, we find that priority auctions can substantially increase a queue's efficiency. At the same time, we observe that substantial inefficiencies emerge even in theoretically efficient auction mechanisms.

The second contribution is that our study illustrates the importance of considering mechanisms that do not have an efficient equilibrium. It allows for the evaluation of mechanisms that might be considered in practice such as the customer-initiated auction. Interestingly, the customer-initiated auction mechanism improved efficiency on average as much as the server-initiated auction mechanism, while only the latter has an efficient equilibrium.

Third, our experimental design allows one to study endowment effects and sunk-cost effects in an environment involving queues. Endowment effects have been found in a large range of contexts (see, e.g., Knetsch 1989; Kahneman et al. 1990; Heyman et al. 2004; Manzur et al. 2016) including queues where customers discourage queue jumping (Mann 1969; Milgram et al. 1986; Oberholzer-Gee 2006; Helweg-Larsen and LoMonaco 2008). We add to this literature that endowment effects may be weak in environments where customers can trade positions. The sunk-cost effect has also been documented extensively in the empirical literature (e.g., Arkes and Blumer 1985; Phillips et al. 1991; Soman and Cheema 2001; Soman and Gourville 2001; Offerman and

[20] See, e.g., Kleinrock (1967), Lui (1985), Glazer and Hassin (1986), Rosenblum (1992), Mitra (2001), Afèche and Mendelson (2004), Kittsteiner and Moldovanu (2005), Gershkov and Schweinzer (2010), Kayı and Ramaekers (2010), and Yang et al. (forthcoming).

Potters 2005; Baliga and Ely 2011). This study is the first to study the sunk-cost effect by manipulating waiting costs for queued customers. Using an experimental protocol that determines time spent waiting in the queue before service starts, we have observed that such sunk costs induce customers to bid more aggressively on average compared to a setting where customers do not sink costs before the server opens.

We envision the following avenues for further research. First of all, how do the auctions perform when entry into the queue is endogenous? The increased efficiency of the queue may attract additional customers to the queue. On the one hand, this may be efficiency enhancing as more customers use the valuable service provided by the server. On the other hand, additional entrants impose a negative externality on other customers in that they may have to wait longer. In particular, some may enter the queue only to collect payments by other customers without having a genuine interest in the offered service. In addition, and relatedly, it would be insightful to test the auction mechanisms in practice using field experiments. In a field setting the question of endogenous entry could be naturally answered.

Relatedly, endogenous entry decisions may also affect the initial queue order. In our experiment we imposed an exogenous queue order, which may be relevant for a large range of settings where people arrive at random in a queue (e.g., waiting lists for parking permits). We leave settings where the entry decision is endogenous

(e.g., queuing for concert tickets) for further research.[21] At first sight our analysis suggests that the customer-initiated auction should be preferred over the server-initiated auction if and only if the resulting arrival process implies relatively efficient queues. However, arrival decisions may also depend on the auction mechanism used, which will complicate the analysis.

This study has several implications for the management of queuing systems in the field. Queues are ubiquitous. They are typically very costly to avoid in the case of consistent demand or supply shocks and they may be the only socially acceptable way to ration scarce demand. The results from our experiment demonstrate that customers can benefit from auction mechanisms that allow them to trade places. We have shown that priority auctions can improve a queue's efficiency considerably while the customers retain all the gains from trade. In practice, many settings may exist where such mechanisms could be implemented, ranging from the allocation of houses, spots in daycare centers, and access to sport facilities to the short-term trading of landing and take-off slots in airports, repair services after a natural disaster, and server allocation in Internet hosting centers. Also, in physical waiting lines such auction mechanisms could be implemented when customers make use of apps on their smartphones that allow them to trade positions using an online platform. Furthermore, we find that customers prefer the server-initiated auction to the customer-initiated auction. Our

[21] For instance, Barzel (1974) shows that both efficient and inefficient queue orders may emerge in a setting with endogenous arrival times, depending on the correlation between the opportunity cost of time and the value of the "prizes" that are awarded on a first-come first-served basis. See also Holt and Sherman (1982).

results suggest that companies interested in offering their customers the opportunity to trade places while waiting to get served should use the server-initiated auction rather than the customer-initiated auction.

5.6. Appendix: Proofs of propositions

Proof of Proposition 1. Suppose, for the moment, that B_n is a strictly increasing function for all $n = 1, \dots, N-1$. Because after each auction, the winner's bid is revealed, the remaining customers can infer the winner's waiting costs. Therefore, if $n+1$ customers are left, it is common knowledge that their c_i's are drawn from F conditional on c_i being in the interval $\left[\underline{c}, \overline{c}_n\right]$ where $\overline{c}_n$ are the waiting costs from the winner of the previous auction with $n+2$ bidders. Let

$$G(x) \equiv \left(\frac{F(x)}{F(\overline{c}_n)}\right)^n$$

denote the cumulative distribution function of the highest-order statistic among n draws from F conditional on the draw being in the interval $\left[\underline{c}, \overline{c}_n\right]$. Define $k_n(c,x)$ as the expected costs of not being served in an auction with n remaining competitors for a bidder having waiting costs c, where x denotes the highest costs among her competitors.

A customer with cost parameter c pretending to have cost parameter $\tilde{c}$ obtains expected utility

$$U_n(c, \tilde{c}, \overline{c}_n) = \int_{\tilde{c}}^{\overline{c}_n} \left(\frac{B_n(x)}{n} - k_n(c,x)\right) dG(x) - B_n(\tilde{c})G(\tilde{c})$$

where the first [second] term on the right-hand side refers to the case that the customer does not win [wins] the auction.

