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THE ROLE OF AFFECT IN RECIPROCITY AND RISK TAKING:

EXPERIMENTAL STUDIES OF ECONOMIC BEHAVIOR

THE ROLE OF AFFECT IN RECIPROCITY AND RISK TAKING

Experimental Studies of Economic Behavior

ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad van doctor
aan de Universiteit van Amsterdam
op gezag van de Rector Magnificus
Prof. mr. P. F. van der Heijden
ten overstaan van een door het college voor promoties
ingestelde commissie, in het openbaar te verdedigen
in de Aula der Universiteit op donderdag 23. februari 2006, te 12.00 uur

door Astrid Hopfensitz

geboren te Mannheim, Duitsland

für meine Eltern und meine Großeltern

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People have always fascinated me. That studying them would some day become my job, I nevertheless did not expect. However I was fortunate enough to meet people and circumstances that allowed me to pursue many of the things I find "interesting". These circumstances have led me through a variety of academic field, from applied mathematics, to economics, to psychology. And I'm more than curious to see where this way will lead me next. My encounter with psychology and emotions research was an advantageous endeavor during which I learned a lot. Emotions are a fascinating topic - full of puzzles and surprises. That they are sometimes so hard to grasp and measure, was frustrating at times but rather enhanced my curiosity to learn about them.

During the last four years I also wrote a thesis. This thesis would have never been possible without the help, encouragement and ideas of many people that I want to thank. Primarily I would like to thank my supervisor Frans van Winden. Without his interest in the topic, his enthusiasm and his willingness to meet for extensive discussions, this thesis would not exist. Frans convinced me that emotions are not only interesting to have but also to study and I am very glad that he did so. Further I would like to thank Sam Bowles who, during my stay at Amherst, convinced me that I should pursue a PhD in Economics. That I decided to do so at an experimental economics lab, is partly due to the generous invitation to a summer school in Experimental Economics at the University of Arizona.

Amsterdam was a wonderful city to live in and I am sad that I will have to leave. In addition to the grachten, the stroopwafels and the bikes, I will miss my friends and colleagues at CREED that have made the last four years a wonderful and productive experience. My special thanks go to Ernesto Reuben who has been a friend, colleague and house-mate. Part of this thesis stems from joint work with Ernesto and I feel very lucky that we met and had the chance to work together. Eva van den Broek has become a great friend and 'sister' for lunch breaks and beyond; Aljaž Ule has been invaluable for distraction, networking and the ordering of food; Jens Grosser always helped watering plants and made me feel less lonely on Sundays in the office and Arno Riedl helped me a lot with advice on experiments, teaching and LaTeX. Arthur Schram made it a pleasure to teach the working-groups of his course. From Joep, Theo, Peter, Gijs and Jos I learned a lot about economics, experiments and soccer in many discussions during seminars and Wednesday coffee breaks. Joris helped me with organizing the CREED lunch seminars and Karin and Claudia with innumerable

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<div align="right">
Astrid Hopfensitz
Amsterdam, December 2005
</div>

Contents

Chapter 1

Introduction

"What should I do? Should I take the job? Should I help my friends move? Should I complain to my neighbors about the noise? Should I invest in the high rated stocks?" Such are just some of the many questions that are on our mind throughout our lives. Some times these questions have clear answers but often they have not. We are not sure if we would like the job, if it is worth helping, how the neighbors will react and how the stock-market will evolve. But we take decisions continuously and most of the time without noticing it. How do we deal with this enormous amount of problems? The answer might be: "without thinking".

Decisions and how we come up with them, are at the very heart of explaining economic behavior. According to much of economic theory, decisions are the result of a logical process in which inputs are evaluated. As long as no mistakes are made this process will result in behavior leading to an optimal outcome. However this seems impossible with all the decisions we have to take in our daily lives. Instincts influence us, experience and emotions. Emotions influence our decisions - this is a long known fact, even to economists (Smith, 1854, [2000]). But for long it was assumed that their influence would only disturb the ideal optimization process and that the effects of emotions are random noise and thus not interesting to economists.

In this thesis, I will argue that emotions influence behavior and that this influence is not just random noise but an essential part of the decision making process. Knowing about the influences of emotions will help us to understand how people behave. Behavioral observations already enable us to infer about the mechanisms of decision making. However this does not allow us to actually know how people come up with these decisions. Only if we take a look into the "black box" leading to decisions, we can start to truly understand behavior. As we believe, emotions are one of the crucial ingredients guiding people in their decisions. However we cannot generalize and say that emotions are "good" or "bad" for decision making. Sometimes emotions are helpful, for example by letting us react faster but sometimes they make us "overreact" in ways we will later regret. However it seems certain by now that emotions are essential for us to live a normal life and that learning, deciding, and most social interaction would be impossible without emotions (Damasio, 1994).

Fortunately the recent upsurge of emotion research in psychology (reflected by the launch of three journals devoted to emotions research: *Motivation and Emotion*, *Cognition and Emotion* and *Emotion*; see also Manstead et al., 2004) has also led economists to stress anew the relevance of emotions (Frank, 1988; Elster, 1996, 1998; Loewenstein, 2000). This is reflected in a number of different ways. Happiness is more and more considered as an important macroeconomic variable (e.g. van Praag and Ferrer-I-Carbonell, 2004; Layard, 2005), emotions are included in models of decision making (e.g. Loewenstein, 2000; Loewenstein and Lerner, 2003), and experimental economists increasingly measure, in addition to behavior, the emotional reactions of subjects in the laboratory (e.g. Bosman and van Winden, 2002; Ben-Shakhar et al., 2004; Camerer et al., 2005).

However acknowledging that emotions are relevant for decision making is only a first step. The new challenge is to figure out how emotions influence us. First we have to appreciate that emotions are of a stunning variety. Indeed, even emotion theorists do not always agree on what the definition of "the emotions" is. While the exact definition of emotions is still disputed, it seems clear by now, that different emotions influence us in different ways (Lerner and Keltner, 2000; Zeelenberg and Pieters, 2005). This seems obvious if we assume that each emotion evolved in humans to serve a specific goal. For example it is believed that fear developed to protect us from dangers and anger to keep others from doing us harm. Thus it follows that we will act differently when we feel fearful than when we feel angry, even though both emotions might make us feel "bad" (Lerner and Keltner, 2000). Reactions induced by emotions will further depend on the specific situation. Experiments under controlled conditions can help us to disentangle the effects of different emotions and situations.

In this thesis we will investigate a number of very different emotions and show how they are related to decision making in economically relevant situations. We will concentrate mostly on two kind of choice situations. First on the existence and persistence of cooperative behavior in anonymous, one-shot interactions. In such situations it has been shown that punishment of non-cooperative behavior can induce high cooperation levels. We will study specifically the motivations that might lead to such punishment and the reactions to punishment by the punished. Among others we will show how anger is related to costly reciprocation of unfair behavior and how the tendency to punish can be subdued by feelings of guilt and shame. In addition to the importance of experienced emotions, we will study for a second kind of choice situation the importance of anticipated emotions. Namely we will observe experience and anticipation of prospect based emotions in a choice situation of monetary investment. We will show how the anticipation of regret and rejoicing influences risk taking and how risk taking is related to feeling hope, anxiety and irritation.

We can not ignore our emotions and they influence us whenever we have a decision to make. Hope might induce me to take the proposed job, anger might make me complain about the noise of my neighbors, guilt can let me to make up for that later and anticipation of regret might keep me from investing high amounts in risky projects.