In equilibrium, for $c > \underline{c}$,

$$\left.\frac{\partial U_n(c,\tilde{c},\overline{c}_n)}{\partial \tilde{c}}\right|_{\tilde{c}=c} = -\left(\frac{B_n(c)}{n} - k_n(c,c)\right)G'(c) - B_n(c)G'(c) - B_n'(c)G(c) = 0 \Leftrightarrow$$

$$B_n'(c)G(c) + \left(1+\frac{1}{n}\right)B_n(c)G'(c) = k_n(c,c)G'(c) \Leftrightarrow$$

$$B_n'(c)G(c)^{1+\frac{1}{n}} + \left(1+\frac{1}{n}\right)B_n(c)G'(c)G(c)^{\frac{1}{n}} = k_n(c,c)G'(c)G(c)^{\frac{1}{n}} \Leftrightarrow$$

$$B_n(c)G(c)^{1+\frac{1}{n}} = \int_{\underline{c}}^{c} k_n(x,x)G(x)^{\frac{1}{n}}dG(x) \Leftrightarrow$$

$$B_n(c) = \frac{n}{n+1}\int_{\underline{c}}^{c} k_n(x,x)d\left(\frac{G(x)}{G(c)}\right)^{1+\frac{1}{n}} = \frac{n}{n+1}\int_{\underline{c}}^{c} k_n(x,x)d\left(\frac{F(x)}{F(c)}\right)^{n+1}.$$

(Check the case $\underline{c} > 0$.) Note that $k_1(c,x) = c$ and $k_n(c,x) = -U_{n-1}(c,c,x) + c$ for $n = 2,3,\dots,N-1$. Now, the proposition follows because $k_n(x,x) = -U_{n-1}(x,x,x) + x = B_{n-1}(x) + x$ for $n = 2,3,\dots,N-1$. (It is readily verified that B_n is a strictly increasing function for all $n = 1,\dots,N-1$, which is the assumption we started with.)

Proof of corollary 2. The proof is by induction. Note that

$$B_1(c) = \frac{1}{2} E\left\{c_2^{(1)} \middle| c_2^{(1)} \le c\right\} = \frac{c}{3}.$$

Now, fix $n = 2,3,\dots,N-1$ and assume that $B_{n-1}(c) = \frac{n-1}{3}c$. It is well-known that for $F = U[0,\overline{c}]$, $E\left\{c_n^{(1)} \middle| c_n^{(1)} \le c\right\} = \frac{n}{n+1}c$. Therefore,

$$\begin{aligned} B_n(c) &= \frac{n}{n+1} E\left\{B_{n-1}\left(c_{n+1}^{(1)}\right) + c_{n+1}^{(1)} \middle| c_{n+1}^{(1)} \le c\right\} \\ &= \frac{n}{n+1} E\left\{\frac{n+2}{3} c_{n+1}^{(1)} \middle| c_{n+1}^{(1)} \le c\right\} \\ &= \frac{n}{n+1}\frac{n+2}{3}\frac{n+1}{n+2}c = \frac{n}{3}c. \end{aligned}$$

Proof of Proposition 3. Let $B_k(c_k)$ denote a customer's equilibrium bid as a function of her waiting costs c_k, where $k = 2$ refers to an arriving customer reaching position 2 and $k = 1$ to the current customer in position 1. According to a standard argument, both the arriving customer and the bidder in front of her use strictly increasing bidding functions in equilibrium. Without loss of generality, we may assume that at the boundaries, $B_1(\underline{c}) = B_2(\underline{c})$ and $B_1(\overline{c}) = B_2(\overline{c})$. Let $\Phi_k(b) \equiv B_k^{-1}(b)$ denote the inverse function of the bidding functions ($k = 1, 2$). Note that bidders need not only obtain utility from the auction itself, but also from later auctions when trading places with customers who arrive later. Let $U_1(c, x)$ denote a customer's expected additional utility she obtains when occupying the first position after the auction if her [the other customer's] waiting costs equal c [x]. $U_2(c)$ represents a customer's expected additional utility if her waiting costs are equal to c and she ends up in position 2 after the auction.

The arriving customer having waiting costs $c > \underline{c}$ solves

$$B_2(c) \in argmax_b \int_{\Phi_1(b)}^{\overline{c}} U_2(c)\, dF_1(c_1) + \int_{\underline{c}}^{\Phi_1(b)} (c + U_1(c, c_1) - b)\, dF_1(c_1).$$

The first-order condition of the maximization problem is given by

$$F_1'\big(\Phi_1(B_2(c))\big)\Phi_1'\big(B_2(c)\big)\big(-U_2(c) + c + U_1\big(c, \Phi_1(B_2(c))\big) - B_2(c)\big) - F_1\left(\Phi_1\big(B_2(c)\big)\right) = 0,$$

which implies

$$B_2(c) = c - U_2(c) + U_1\left(c, \Phi_1\big(B_2(c)\big)\right) - \frac{F_1\left(\Phi_1\big(B_2(c)\big)\right)}{F_1'\left(\Phi_1\big(B_2(c)\big)\right)\Phi_1'\big(B_2(c)\big)}.$$

When defending her position, a customer having waiting costs $c > \underline{c}$ solves

$$B_1(c) \in argmax_b \int_{\underline{c}}^{\Phi_2(b)} U_1(c, c_2)\, dF_2(c_2) + \int_{\Phi_2(b)}^{\overline{c}} \big(B_2(c_2) - c + U_2(c)\big)\, dF_2(c_2).$$

The first-order condition:

$$U_1\left(c, \Phi_2\left(B_1(c)\right)\right) - B_1(c) + c - U_2(c) = 0$$

which implies that in equilibrium,

$$B_1(c) = U_1\left(c, \Phi_2\left(B_1(c)\right)\right) + c - U_2(c).$$

Suppose that $B_1(c) \leq B_2(c)$. As both B_1 and B_2 are strictly increasing, $\Phi_2\left(B_1(c)\right) \leq \Phi_1\left(B_2(c)\right)$ so that

$$\begin{aligned} B_1(c) &= U_1\left(c, \Phi_2\left(B_1(c)\right)\right) + c - U_2(c) \\ &\geq U_1\left(c, \Phi_1\left(B_2(c)\right)\right) + c - U_2(c) > B_2(c) \end{aligned}$$

which establishes a contradiction. Therefore, $B_1(c) > B_2(c)$ for all $c > \underline{c}$.

5.7. Appendix: Experimental instructions

Translated from Dutch:

General instructions
Welcome to this experiment! You can earn money in this experiment. The amount that you will earn depends on your decisions and the decisions of other participants in the same experiment. Your earnings are paid to you privately at the end of the experiment.

It is impossible for us to relate your name to your decisions. Therefore, your anonymity is guaranteed. Keep your decisions private. Talking with the other participants during the experiment is not allowed.

During the experiment you can gain and lose points. At the end of the experiment these points are exchanged for euros. 100 points is equal to €1.00.

At the beginning of the experiment you will receive a deposit of [starting capital] points. The points that you earn during the experiment are added to your deposit. The points you lose are subtracted from your deposit.

The experiment consists of four parts. The first and second parts consist of five rounds each. At the beginning of a round you and four others will be given a random position in a queue. You can change positions using auctions. The type of auction in the first part differs from the type of auction in the second part.

In the third part, you can vote for the type of auction that you prefer. The type of auction with the most votes will be used to determine the order of a queue. Your position in this queue will determine when you can leave the experiment.

Instructions for parts 1 and 2
[*Simultaneous arrival process:* This part consists of five rounds. In each round you will be placed with four others in a queue. Your starting position within the queue is determined randomly.]

[*Sequential arrival process:* This part consists of five rounds. In each round you will be placed with four others in a queue, where your position depends on your arrival time. Your arrival time equals the number of turns that you need to wait before the first customer is served. The arrival time is determined randomly. At the beginning of each round, you will find your arrival time and starting position on the screen.]

You can change positions using auctions. Your final position determines how many turns you will have to wait before being served. You will incur waiting costs for each turn that you have to wait. Waiting costs are subtracted from your deposit.

The customer in position 1 does not have to wait and, therefore, does not incur any waiting costs. The customer in position 2 has to wait one turn. The customer in position 3 has to wait two turns. The customer in position 4 has to wait three turns. And the customer in position 5 has to wait four turns.

Your waiting cost per turn is an integer between 0 and 100. This is also true for the other four participants in the queue. For each round the waiting costs are randomly drawn by the computer for all customers, where every value between 0 and 100 has the same likelihood to be drawn. In each round the waiting costs are independent from the waiting costs in the previous rounds and the waiting costs of other participants.

Example: Imagine that your waiting costs are equal to 10 and that at the end of the round your position is 5. You have to wait four turns. The total waiting costs for that round are: 10*4 = 40.

Server-initiated auction

In this part, you can bid on each position in the queue. The round starts with an auction for position 1. The winner is the customer with the highest bid. (In case of a tie, the computer will determine who wins using a fair lottery.) The winner gets position 1 and distributes his bid evenly among the other bidders. The next auction is for position 2. The winner is again the customer with the highest bid. The winner's bid is distributed evenly among the customers behind him or her. The customer in position 1 does not get anything. Positions 3 and 4 are auctioned the same way. Winners cannot participate in the remaining auction within the same round.

Example: Imagine that position 2 is auctioned. The customers with position 2, 3, 4 and 5 can place a bid. Imagine that the customer with position 3 places the highest bid: 75. This customer goes to position 2 while the customer in position 2 moves to position 3.

The three bidders, who now stand behind the customer in position 2, receive each 75/3 = 25.

Test questions

Imagine that your current position is 5 and that you can bid on position 1. Your bid is 10 and among the four other bids, 20 is the highest bid. What is the outcome?

- You win the auction and pay 10.
- You lose the auction and receive nothing
- You lose the auction and receive 5 (correct answer)

Imagine that your current position is 5 and that you can bid on position 4. You bid 50 and the other remaining bidder bids 25. What is the outcome?

- You win the auction and pay 50 (correct answer)
- You lose the auction and receive 25
- You win the auction and pay nothing

Customer-initiated auction

In this part, every customer gets the chance to swap positions using an auction. The round starts with the customer in position 2 (W2) joining the customer in position 1 (W1). W1 and W2 both place a bid. If the bid of W2 is higher than the bid of W1, then W1 and W2 swap positions. If the bid is lower then there is no swap. (In case of a tie, there is a 50% chance of a swap.) If W1 and W2 swap positions, then W2 pays his or her own bid to W1.

Then the third customer (W3) joins the queue (on position 3). He or she places a bid on position 2. The customer currently in position 2 also places a bid. W3 wins if his or her bid is higher. In that case, W3 and the customer in position 2 swap places and W3 pays this customer his or her bid. If W3 moves to position 2 then an auction starts for position 1. If W3 loses the auction for position 2 then there is no auction for position 1. In a similar way, the fourth and fifth customers are able to move forward in the queue.