Outline of this Thesis

Emotions are complex mechanisms that influence human behavior, but so far their impact has only occasionally been considered by economists. In chapter 2 we will introduce emotions and give an overview of known facts and methods. We will explain the processes that lead us to experience emotions, give an overview of the effects of emotions on behavior and cognition, and show how emotions can be categorized and compared. The chapter will conclude with an overview of different measurement techniques that are used to measure emotions. Based on this discussion we will motivate our choice of methods for the presented experiments in this thesis. As psychological research shows us, due to their diverse action tendencies, it is very important to differentiate between different kinds of emotions. For this reason social psychology utilizes mostly self-reports, which are still the best way of learning about the specific emotions experienced by the subject. Self-reports can be complemented by physiological measures to get an objective but nevertheless explicit measure of emotions. We therefore utilize in our experiments mostly self-report scales and combine these in one case with physiological measures of arousal.

In chapter 3 we will look at some of the approaches taken by economists to include emotions into their theories and models. Namely the valence approach, which assumes that the experience of negative emotions reduces utility, and models where emotions are assumed to be signaling devices. While so far many economic models are mainly concentrating on the impact of anticipated emotions, the dual impact of emotions is crucial. Emotions influence behavior, on the one hand, directly by influencing memory, attention, judgement and valuation and, on the other hand, through anticipation of emotions and reactions to this anticipation.

Emotions differ on several dimensions and thus, for a precise understanding of their impact, we have to differentiate between different types of emotions. We will mostly concentrate on "negative" emotions, which have somewhat clearer action tendencies and are thus especially interesting to consider when analyzing the impact of emotions on behavior. We will cover some of the emotions from Lazarus (1991) working classification of classical negative emotions, namely:

> Emotions resulting from a primary appraisal of goal relevance and incongruence. These include: anger, anxiety, fright, envy, jealousy, guilt, shame and disgust. (Lazarus, 1991, p.82)

The following four chapters will discuss some of these emotions. Most of them have already received some attention from economists but very little experimental evidence exists about their actual impact.

In chapters 4 to 6, we will observe the importance of experienced emotions in choice situations that concern the conservation and creation of cooperative behavior in anonymous, non-repeated interactions. Research has shown that allowing for the punishment of norm-violaters can induce people to adhere to these norms. We will observe how the experience of emotions is related to the willingness to incur costs

to induce such punishment. Further we will observe how the experience of moral emotions influences the reactions of the recipient of punishment.

Chapter 4, will discuss the experience of anger. Specifically, it is shown how anger is influencing reciprocity when induced through "unfairness". Additionally, we discuss and compare multiple methods of measuring this emotion. Emotions were measured by self-reports and this measure was related to a physiological measure of arousal, namely the skin conductance level. We observe behavior and emotions for the Power-to-Take game, in which responders can reciprocate unfairness by destroying their own income. We will show, that destruction of resources by responders is related to an increase in arousal prior to taking that decision. We further show that reported anger is positively correlated with this increases in arousal. The results lend support to the validity of self-report scales in comparable studies of social interactions.

Chapter 5 extends the discussion of anger and addresses the issue of what can lead to the experience of this emotion. Emotional reactions to unfairness will be distinguished from the effects of envy and jealousy. Unfairness can elicit anger but this does not need to be related to the feelings of jealousy or envy. We show that even though in the Power-to-Take game reported in the previous chapter, anger was related to destruction, no such relation was found for jealousy, despite a correlation of anger and jealousy. We conclude that anger can be elicited both through the cognitive evaluation of unfairness and the emotional reaction of jealousy. Anger might be experienced in both cases, but the specific trigger that leads to anger is not the same. A reduction in unfairness might therefore reduce anger but not affect jealousy.

The action tendency of anger can be countered by social emotions, as guilt and shame. These emotions are considered to be especially unique in humans and seem to be crucial to overcome social dilemma situations. In chapter 6, we will observe the impact of shame and guilt on retaliation behavior. We will show that the effectiveness of punishment also depends on the emotional reaction of the individuals who are punished. If individuals feel anger after being punished, they might be motivated to retaliate towards the punisher. Therefore, anger alone may induce multiple rounds of punishment and consequently result in a significant destruction of resources. We will show that the social emotions of shame and guilt motivate individuals to abstain from retaliation. We will study cooperation and punishment behavior for a simple social dilemma game. In this game individuals who are punished, always have the opportunity to retaliate. We find that in the presence of our punishment institution, cooperation is sustained at a high level. We replicate the importance of anger as a motivation for punishment. First movers who punish do so because they are angry. We further observe how social emotions in second movers are related to their decision to retaliate. We find that second movers who retaliate do so because they are angry and do *not* feel shame. In addition, subsequent to feelings of shame, second movers change their behavior and act more cooperatively. We conclude that if an opportunity for retaliation exists, the experience of anger alone can lead to multiple rounds of punishment and to a significant destruction of resources. This effect can be countered by the experience of moral emotions.

In chapter 7, we will turn to choice situations that concern risk taking in monetary gambles. In situation with uncertain outcome, not only experienced but also anticipated emotions will influence the decision making. We will therefore turn to prospect based emotions namely: anxiety, irritation, hope, regret and disappointment. We will discuss the experience and the anticipation of these emotions, and analyze them in an investment setting, where risk is varied in timing and intensity. The anticipation of a variety of prospect based emotions has already been included in theoretical models of decision making. However it is not clear to which degree humans indeed anticipate these emotions. We will consider a simple one-person and one-shot investment game. Decisions concern the allocation of real money to two projects, one of which is safe while the other is risky. Changes in investment behavior are studied when a "global risk", that is, a risk threatening any investment, is included and the timing of the resolution of this risk is varied. In all treatments we observe many subjects choosing intermediate investment and in all treatments involving global risk we observe a relatively high percentage of subjects deciding to invest all their money. Even though the resolution of the global risk was clearly disconnected from the resolution of the decision risk, subjects do not ignore the global risk. The analysis of the experienced and anticipated prospect based emotions shows that feeling hope and irritation is related to investment decisions. However, this relation is not the same in all treatments. We observe that anticipated regret and rejoicing are both related to investment and further that both emotions can be related to more as well as to less investment. Finally, we observe only very weak effects of anxiety. This is surprising given the widespread belief that anxiety should influence investment decisions. All in all, the anticipation and experience of a variety of emotions turns out to be influential in individual decisions concerning choices of financial risk taking. A shift in which emotions are anticipated and/or experienced can lead to shifts in behavior. Investment behavior might thus seem puzzling if these emotions are not taken into account.

Chapter 8 concludes and summarizes the findings of this thesis. We hope that the findings from this thesis will enhance our understanding of how specific emotions influence decision making. Specifically that as well experienced as anticipated emotions have to be considered in many economic decisions. Both kind of emotional experiences can help us make decisions when it is not obvious which choice is the "right" one. This might be either in situations concerning fairness, where norm enforcement is costly but morally desirable. Or in choice situations of financial risk, where dependent on the expected outcome, ex-post either risk-seeking or risk-avoidance might seem the best thing to do.

Chapter 2

Emotions

How pleasant it was in the garden! And how delightful other people's emotions were! - Much more delightful than their ideas, it seemed to him. One's own soul, and the passions of one's friends, - those were the fascinating things in life.

The Picture of Dorian Gray (Wilde, 1891, [1998])

Emotions are almost at the same time very easy and very hard to define. Surely, everybody reading this has experienced emotions and can easily reflect on the feelings and situations accompanying them. But asked about a precise definition of what emotions are, most people will probably stammer and fail. Emotions seem to be inseparably related to "that funny feeling in the stomach", sweaty palms and a pounding heart, which the person did not consciously want to happen and which are hard to explain in a "rational way".

Emotions and feelings have been dominating literature and philosophy for centuries and have long been considered as being at the heart of most of human actions and motivations. Why modern man (at least in the economic sciences) mostly denies this intrinsic combination of emotions and behavior, will be discussed in more detail in chapter 3. First we will try to give an overview of what we should include (and exclude) in the discussion of emotions, what is generating emotions, and what their impact is on behavior. We will present some ways of categorizing emotions and last but not least, we will discuss ways of measuring emotional reactions in humans. In later chapters we will refer to some of the basic principles presented in this overview.

2.1 What is an Emotion?

Since people talk about emotions all the time, it is important to understand what characterizes an emotion from a scientific point of view. Many definitions of emotions coexist and we will not try to settle the discussion. In the following we will try to give

an overview of opinions and concepts that prevail in the literature. Naturally we will only be able to give a very incomplete picture of the nature of emotions. For more extensive reviews of emotions see for example Frijda (1988), Lazarus (1991), Oatley and Jenkins (1996), Picard (1997), Ben-Ze'ev (2000) and Manstead et al. (2004).

Emotions, seem to be reactions which we can not fully control. However not all uncontrollable reactions of our body are emotions. Consider that exposed to extreme physical activity, our heart starts racing without us willing it to do so. The difference to an emotional reaction is, that emotions are not immediately necessary for the physical survival of the body (at least so it seems). Emotions are more than simply reactions to physiological changes in our body (e.g. the decrease of oxygen in our blood). Further we have to distinguish emotions from reflexes. According to Lazarus: "Startle is a good example of the distinction between reflexes and emotions. Some writers have treated startle as a primitive emotion. I believe this is a mistake, because it confuses emotion with reflexes. Startle is relatively fixed and rigid and is best regarded as a sensorimotor reflex" (Lazarus, 1991, p.53). According to this view emotions are *complex* interactions. More precisely, emotions imply: "multiple motives, evaluations of adaptational requirements, foresight and stepwise planning, and a mobilized bodily reaction - all of which make an emotion truly a cognitive-motivational-relational configuration" (Lazarus, 1991). We can thus summarize that emotions are experienced when an event relevant for our concerns, goals or preferences, is evaluated. This evaluation then leads to a complex reaction, resulting in emotions.

Different emotions can be defined through their associated action tendencies. Fear is for example associated with the tendency for flight and love with the tendency for approach. Whether action tendencies are the optimal way of defining emotions is controversial. Some emotions do not have a (clear) action tendency. For example, sadness and depression are rather characterized by withdrawal from action, but nevertheless they seem to be emotions. This is known as the *perennial dilemma* - namely whether physiological activity is necessary to be sure that a person is experiencing an emotion (LeDoux, 1996). This problem can be avoided by defining emotions as:

> Emotions are changes in readiness for action as such (we call these changes in activation), or changes in cognitive readiness (they have come under investigation as attentional arousal), or changes in readiness for modifying or establishing relationships with the environment (we called these action tendencies), or changes in readiness for specific concern-satisfying activities (we called these desires and enjoyments). (Frijda, 1986, p.466)

Thus emotions are complex reactions to external (or internal) events which will lead to changes in readiness. However these changes in readiness do not necessarily have to imply actions.

We further have to differentiate between emotions and related concepts, as mood and feeling. Feelings are mostly associated with physiological awareness. "It is more precise to restrict the word feeling to the awareness of bodily sensations and to

reserve the word emotion for occasions on which there has been an appraisal of harm or benefit" (Lazarus, 1991, p.57). Feelings and emotions interact in the sense, that emotional appraisal is cognitively recognized and therefore leading to feelings, but feelings do not imply emotions (LeDoux, 1996, referring to Damasio).

Moods are yet another related concept. The difference between moods and emotions is that moods are often object-less and free-floating and that they last for long time periods (Oatley and Jenkins, 1996). Emotions can enhance a certain mood, while a certain mood can make the experience of an emotion more likely. Mood is often induced in experiments in social psychology for example by movie clips or introspection. Because moods generally last for some time, the effect on actions done during that time period can be easily observed.

2.2 What is Generating Emotions?

Emotions are, as we have seen in our initial definitions, a reaction to external or internal events. Of further interest is how the appraisal of these events results in the experience of emotions.

The experience of emotions is influenced by our bodies. While the theory of action tendencies implies that emotions result in bodily reactions, there is also evidence that bodily reactions elicit emotions. Schachter and Singer (1962) hypothesized that physiological changes, can lead to different emotional attribution, dependent on the given frame. After being injected a drug which lead to stimulation of the nervous system, subjects that were uninformed or ill-informed about these effects, attributed their bodily changes to emotions. The specific emotions they reported dependent on the environment they faced. If facing either happy or angry others, they stated to feel happy or angry themselves. Subjects that were informed about the effects of the drug did not report these emotions.

Examples of people being fooled by false feedback about their body reactions, served as strong evidence for researchers arguing that emotions are solely experienced through the feedback of bodily responses. This idea was already proposed by James (1884) when he asked if "we run from a bear because we are afraid, or if we are afraid because we run from the bear?" He concluded that:

> Our natural way of thinking about these standard emotions is that the mental perception of some fact excites the mental affection called the emotion, and that this latter state of mind gives rise to the bodily expression. My thesis on the contrary is that *the bodily changes follow directly the PERCEPTION of the exciting fact, and that our feeling of the same changes as they occur IS the emotion*. (James, 1884, p. 190)

One crucial characteristic of emotions is the speed of their onset. However the information transfer through bodily arousal does not seem to be fast enough to account for
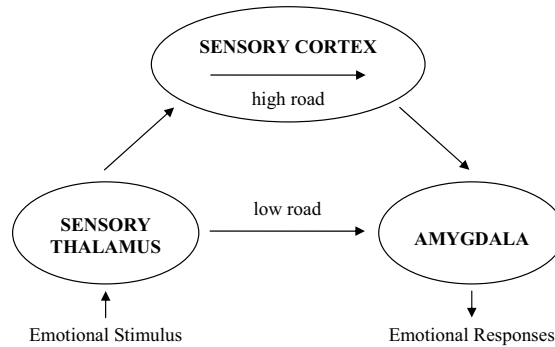
Figure 2.1: The Low and the High Roads to the Amygdala (LeDoux, 1996)

the quick onset of emotions. Therefore, the experience of emotions seems to depend on more than just the feedback from physiological reactions.

The speed of emotional reactions is also seen as a reason for their evolutionary origin. In emergency situations, it is sometimes necessary to overrule the slow but precise cognitive processes, by fast but less precise processes leading to immediate action (LeDoux, 1996). In LeDoux's words, for the case of fear there is a "low road" from the sensory thalamus to the amygdala that is carrying intuitive information and is faster than the "high road" through the sensory cortex (see Figure 2.1). For example fear makes us react to a coiled up snake, before we are even sure of it being a real snake and not just a piece of wood. But the costs of jumping away from a piece of wood are low compared to the costs of staying close to a snake till we recognize it and it might already attack us.