Example: A fifth customer (W5) joins the queue in position 5. The first possible swap is with the customer in position 4 (W4). Imagine that W5 bids 100 and W4 bids 50. Because W5 placed a higher bid, W5 and W4 swap positions. W4 receives 100 from W5. W5 is now in position 4 and W4 is in position 5. Subsequently, W5 has the opportunity to swap positions with W3, who is in position 3. Because W3 placed a higher bid, there is no swap. The round is now completed. The customers will be served in the current order.

Test questions

Imagine that your current position is 5 and that you bid on position 4. You bid 10 and the customer in position 4 (W4) bids 22. What is the outcome?

- You win the auction, pay 10 and swap positions
- You lose the auction, receive nothing, and positions are not swapped (correct answer)
- You win the auction, pay nothing, and positions are not swapped

Imagine that your current position is 1 and that you can bid on your own position. You bid 10 and the customer currently in position 2 bids 5. What is the outcome?

- You win the auction, pay 10, and swap positions
- You lose the auction, receive nothing, and positions are not swapped
- You win the auction, pay nothing, and positions are not swapped (correct answer)

Instructions for part 3

In this part you can vote for the type of auction that will be used in the next part to determine the queue for leaving the experiment. In the next part you are put in a queue with four others. These are the same participants with whom you interacted in parts 1 and 2. The starting positions in this queue are determined randomly. You can change positions using auctions. Your final position determines when you can leave the experiment. In this part, you do not pay for any waiting costs, but you will be required to wait longer depending on your position in the queue. Every turn takes 5 minutes.

The customer in position 1 does not have to wait and can leave the experiment right away. The customer in position 2 has to wait a single turn, which takes 5 minutes. The customer in position 3 has to wait two turns, which takes 10 minutes. The customer in position 4 has to wait three turns, which takes 15 minutes. And the customer in position 5 has to wait four turns, which takes 20 minutes.

The bids are still displayed in terms of points. 100 points is equal to €1.00.

As previously mentioned, in this part you do not pay any waiting costs. You do pay any winning bids from your deposit. Payments by other participants are added to your deposit. Your deposit is paid to you if it is your turn.

You can vote for the type of auction that was used in part 1 and for the type of auction that was used in part 2. The auction with the most votes of all participants in the laboratory will be used to determine the queue order. If both types get the same number of votes, then the auction type is picked randomly.

6. Discussion and Implications

The aim of this thesis is to contribute to our understanding of consumers' perceptions of property rights. Chapter 2 and 3 explore why consumers make a moral distinction between theft and piracy. Chapter 4 explores to what extent the nominal representation of choices can affect the likelihood of theft. Chapter 5 studies to what extent a queue position can be traded as a normal good and whether exogenous enforcement of property rights affects fairness perceptions. This chapter contains an overview of the main findings, the theoretical contributions and the managerial implications of the studies reported in this thesis.

6.1. Theoretical Contributions

6.1.1. Piracy

One of the most contentious debates concerning property rights is the issue of digital piracy. There are public policy and theoretical reasons why this debate is relevant. Piracy affects a large and growing part of modern economies, namely that of information goods. Furthermore, it is becoming easier and faster to retrieve, copy and transfer information goods. Because information goods are technically difficult to protect against unauthorized use, the enforcement of intellectual property rights relies mostly on consumer self-enforcement. Consumer self-enforcement, in turn, depends on how property rights of information goods are intuitively perceived.

Consumers' lack of respect towards intellectual property rights raises a number of theoretical questions. Extant research on piracy focuses on factors that can be associated with the decision to pirate (Watson *et al.* 2015). However, this approach is unable to identify factors that are specific to piracy. Thus, to understand the peculiar nature of piracy it is necessary to experimentally compare piracy with the oft-related property crime, theft. The experiments presented in Chapter 2 and 3 explicitly compare piracy with theft to establish whether piracy is more likely to occur than theft and to pinpoint possible explanations of this discrepancy. Chapter 3 replicates the main findings of Chapter 2 in a monetarily incentivized setting to increase the external validity of our findings.

The baseline prediction based on standard economic theory is that there is no difference between the likelihood of theft and piracy if the value of the focal good, the probability of being caught and the possible penalty are all equal. Previous studies suggest that consumers morally make a distinction between theft and piracy, which implies that economic factors alone cannot explain the prevalence of piracy (Green and Kugler 2010). However, Chapter 2 and 3 provide strong evidence that the likelihood of piracy is indeed higher than that of theft, even if economic factors are kept constant. To the best of our knowledge, these studies are the first to provide experimental evidence for this dissociation.

Chapter 2 and 3 draw from prospect theory to provide a novel explanation to the moral distinction between piracy and theft. Prospect theory stipulates that decision-makers are averse to losses. The literature on prospect theory has mainly focused on individual decision-making. As a result, most studies in this literature focus on

the scenario in which decision-makers only had to choose between outcomes concerning their own gains and losses. To explain the moral dissociation between theft and piracy, we extend the scope of loss aversion to include losses incurred by others, which is dubbed second-person loss aversion (SPLA). A notable difference between piracy and theft is that owners only experience a possessive loss in the case of theft because goods that can be subject to theft are by definition rivalrous. Chapter 2 shows that the strong aversion to theft is primarily the result of an aversion to causing possessive losses to others even though these losses are a gain to the focal decision-maker. Furthermore, Chapter 2 shows that tangibility or economic losses are much less of a concern to consumers even though earlier studies on piracy tend to focus on these factors (e.g., Hennig-Thurau *et al.* 2007).

6.1.2. Dilution Illusion

There is extensive evidence that changing the nominal representation of choices affects decision-making (e.g., Shafir *et al.* 1997). However, the literature on the effects of changing the nominal representation has primarily focused on choice sets that do not affect others. The study presented in Chapter 4 aims to discover to what extent the nominal representation of choices affects decision-making in an incentivized *interpersonal* context. Particularly, we consider how changes in the nominal representation affect the degree of theft. We hypothesized that decision-makers are likely to steal more if doing so does not affect the other nominally, which is called dilution illusion. Chapter 4 provides strong evidence in support of this hypothesis.

Furthermore, the incentivized experiment presented in Chapter 4 is to the best of our knowledge the first to provide evidence that changing the nominal representation can affect interpersonal decision-making.

The second main contribution of Chapter 4 is pinpointing whether the observed behavior is the result of strategic decision-making or a psychological bias. A possible explanation of the dilution illusion is that decision-makers might reason that others are less concerned if there are no nominal changes to their possessions. This would imply that the effect is the result of deliberate, strategic decision-making. The experimental design of the study provided decision-makers the option to revise their initial offer while revealing more information about the potential real consequences of this offer. We find that the dilution illusion is less pronounced in the final offers compared to initial offers. This implies that decision-makers tend to correct their own bias caused by the dilution illusion. Furthermore, we find that decision-makers who score high on cognitive ability are less likely to be susceptible to the dilution illusion. Combined, these findings strongly suggest that the dilution illusion is primarily a psychological bias, which effect is in line with recent literature on the relationship between intuitive decision-making and selfishness (Rand, Greene and Nowak 2012).

We argue that this psychological bias results from our intuitive perceptions of property rights. Decision-makers tend to rely on the distribution of nominal possessions to determine who owns what. However, in our experiment it was possible to disentangle the amount of nominal possessions from the monetary value that these possessions represent. We find that offers are more selfish if the

other's nominal possessions are not affected but we also find that offers are more altruistic if the focal person can only affect the amount of nominal possessions held by the other. Together, these two findings strongly suggest that decision-makers are overly focused on the distribution of nominal possessions, even if this disadvantageous to themselves. However, the extant experimental literature on theft and selfishness does not distinguish between the nominal and real possessions (e.g., Reb and Connolly 2007). Therefore, a major theoretical implication of Chapter 4 is that future studies on theft and selfishness should take into account the potential effects of the nominal representation of choices to be able to provide more precise explanations of social behavior.

6.1.3. Trading places

Chapter 5 shows that the introduction of property rights in queues can increases queue efficiency considerably. A number of studies in the theoretical literature on the application of mechanism design in queues suggest the possibility of allowing consumers to trade places to increase efficiency (e.g., Gershkov and Schweinzer 2010). To our knowledge, the study presented in Chapter 5 is the first empirical investigation to explore this possibility. As hypothesized, we find that the ability to trade places increases queue efficiency significantly. However, the initial queue efficiency and the type of auction mechanism strongly moderate to what extent an improvement in queue efficiency can be expected.

The introduction of property rights in a queue to allow consumers to trade places offers an unexplored avenue to study biases

associated with ownership. Particularly, Chapter 5 investigates whether there is any evidence for the sunk-cost effect (Arkes and Blumer 1985) and the endowment effect (Kahneman *et al.* 1990) in a queuing context. In the experiment the number of minutes spent before joining the queue was manipulated. According to standard economic theory this waiting time should be considered sunk and, thus, not affect future decision-making. We find, however, a robust sunk-cost effect across mechanisms. Particularly, in the customer-initiated auction a higher arrival time positively affect bids but in the server-initiated auction a higher arrival bids were significantly lower. This asymmetrical occurrence of the sunk-cost effect is in line with Baliga and Ely's (2011) study of the bias. However, we were unable to find any evidence for the presence of the endowment effect. A possible explanation is that consumers are less likely to be susceptible to the sunk cost effect if the focal object is intangible (Reinstein and Riener 2012). Furthermore, in the experiment consumers could only change positions; it was not possible to remove someone from the queue completely, which might have induced an endowment effect.

The study of queues in the marketing literature has primarily focused on how consumers experience waiting and how the waiting experience can be improved. Studies in this literature either consider interventions to shorten overall time or techniques to alleviate the perceived disutility of waiting (e.g., Kumar *et al.* 1997). There are studies that consider priority auctions in queues but these specific mechanisms advantages winners while everyone else in the queue is forced to wait longer without receiving any compensation (e.g., Zhou and Soman 2008). The mechanisms

studied in Chapter 5 provide a novel method of improving the waiting experience in queues that has not been considered in the marketing literature before. It allows consumers to save time while providing compensation to those who are prepared to wait longer. In other words, the considered mechanisms are able to re-arrange the queue to increase efficiency without imposing any negative externalities. Thus, we show that the study of trading mechanisms to improve waiting experience is a fruitful research avenue.

6.2. Managerial Implications

6.2.1. Piracy

Chapter 2 and 3 focus on piracy as a context to provide evidence for the existence of SPLA. Subsequently, SPLA has managerial implications for the prevention of piracy. Current public policy measures against piracy primarily aim to convince consumers that piracy is morally indistinguishable from theft (Loughlan 2007; Zamoon and Curley 2008). This strategy assumes that consumers can be convinced to change their moral attitude towards piracy. Our findings show that the moral distinction between theft and piracy is likely grounded in how losses are perceived. Thus, these public policy measures can only be effective if consumers can be convinced to perceive or weigh losses differently. However, studies show that humans are predisposed to be loss averse (e.g., De Martino *et al.* 2010; Gintis 2007). This implies that convincing consumers to perceive and weigh losses differently is difficult, which can be compared to teaching people to stop seeing visual

illusions. Therefore, it is unlikely that the current public policy measures are effective in preventing piracy.