The evolutionary reason for the origin of emotions was already proposed by Darwin. He observed and argued that the facial expression of emotions is related in humans and other animals (Darwin, 1872, [1998]). According to Lazarus (1991, p.71): "the most widely accepted position is that the face, through a complex and interconnected set of muscles, gives innate expression to the primary emotions that humans inherited in the evolution of the species, and that the pattern of expression for each emotion is universal for that species." Ekman showed in extensive, cross-cultural research, which characteristics are common to facial expressions and which are not (Ekman, 1993).

The question is, if emotions even though they gave an evolutionary advantage at some point, are simply a relict of those times and not necessary for modern humans or if their existence is still crucial for modern man.

2.3 The Impact of Emotions on Behavior

Emotions in general are known to have an impact on memory, learning and perception. This has been demonstrated in a variety of experiments. For example pictures displaying a scene with emotional content are better remembered, even though the memory might be not very precise and dominated by the emotion eliciting event (Christianson and Loftus, 1991). Mood is influencing recollection by making it easier to remember situations that were experienced in the same kind of mood (Bower, 1981; Blaney, 1986). Further due to mood congruency, mood can influence cognition by the person mainly taking in information that agrees with her mood (Bower, 1981).

Cognition is further affected by emotions by directing the attention to the emotion eliciting event. For example if asked to pick out the "odd" out of a set of pictures, people are faster at finding pictures with an emotional content, like spiders and angry faces (Oehman et al., 2001). Emotion can thus be seen as a system to interrupt ongoing processes and direct the attention at relevant stimuli (Simon, 1967). In general it has been suggested that emotions (and the lack of them) have a crucial impact on normal, everyday behavior (Damasio, 1994; Bechara et al., 1997). And that the ability to "manage" emotions is an important skill, that is sometimes referred to as emotional intelligence (Goleman, 1997).

It is generally agreed, that emotions are not just a by-product of our evolutionary past, but that they are a necessary mechanism in a world that is complex and imperfectly known. Cognitive science has argued that emotions are necessary for the existence of any intelligent being and emotions are used as an important concept in the study of artificial intelligence (Simon, 1967; Picard, 1997). Robots are programmed with mechanisms that make them approach something that is good for them and flee from danger, essentially imitating the action tendencies of love and fear (Evans, 2001).

The theory of action tendencies implies that each emotion has a specific behavioral pattern associated with it. Thus for every single emotion there will be certain behavioral consequences. In this thesis we will for different emotions observe these consequences.

2.4 Categorizing Emotions

Emotions serve a goal and different emotions will have different impacts. Therefore it is necessary to clarify which and how many emotions exist and what are the relationships between them.

There have been multiple attempts to make an inventory of emotions, emotion names and their relations. For example by cluster analysis of (English) emotion names, resulting in the observation of six main clusters (love, joy, surprise, anger, sadness and fear, see Shaver et al., 1987). Emotions have been presented in emotion scales, similar to a color circle, to explain the combination of complex emotions out of basic types (see Figure 2.2 from Plutchik, 2001). And Ortony et al. (1988) developed a global
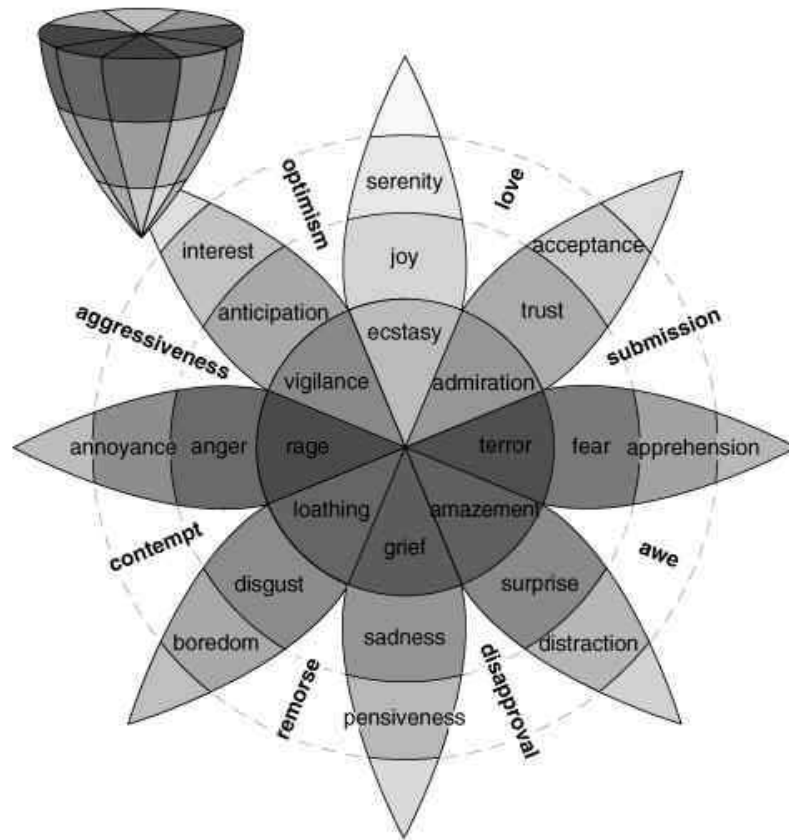
Figure 2.2: Emotion scale by Plutchik (2001)

structure of emotion types according to their causes and consequences (see Figure 2.3).

Abstraction seems necessary since there are not only many emotions, but even more words for them. Many emotion words are synonymous for the same state or simply express different intensities of the same emotion (e.g. annoyance, anger and rage). And different languages have different expressions for emotions.[1] Special care is therefore required for cross cultural comparisons. But comparisons are not impossible, since some emotions have universal characteristics. For example many emotions can be differentiated by the two dimensions of pleasure and arousal (Russell et al., 1989, see Figure 2.4). Even though also in such a circumplex representation some emotions can not be distinguished (e.g. regret and disappointment) this is an often used way to differentiate between emotions. This idea can also be extended to include

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[1] This does not mean that an emotion that has no word in one language does not exist in the corresponding culture. One common example is the German word "Schadenfreude", which even though not existent in English, is known as a feeling to native English speakers.
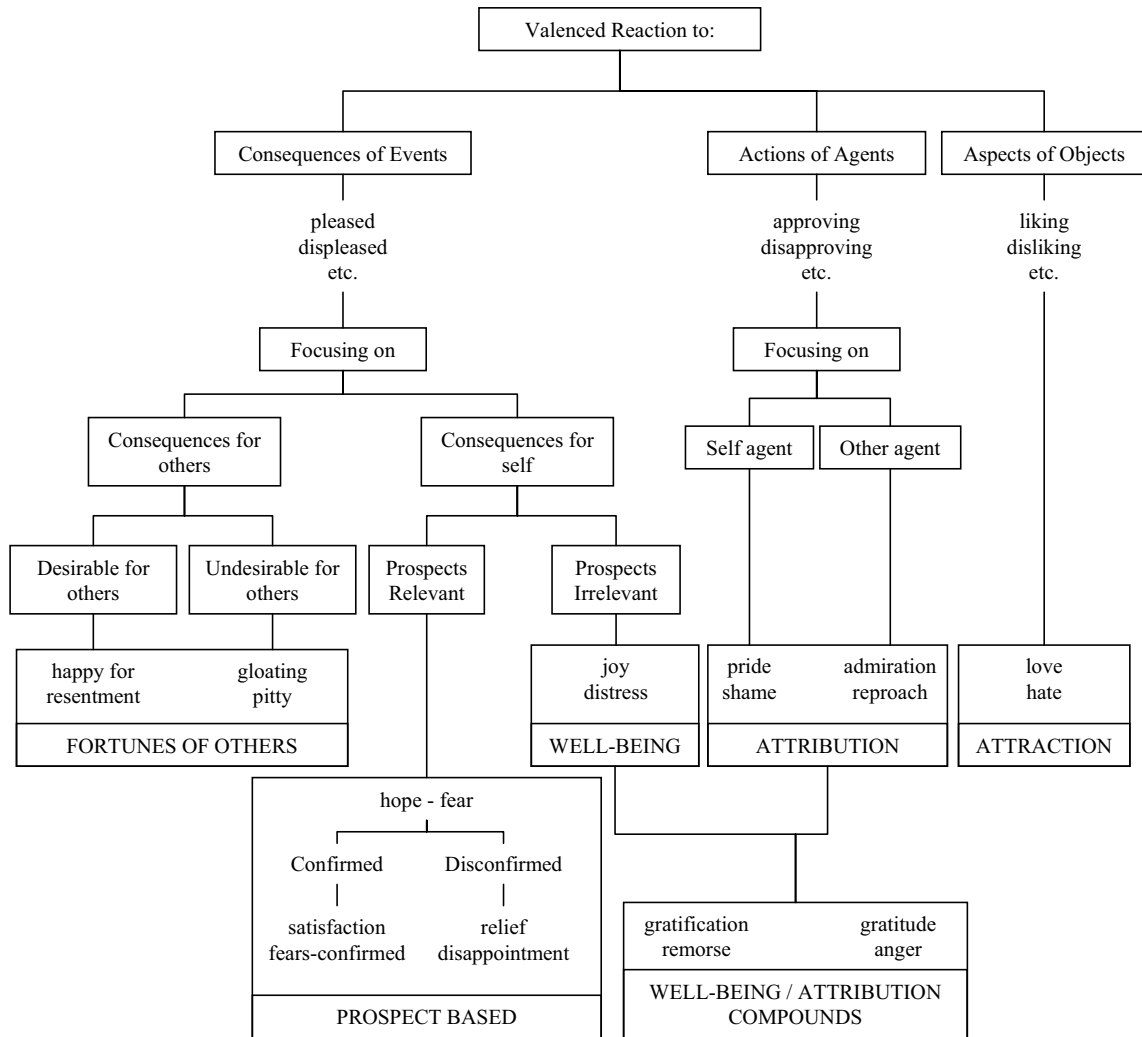
Figure 2.3: Global Structure of Emotion Types (Ortony et al., 1988)
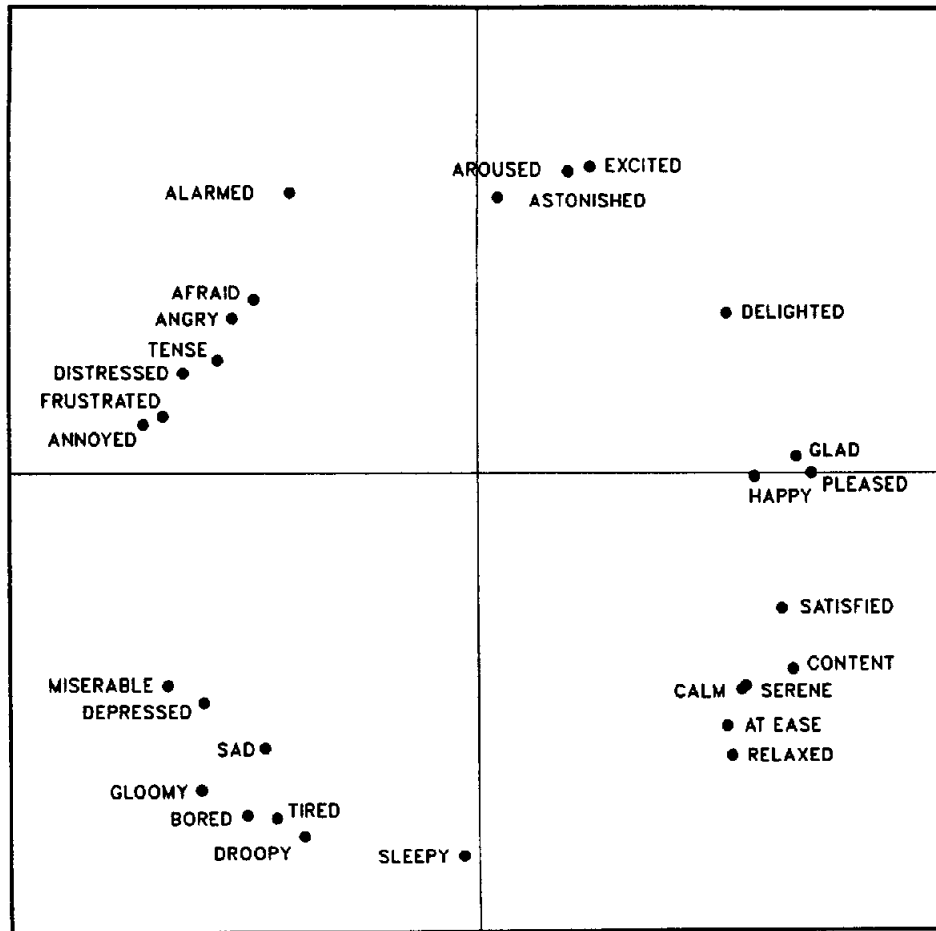
Figure 2.4: A circumplex representation of feelings; shown is a two-dimensional scaling solution of 28 English words, with pleasure on the horizontal and arousal on the vertical axis (Russell et al., 1989).

other dimensions to characterize the emotion.

Various ways of grouping emotions have been suggested, specifically the difference between "basic emotions" and "higher" emotions. Basic emotions are emotions which are present in "all" humans and also in other mamals[2]. Examples are fear, anger and anxiety. Higher, moral or social emotions, are emotions that are shaped and defined by culture, education and society. Examples include envy, shame and guilt.

The differentiation of primary and non-primary emotions is a methodological one,

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[2]To be certain that other animals experience the same emotions as humans is impossible. Nevertheless we know that non-human animals have similar brain reactions when for example exposed to stress. Neurological and behavioral evidence from experiments with monkeys, rats and mice is used to study for example fear and anxiety (LeDoux, 1996).

which has been repeatedly criticized (Lazarus, 1991). Many different views exist of what should be included in a list of basic emotions (Ortony et al., 1988). Some include just two opposed concepts as: happiness - sadness or pain - pleasure. Others, list many different emotion names (e.g. Frijda: desire, joy, pride, surprise, distress, anger, aversion, contempt, fear, shame, in Ortony et al., 1988). But actually many of these lists cover the same basic ideas and there seems to be little disagreement about the actual existence of some kind of basic emotions.

Self-conscious or social emotions are emotions linked to the norms in a society (Thoits, 2004). Such emotions arise from evaluating the self from the perspective of others and include emotions as shame, guilt, embarrassment and pride. Socially defined emotions are especially interesting from an anthropological and sociological point of view. Based on them, different institutions might have evolved, or reversely, emotions might have been shaped by different institutions. Moral emotions can overlap with what are considered basic emotions by others. Anger is for example a moral emotion that is nevertheless also widely agreed on being a basic emotion (Haidt, 2003). The actions of cooperation, sharing and free riding might be crucially influenced by what kind of social emotions are experienced (Fessler, 2001; Bowles and Gintis, 2003).