The findings of Chapter 2 and 3 strongly suggest that rivalrous goods are more likely to be respected. This implies that piracy can be impeded to some extent if information goods can be made or at least appear to be rivalrous, which also known as digital scarcity. For example, domain names are rivalrous information goods because a broad consensus exists that the Internet Corporation for Assigned Names and Numbers is authorized to manage ownership of domain names. As a result, only legitimate owners are able to make use of their domain names. McConaghy and Holtzman (2015) argue that recent developments in applied cryptography allow for a broader application of digital scarcity. Digital scarcity is possible if a single, widely respected ledger keeps track of ownership of digital assets. Such ledgers do not exist yet for other types of information goods, such as articles, books, music and movies. The creation of these ledgers would provide consumers the option to verify easily whether their copy is authorized. Arguably, the increased transparency would encourage consumers to obtain legitimate copies.

6.2.2. Framing nominal possessions

Chapter 4 shows that the nominal representation of choices can affect decision-making in an interpersonal context. There are a number of real-life social contexts in which the nominal representation can deviate from the representation in real terms. For example, in corporate governance controlling shareholders often

have the option to issue new shares, which dilutes the value of a single share. The same controlling shareholders might also determine how the new shares are distributed, even though the value that these shares represent is appropriated from all shareholders. There are numerous cases in which controlling shareholders transferred value to themselves by diluting minority shareholders (Johnson *et al.* 2000). Interestingly, in most of these cases the law does not protect diluted shareholders even though economically it is equivalent to theft. The findings of Chapter 4 shows that there is a strong bias to consider choices in terms of their nominal representation and nudges decision-makers to be behave more selfishly as observed in the field of corporate governance. One of the possible causes of this public issue is that legislators or shareholders tend to draft laws or terms without taking into account that the nominal representation of possessions might disentangle from the possessions in real terms, which eventually can disadvantage parties that are already in a weaker bargaining position.

Chapter 4 also has implications for the presentation of financial products to consumers and firms. The value of financial products is often presented in nominal terms (Belsky and Gilovich 2010). For example, life insurances are often presented in terms of the potential nominal payoff in case of death. Less salient parameters such as contract duration and expiration events can have considerable influence on the underlying value of a life insurance. The findings of Chapter 4 suggest that insurance agents can appropriate more value from clients through adjusting parameters that do not necessarily affect the potential nominal payoff. Even

though this tendency might not be deliberate as argued in Chapter 4, insurance agents can be required to present financial figures in real terms to avoid disadvantaging clients who are also likely to be subject to the dilution illusion.

6.2.3. Property rights in queues and waiting lists

Chapter 5 considers the situation in which consumers are able to trade places in a queue. The managerial implications of this study are twofold: (1) economic and (2) moral. First, we show that on average allowing consumers to trade places in a queue increases economic efficiency. Currently, firms that are faced with long queues or waiting lists often aim to improve the user experience of waiting rather than to provide solutions that would allow consumers to save time (e.g., Kumar *et al.* 1997). Our study provides empirical support that consumers are willing to pay to save time or willing to accept money to spend more time in a queue. Specifically, consumers who have high opportunity costs are likely attracted to the option to literally buy time. While consumers with low opportunity costs are inclined to receive a monetary compensation for additional time spent in a queue. Thus, providing consumers a mechanism to trade places can considerably lower the economic cost of waiting in line and as a result considerably improve the experience of waiting in line either through decreasing time spent in a queue or receiving a financial compensation.

Second, consumers do not necessarily consider a mechanism that protects all property rights as more fair. Consumers tend to morally

disapprove of queue jumping, irrespective of whether the jumper paid the server to get ahead (Mann 1969). Arguably, this disapproval stems from the fact that the consumers standing behind the jumper are forced to wait even more without receiving any compensation. In Chapter 5 we explore two mechanisms that always compensate consumers if someone else takes their position. However, the two mechanisms differ in terms of enforcing the right to 'refusing to sell'. In the server-initiated auction mechanism this right is not enforced while in the customer-initiated auction mechanism consumers are able to prevent to sell their position to someone else. We find that consumers considered the server-initiated auction is considered more fair than the customer-initiated auction. Furthermore, we provide evidence that fairness considerations explain why a majority of the participants voted for implementing the server-initiated auction mechanism. The managerial implication of these findings is that managers should not necessarily prefer queue position trading mechanisms that respect all property rights.

Summary

Property rights determine who owns what. Trade is very difficult if it is unclear who owns what or if property rights are not enforced. For this reason many scholars argue that property rights and their enforcement are essential to economic prosperity. A distinction can be made between a legal and psychological approach to property rights. A legal approach to property rights considers how the rules of property rights are codified in law while a psychological approach focuses on how humans tend to think about property rights intuitively.

The two approaches seem to diverge if more unconventional goods are considered. These goods are defined in this thesis as being intangible or non-rivalrous. A nonrivalrous good means that the good can be used by more than one person at the same time. Information goods, such as music and texts, are examples of nonrivalrous goods. This thesis consists of four studies that investigate how consumers perceive unconventional goods in different contexts. The aim of these four studies combined is to gain a better understanding of consumers' perception of property rights, which not only furthers relevant theories but also provides practical recommendations to policy-makers and managers.