Another basic categorization is the difference of positive versus negative emotions. Positive emotions are pleasurable for the person experiencing them, while the experience of negative emotions is unpleasant. However such a concept is ambiguous. A negative emotion might be unpleasant in the short run, but be good for the agent in the long run.[3] One example for this is anger. Although anger makes us feel bad, it is nevertheless an emotion of approach and even of reconciliation on a new basis (Oatley and Jenkins, 1996). Thus positive or negative can either be used concerning the pleasure the emotion brings to the agent, or concerning the long run effects of the emotion on the agent. In the following we will use "negative emotions" for emotions whose experience is disliked.

2.5 Measuring Emotions

If we want to measure and observe the impact of an emotion, we need to agree on variables that define that emotion. Since emotions can not be "experienced" from the outside, there have been various attempts to find objective measurements. These do involve:

- Questionnaires

- Behavioral observations

- Facial observations

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[3]From an evolutionary perspective this should always be the case. An emotion that is detested, should result in an action that is protecting the agent from something ultimately bad.

- Physiological measures

- Brain scans

In the following we will briefly discuss the advantages and limitations of these approaches.

Many experiments concerning emotions in social psychology rely on self-reports of the subjects emotional experience. Subjects are usually asked to rate their current or anticipated feelings on a continuous or categorized scale. Dependent on the formulation of the "time frame", scales can be used both for long term and short term measurements. That is, either for moods, traits or immediate emotional experience. Cross cultural scales use pictographs or photos instead of words (e.g. Bradley and Lang, 1994; Morris, 1995; Desmet et al., 2000). To ask subjects about their experience, heavily relies on the assumption that subjects are intrinsically motivated to answer truthfully. As we have seen before, even the individual can be fooled by its perception of its own emotion. In addition self-reports can be influenced by subjects beliefs about what they are expected to answer and might not reflect the true experienced moods (Parrott and Hertel, 1999). Finally the subjective intensity of the experienced emotion is influenced by a number of different factors (e.g. duration, recollection and bodily changes; see e.g. Sonnemans and Frijda, 1994). Many questionnaires do not differentiate between these factors. Thus self-reports might sometimes not be able to measure the actual emotional experience. Their advantage is though that they are easy applicable and despite their disadvantages they are considered as "the most common and potentially the best way to measure a person's emotional experience" (Robinson and Clore, 2002).

An alternative way to measure emotions is to observe behavior and conclude from it on the experienced emotions. Based on the theory of action tendencies, this seems a good measurement for emotions that have a clear and observable tendency. But action tendencies do not always need to result in actions, some emotions do not have observable tendencies and some times different combinations of tendencies can result in the same observable action. Thus to conclude from behavior on the experienced emotion, is only possible in a highly controlled environment.

Facial expressions of emotions seem to be universal, hard to imitate and closely related to specific emotions (Ekman, 1993). Therefore facial expressions are often used to measure emotions. The problems with such measures are that culture and norms can suppress the facial expression of emotions (in experiments subject are sometimes secretly filmed to make them believe that they are unobserved and to avoid the suppression of facial expressions) and that only some emotions are clearly characterized through facial expressions. A refined method of using the uniqueness of facial reactions, is to measure activation of certain facial muscles (Cacioppo et al., 1993). Such measures are sensitive to muscle activity even when observable facial expressions are not present.[4] However, this measurement technique, as other physiological measures,

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[4]There are two facial muscles which are important in measuring emotions: the corrugator supercilii (above the brow, used in frowning) and the zygomaticus major (around the edges of the mouth, which

has the disadvantage of being costly, time consuming and more or less intrusive. Since electrodes have to be attached to the face of the subject, it is not a very natural situation and behavior might be influenced accordingly.

Physiological measurements, as for example skin conductance, blood pressure or heart rate, seem objective and reliable and are frequently used in psychological experiments. All of these measures are mainly able to register arousal. As we have seen from the circumplex model (Figure 2.4), arousal is only one of (at least) two dimensions that define emotions. Further, also concentration and cognitive effort might result in changes in physiological measures.

Therefore, the more a measure relies on "objective", physiological techniques, the less this measure can be influenced by the subject but the less information the researchers gain about the specific emotion that was experienced. If we want to know which was the precise emotions that was experienced, a combination of these techniques might result in the best results, that is, in an objective but nevertheless informative measure.

Finally, neuroscience has lately made huge advances in analyzing how brain activities are related to emotional experience. These methods are not only very costly to use, but so far it is often not possible to conclude solely from the activation of certain brain regions to the emotional experience.

Since all measures can be biased, we additionally need to take the external situation of the agent into account, that is, the circumstances under which the emotion was caused. Much care is required for this, since emotions can be influenced by many different external and internal causes, which might not all be known to the observer. Mood, feelings and emotions can be influenced by personal traits and dispositions as well as by characteristics of the society and situation. Thus traits as well as norms influence when and what kind of moods and emotions are experienced. They restrict the public display of emotions but also influence which situations elicit emotions and how people react to emotions.

Because we are interested in the influences of specific emotions, we will use in the experiments of this thesis self-reports and to some degree physiological measures of arousal.

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is used in smiling). The activity of the corrugator supercilii increases when experiencing negative emotions. The activity of the zygomaticus major increases when experiencing positive emotions.

Chapter 3

Economics and Emotions

At first sight and for many economists, emotions do not fit in a theory of economic behavior. But looking back at the development of economics this has not always been the case. Adam Smith in his "Theory of Moral Sentiments" stressed the importance of emotions:

> When we are about to act, the eagerness of passion will seldom allow us to consider what we are doing with the candor of an indifferent person. The violent emotions which at that time agitate us, discolor our view of things, even when we are endeavoring to place ourselves in the situation of another, and to regard the objects that interest us in the light in which they will naturally appear to him. When the action is over, indeed, and the passions which prompted it have subsided, we can enter more coolly into the sentiments of the indifferent spectator. What before interested us is now become almost as indifferent to us as it always was to him, and we can now examine our own conduct with his candor and impartiality. This self-deceit, this fatal weakness of mankind, is the source of half the disorders of human life. (Smith, 1854, [2000], p.221)

However, notwithstanding his appreciation of the impact of affect on behavior, Adam Smith concludes that these effects are disruptive and a "fatal weakness of mankind". While the ancient theories of Plato and Aristotle suggest that emotions are not wholly bad, modern philosophy had largely adopted the view of the disruptive effects of emotions on rationality. Especially to Descartes has been attributed the assumption that man would be much better off if he could control his emotions. This assumption, together with the difficulties in quantifying, differentiating and measuring emotions, has long prevented them from being specifically included into neoclassical economic theory. Their importance for humans was (still) appreciated by many scientists, but rationality was considered as the main and driving force of economic agents.