Chapter 2 and 3 focus on consumers' perception of digital piracy. Digital piracy, or simply piracy, is defined as the unauthorized use or sale of copyrighted content. With the rise and expansion of the internet, it became very easy to commit piracy. In most countries

piracy is a punishable offence because it deprives copyright holders of potential revenue and, for this reason, it is often equated with theft. However, previous studies strongly suggest that consumers have a lenient attitude towards piracy while theft is universally morally abhorred.

Chapter 2 investigates to what extent a moral distinction exists between theft and piracy, and what might explain this distinction. We argue that extending the theory of loss aversion provides a novel explanation to why consumers have a different attitude towards piracy and, as a result, are more likely to commit piracy than theft. Loss aversion is the tendency to give more weight to losses than to gains in decision-making. Accordingly, losing one dollar has more impact on one's happiness than finding one dollar. Traditionally, the study of loss aversion focuses primarily on the impact decisions have on the decision-makers themselves. We extend loss aversion to include second-persons. These are persons who are directly affected as a result of the choices these decision-makers make. For example, stealing a dollar implies someone else, the second-person, is losing a dollar. In the case of piracy, however, the loss caused to the victim consists of foregone gains, which is more abstract than immediately experienced losses. Chapter 2 presents four experiments that together provide evidence in support of this theory.

Chapter 3 builds on the findings of Chapter 2 and consists of two incentivized economic experiments. Participants in these experiments could either steal or pirate from other participants, which had real monetary consequences for the participants involved. In the second experiment we also manipulated the price

at which the good can be bought legally to make the option of stealing or pirating more or less attractive. The findings of both experiments show that consumers are more likely to pirate than to steal, which is in line with the findings of Chapter 2. We also find that higher prices increase the attractiveness of piracy more than it does for theft. Together, the findings of Chapter 2 and Chapter 3 strongly suggest that the moral distinction between theft and piracy is psychological and, thus, difficult to undo. This also explains why the widespread use of public service announcements to fight piracy has been ineffective.

Chapter 4 presents a study on how framing possessions can affect decision-making. Theoretically, there are two ways to steal value: (1) taking away possessions or (2) diluting the value of these possessions. Although taking and diluting results in the same economic outcome, earlier studies suggest that consumers are more sensitive to taking than to dilution. We show in an incentivized economic experiment that participants behave more selfishly if they can appropriate value through dilution. The observed effect is called the dilution illusion because diluting someone gives the illusion that the other person is not disadvantaged. The findings suggest that the dilution illusion is a psychological bias and, thus, not the result of deliberate considerations. We argue that the dilution illusion results from our intuitive perceptions of property rights, which tend to be based on how possessions are divided nominally.

Chapter 5 considers to what extent the introduction of property rights in queues affect decision-making. Queues are well known to be an inefficient allocation mechanism. Unfortunately, in many

contexts queues are inevitable due to practical, ethical or legal reasons. Chapter 5 investigates the possibility to allow consumers waiting in a queue to trade places. Theoretically, trading places is expected to improve queue efficiency, which results in a better customer waiting experience overall. In a laboratory experiment two auction mechanisms are compared: (1) the server-initiated auction mechanism and (2) the customer-initiated auction mechanism. In both mechanisms consumers are always compensated if they move backwards in the queue. The main difference between two auction mechanisms is that in the customer-initiated auction mechanism consumers have the right to refuse to trade places. The experimental findings show that both mechanisms are equally effective in making queues more efficient. However, biases associated with property ownership are more pronounced in the customer-initiated auction than in the server-initiated auction. We argue that trading places in queues is a promising yet unexplored context to study perceptions of property rights. Practically, providing the ability to trade places in queues or waiting lists can improve the waiting experience considerably for all parties involved. To this end, we recommend managers to consider implementing solutions that would facilitate exchange in a queue or waiting list.

Samenvatting

Eigendomsrechten bepalen wie eigenaar is van wat. Handel is lastig indien het onduidelijk is wie eigenaar is van wat of als eigendomsrechten niet worden gehandhaafd. Om deze reden stelt een aantal wetenschappers dat eigendomsrechten essentieel zijn voor economische welvaart. Er kan een verschil worden gemaakt tussen een juridisch en een psychologisch perspectief op eigendomsrechten. Een juridisch perspectief legt nadruk op hoe de regels van eigendomsrechten in de wet worden gecodificeerd terwijl het psychologisch perspectief focust op hoe mensen intuitief denken over eigendomsrechten.

De twee perspectieven lijken niet overeen te komen indien deze worden toegepast op zogenoemde onconventionele goederen. Deze goederen worden gedefinieerd in dit proefschrift als goederen die ontastbaar of niet-rivaliserend zijn. Een niet-rivaliserend goed betekent dat het goed door meer dan één persoon tegelijkertijd kan worden gebruikt. Informatiegoederen, zoals muziek en teksten, zijn voorbeelden van niet-rivaliserende goederen. Dit proefschrift bestaat uit vier studies die onderzoeken hoe consumenten omgaan met onconventionele goederen in verschillende contexten. Het doel van deze studies is om beter te begrijpen hoe consumenten denken over eigendomsrechten, wat niet alleen theoretisch bijdraagt maar ook leidt tot praktische aanbevelingen voor beleidsmakers en managers.

Hoofdstuk 2 en 3 focussen op hoe consumenten digitale piraterij waarnemen. Digitale piraterij, kortweg piraterij wordt gedefinieerd als het onrechtmatig gebruik of verkoop van auteursrechtelijk beschermde werken. Dankzij de opkomst en uitbreiding van het internet, is het erg makkelijk geworden om piraterij te plegen. In de meeste landen is piraterij strafbaar omdat dit leidt tot inkomensderving en wordt om deze reden vaak vergeleken met diefstal. Maar eerdere studies suggereren sterk dat consumenten een soepele houding hebben ten opzichte van piraterij terwijl diefstal breed moreel wordt afgekeurd.