The ignorance of how real humans do react in many economic situations was easy to maintain, as long as theories of behavior were based on theoretic assumptions. But
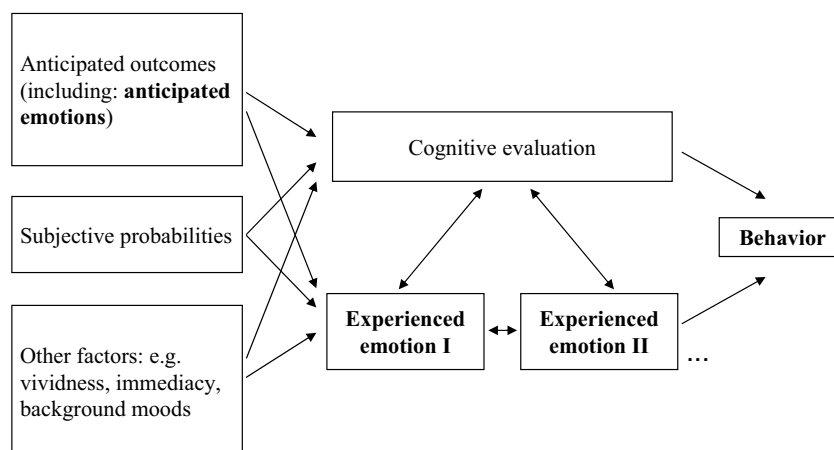
Figure 3.1: The dual impact of emotions on behavior (Loewenstein et al., 2001)

as soon as experiments became an essential part of economic research, non rational behavior turned up wherever economists were looking. As a result emotions found their way back into sociology, anthropology, social psychology and also economics (Elster, 1998; Loewenstein, 2000; Kahneman, 2003; Frijda et al., 2004).

If at all considered, the most common approach is to include emotions, feelings and the well-being of a person, in the individuals utility function. It seems straightforward that desirable and undesirable states in addition to monetary payoffs, get included in the calculation of the expected utility of a situation. Even though straightforward, this approach does cover only half of the picture of the impact of emotions. As we have seen in Section 2.3, emotions alter our memory and our cognition at the very moment we experience them. Therefore a complete theory should account for two levels of possible impact:

1. The impact of emotions on behavior, cognition and memory. This impact can only partially be controlled by the individual and might even be unconscious.

2. The cognitive appraisal of emotional states of the individual now and in the future, as well as the appraisal of the emotional reactions of others. This means the evaluation of present and future states in the light of the emotional "payoff".

This double impact of emotion is also summarized in the schematic model of the generation of behavior by Loewenstein et al. (2001) (see Figure 3.1).

The second of the two points seems to be much easier to analyze than the first. However we must be careful even with the supposedly rational evaluation of emotions. First, since rationality is usually stressed as the optimal behavior of agents, people might be reluctant to admit that they are taking emotions into account. Second, they might be not very good in making good predictions about emotions, even if they do.

There is evidence for the so-called "hot-cold empathy gap" which makes us overvalue the importance of situations that are similar to the situation we are in (Loewenstein, 2000). This is not only true for emotional states, but also for other "visceral factors".[1] People seem to be even worse in predicting emotional reactions in others. They predict, for example, a longer duration of negative affective reactions in others, than in themselves (Igou and Bless, 2002). To understand both the direct as well as the indirect effects of emotions, we have to measure experience and anticipation of emotions in economic situations.

We will now give a brief overview of some of the economic theories that have approached the challenge of emotions.

3.1 Emotions Affecting Utility

The assumption of rational anticipation of emotions, has been modelled for a variety of emotional states. Crucial for these models is that (1.) agents are able to predict their future emotional states and that (2.) the impact of these predictions on behavior is known.

As discussed above it seems questionable if humans are very good in predicting their future emotions. Nevertheless this is generally assumed to be true. Concerning the second assumption it is generally thought that the anticipation of emotions can be modelled as an additional factor influencing utility. To do so, the so called "valence" approach is usually adopted. Valence is related to how "positive" or "negative" the emotion is evaluated and can thus easily be related to the utility concept. Already Bentham (1789) assumed that pleasures and pains create positive and negative utility. However as we have seen earlier, emotions are characterized through many more then just this one dimension of "good" versus "bad". Thus a valence approach necessarily misses out on some of the main characteristics of emotions (Zeelenberg and Pieters, 2005).

Despite these problems, an inclusion of rational anticipation of emotional states is an important first step for modelling emotions. To name just a few, models have been formulated concerning regret (Bell, 1982; Loomes and Sugden, 1982), disappointment (Bell, 1985; Loomes and Sugden, 1986), anxiety (Caplin and Leahy, 2001; Wu, 1999), anger (Hirshleifer, 1987), envy (Kirchsteiger, 1994), positive affect (Hermalin and Isen, 2000) and others. We will come back to some of these models in later chapters when the specific emotions are discussed.

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[1]Visceral factors are: "a wide range of negative emotions (anger, fear), drive states (hunger, thirst, sexual desire), and feeling states (pain)".

Point of   Point of earliest
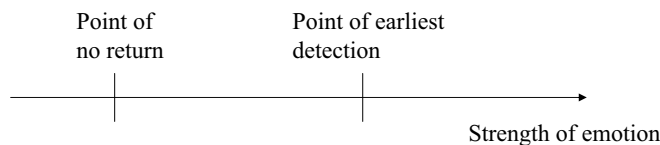no return   detection

Strength of emotion

Figure 3.2: The dilemma of the detection of emotions (Elster, 1999)

3.2   Emotions and Game Theory

Another way of looking at the strategic impact of emotions, is by including emotions in a game and considering their impact on possible strategies. Game theoretical discussions of emotions are related to evolutionary explanations of emotions, namely for which situations and through which mechanisms emotions increase fitness. In this context the impact of emotions can be roughly divided in two categories:

1. Emotions as a change of payoffs.

2. Emotions as a signaling mechanism.

The first is related to the above discussed inclusions of emotions in the utility function. Specifically psychological game theory considers emotions as a way to alter the payoff matrix of traditional games (Geanakoplos et al., 1989). This implies that emotions as shame or surprise can be included (negatively or positively) in the payoff matrix. Which in turn stresses the importance of expectations. For example the pleasure of surprising someone will depend on the expectations of the other person. Similarly if we do not want to disappoint others, we need to know about their expectations.

Signaling is a further important aspect of emotions. According to Frank (1988) "passions often serve our interests very well [...] because we face important problems that simply cannot be solved by rational action". One way how this can be achieved, is through emotions solving the commitment problem. Frank uses *commitment model* as: "shorthand for the notion that seemingly irrational behavior is sometimes explained by emotional predispositions that help solve commitment problems". Emotions can be regarded as one way of pre-committing to an action, "a behavioral predisposition, in economic terms, is thus much like a tax on not behaving in a particular way". Therefore emotions can force partners to certain "non-rational", but eventually advantageous behavior.

The idea is, that emotions can lead to a loss of control, where an agent does what he, in a "rational" state, would not be willing to do. This is related to the assumption that for strong emotions a *point of no return* exists which might happen before the emotion can be detected by the agent (see Figure 3.2).

3.3 Emotions in Economic Experiments

Most of the economic theories involving emotions, refer to psychological evidence. But: "by and large, psychological studies of the emotions have not focused on how emotions generate behavior" (Elster, 1998). The main focus of psychologists interested in emotions, has been how emotions are created and experienced. The challenge is thus, to develop experiments to test how the experience of emotions influences decision making.

Economic experiments concerned with the impact of emotions can vary in a number of ways. One difference is the elicitation of the emotion. This can be either done exogenously, for example through "mood induction" by movies, pictures or through the writing of essays. Alternatively, the emotions can be induced endogenously. This is the case when only emotions created by the specific situation are considered. It is not clear whether different mood induction mechanisms will result in the same behavior. Thus caution is required when from one kind of method conclusions are drawn considering another induction method.