Hoofdstuk 2 bestudeert in welke mate een moreel verschil wordt gemaakt tussen diefstal en piraterij en wat dit verschil zou kunnen verklaren. Wij beargumenteren dat een uitbreiding van de theorie van verliesaversie een nieuwe verklaring kan vormen voor waarom consumenten een andere morele houding hebben jegens piraterij, wat als gevolg heeft dat zij eerder piraterij plegen dan diefstal. Verliesaversie is de neiging om meer gewicht te geven aan verliezen dan aan winsten in het maken van beslissingen. Bijvoorbeeld, het verliezen van één euro heeft meer invloed op je gelukkigheid dan het vinden van één euro. Onderzoek naar verliesaversie concentreert zich normaliter op de invloed van beslissingen op de beslisser zelf. Wij breiden de theorie van verliesaversie uit om rekening te houden met tweede personen. Dit zijn personen die direct de gevolgen ervaren van de beslissingen die door beslissers worden genomen. Bijvoorbeeld, het stelen van een euro impliceert dat iemand anders, de tweede persoon, een euro verliest. Bij piraterij bestaat het verlies uit winstverderving, wat abstracter is dan verliezen die direct worden ervaren. Hoofdstuk 2

presenteert vier experimenten die de uitbreiding van de theorie van verliesaversie ondersteunen.

Hoofdstuk 3 bouwt voort op de bevindingen van Hoofdstuk 2 and bestaat uit twee economische experimenten. Deelnemers van deze experimenten konden stelen of piraterij plegen, wat als gevolg had dat andere deelnemers financieel werden benadeeld. In het tweede experiment werd ook de prijs om het goed rechtmatig te krijgen gemanipuleerd zodat de optie om te stelen of piraterij te plegen aantrekkelijker of juist minder aantrekkelijk wordt gemaakt. De bevindingen van beide experimenten tonen aan dat consumenten eerder geneigd zijn piraterij te plegen dan diefstal, wat in lijn is met de bevindingen van Hoofdstuk 2. We vinden ook dat een hogere prijs piraterij relatief aantrekkelijker maakt dan diefstal. De bevindingen van Hoofdstuk 2 en 3 suggereren dat het morele verschil tussen diefstal and piraterij psychologisch van aard is en daarom lastig ongedaan te maken valt. Dit verklaart ook waarom publieke voorlichting om piraterij te bestrijden, ineffectief is gebleken.

Hoofdstuk 4 bestaat uit een studie over hoe de presentatie (*framing*) van bezittingen invloed kan hebben op morele beslissingen. Theoretisch zijn er twee manieren om iets van waarde van een ander te ontnemen: (1) het afpakken van bezittingen of (2) het verwateren van de waarde van deze bezittingen. Hoewel afpakken en verwateren beide leiden tot dezelfde economische uitkomst, suggereren eerdere onderzoeken dat consumenten gevoeliger zijn voor afpakken dan voor verwateren. In een economisch experimenten laten wij zien dat deelnemers zelfzuchtiger gedragen als het mogelijk is om waarde toe te eigenen door middel van

verwatering. Het waargenomen effect wordt de verwaterillusie genoemd omdat verwaterng de illusie kan geven dat het slachtoffer niet is benadeeld. De bevindingen suggereren dat de illusie psychologisch van aard is en dus niet het resultaat van bewuste overwegingen. We beargumenten dat de illusie het resultaat is van intuitive percepties van eigendomsrechten; deze zijn met name gebaseerd op hoe bezittingen nominaal zijn verdeeld.

Hoofdstuk 5 bestudeert hoe de introductie van eigendomsrechten in een wachtrij invloed heeft op beslissingen. Een wachtrij staat in de economische literatuur bekend als een inefficient allocatiemechanisme. Maar in veel contexten zijn wachtrijen onvermijdbaar vanwege praktische, ethische of juridische redenen. Hoofdstuk 5 gaat in op de mogelijkheid om van plaats te kunnen ruilen in een wachtrij. Theoretisch wordt verwacht dat de mogelijkheid om van plaats te ruilen de efficientië van een wachtrij verbetert, met als resultaat een prettigere wachtervaing voor de wachtenden. In een laboratoriumexperiment worden twee veilingsmechanismen met elkaar vergeleken: (1) het *server-initiated* veilingsmechanisme en (2) het *customer-initiated* veilingsmechanisme. In beide mechanismen worden wachtenden altijd financieel gecompenseerd als de nieuwe plek verder achter in de rij is. Het belangrijkste verschil tussen de twee veilingsmechanismen is dat met het *customer-initiated* veilingsmechanisme wachtenden het recht hebben om een nieuwe plek te weigeren. De experimentele bevindingen laten zien dat beide mechanismen even effectief zijn in het efficienter maken van de wachtrij. Maar afwijkend gedrag dat valt te relateren aan de psychologische perceptie van eigendomsrechten, zijn

nadrukkelijker aanwezig met het *customer-initiated* veilingsmechanisme. Wij stellen dat het ruilen van plaatsen in een wachtrij een veelbelovende maar weinig onderzochte context is om percepties van eigendomsrechten te bestuderen. Vanuit een praktisch oogpunt kan de mogelijkheid om te ruilen van plaats in een wachtrij of -lijst de wachtervaring aanzienlijk verbeteren. Wij bevelen managers en beleidsmakers daarom ook aan om oplossingen die het ruilen in een wachtrij of -lijst mogelijk maakt te implementeren.

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