Exogeneous mood induction has been used, for example in gift exchange games considering "happy" and "sad" moods (Kirchsteiger et al., 2005) or the effect of disgust and sadness on the endowment effect (Lerner et al., 2004). Situation-induced emotions were considered, for example, in a trading environment with real financial traders (Lo and Repin, 2002), in combination with delayed monetary rewards (McClure et al., 2004) or in two player games allowing for appropriation as for example the Power-to-Take game (Bosman and van Winden, 2002).

Furthermore emotions have to be measured. However measurement might itself either induce emotions or alter behavior. As we have discussed, a variety of measurement techniques is available, each with its specific advantages and disadvantages. In economic experiments self-reports, physiological measures as well as brain scans have been used. Dependent on the research question to be asked, different techniques might be appropriate. Generally it can be observed that it becomes more and more common to measure affective states in economic experiments. With this thesis we hope to add to this line of research by experimentally investigating a number of emotions in economically relevant situations.

Chapter 4

Anger and Reciprocity*

> "Try another Subtraction sum," [said the Red Queen].
> "Take a bone from a dog: what remains?"
> Alice considered. "The bone wouldn't remain, of course, if
> I took it - and the dog wouldn't remain: it would come to
> bite me - and I'm sure I shouldn't remain!"
> "Then you think nothing would remain?" said the Red
> Queen.
> "I think that's the answer."
> "Wrong, as usual," said the Red Queen: "the dog's temper
> would remain."
> "But I don't see how-"
> "Why, look here!" the Red Queen cried. "The dog would
> lose its temper, wouldn't it?"
> "Perhaps it would," Alice replied cautiously.
> "Then if the dog went away, its temper would remain!" the
> Red Queen exclaimed triumphantly.

Alice in Wonderland, (Carroll, 1865, [2005])

Anger is one of the emotions, most easily agreed on as being a basic emotion. Of
the emotions that are considered as more or less basic, anger is also one of the most
important for social interactions and a highly moral emotion (Haidt, 2003). First the
elicitation of anger is always related to the actions of another "agent". If we get angry
at the stone on which we were hurting our toes, this is mostly because we also ascribe
some kind of agency to the stone (Ben-Ze'ev, 2000). Second anger was found to be
primarily related to the appraisals of unfairness and immorality, and this more so than
to goal obstruction and unpleasantness (Scherer, 1997).

Anger and the avoidance of anger is part of almost any human interaction and con-

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sequently of major interest to economists when analyzing multiple player interaction. A better understanding of anger might help us explain, for example how and why cooperative behavior exists. Since anger might lead to a loss of control, its anticipation in others might lead to "nice" behavior. Which points out again the difficulty of defining what we should call a positive or negative emotion. Anger is often seen as a negative emotion since it is unpleasant to the individual experiencing it. But eventually it might be a very "positive" emotion, by increasing respect and consideration for others.

The relation of self-reported anger to reciprocity has already been observed in games where players can react to unfair behavior (Bosman and van Winden, 2002). Other studies have turned to using functional neuroimaging to study motivations for reciprocation of unfairness (Sanfey et al., 2003; Quervain et al., 2004). However, as we have seen earlier (see Section 2.5), any measure of emotions has its problems. Therefore, it seems important to explore complementary techniques, which can be used for investigating decision-making in social interaction. Focusing on emotions, a combination of physiological and self-report measures seems very promising (Winkielman and Berridge, 2004). These more conventional measures have been validated and are relatively well understood by psychologists. Additionally their comparative low costs and their ease in usage make them very interesting for economic experiments. In this chapter we will apply both, physiological measures and self-reports, to investigate the emotional basis of reciprocity in bargaining, using the Power-to-Take game (Bosman and van Winden, 2002).

4.1   What is Anger?

Despite the dispute regarding what is and should be considered as a basic emotion, anger and anger-like emotions are part of almost all of the existing proposals of basic emotions (Ortony et al., 1988). It seems that anger is indeed one the most widely known emotional experiences which is not only present in humans but also other animals (Darwin, 1872, [1998]). This of course does not imply that anger is elicited in humans and animals by the same situations. Anger emotions are elicited when "(disapproving of) someone else's blameworthy action and (being displeased about) the related undesirable event" (Ortony et al., 1988). What is considered as a blameworthy action will clearly depend on personal differences but also on cultural norms and expectations about behavior. Also whether an event is considered as undesirable will depend on expectations and experience. Once anger has been elicited, the intensity of the experienced emotion will depend on the following three variables (Ortony et al., 1988):

1. The degree of judged blameworthiness.

2. Deviation of the agent's action from person/role-based expectations.

3. The degree to which the event is undesirable.

Anger, though global in nature, may thus be experienced very differently across cultures and even more so across species.

The action tendency of anger is to attack, to approach and to undo the undesirable event. According to Frijda et al. (1989) anger is associated with the desire to change the situation and for "moving against" someone or something. This action tendency to attack and approach can also be found in the physiological activation during anger. Anger is for example associated with the activation of the anterior cingulate, a pattern which is also related to approach, attention and goal-directed behavior (Elliott and Dolan, 2003). Further, anger has been found to be related to increased heart rate in combination with high skin temperature (Ekman et al., 1983).

It is important to note that the action tendency need not result in actual attack. The display of and reaction to anger varies significantly dependent on culture and education. While some cultures see the display of anger as a way of negotiation (e.g. in most of western cultures) it is considered as a loss of face in others (e.g. Japan) (Tavris, 1982, p.67).

The impact of anger has been modelled game theoretically by Hirshleifer (1987). Experiencing anger implies in this model that an actor is going to react to an unequal distribution of wealth by another agent, through destruction of resources for both actors. Similarly the model of "loss of temper" by Morrison (1996) assumes that there is a certain possibility that your partner is not rational and might loose his temper in a game. In such a situation it can be shown that equilibria exist where you are nice to your partner to avoid the possibility of him getting angry.

4.2 Anger in the Power-to-Take Game

In the two-person Power-to-Take game, which is played only once and anonymously, both players receive equal endowments. One player (the take authority) has to decide first on how much money to take from the other player (the responder), that is, the take rate. Subsequently, after observing this take rate, responders have the option of destroying any percentage (from 0% to 100%) of their *own* money. The money that is left after this destruction, together with the take rate, determines how much the take authority appropriates and what remains for the responder. Note that, for take rates greater than zero, the take authority will always end up with greater earnings than the responder. Consequently the Power-to-Take game is a stark setting for reciprocity, a simple but realistic representation of many forms of social interaction involving appropriation[1].

Standard economic theory predicts that responders will never destroy anything if the take rate is less than 100% because any destruction would leave them with less money, and more money is assumed to be preferable to less. However, substantial

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[1]For further discussion and applications, see (Bosman and van Winden, 2002).

punishment through destruction has been observed in experiments[2]. Moreover, as already noted, destruction has been found to be strongly correlated with the experienced intensity of anger-type emotions as reported by responders (Bosman and van Winden, 2002). Interestingly, in Power-to-Take game experiments, emotional intensity has also been found to be related to the difference between the actual and the *expected* take rate, in line with the psychological observation that unexpectedness and disappointment are important triggers of emotions (Frijda, 1986; Ortony et al., 1988). In this study we used a physiological measure (skin conductance level) correlated with emotional arousal to shed more light on the relationships between destruction, expectations, and experienced emotions (Winton et al., 1984). In addition, self-reports were used to investigate the correspondence between the physiological and behavioral measures. Because of the ease and low costs of using self-reports, and because of the information they can provide on the types of emotions involved, a clear correspondence between the two measures would be important for stimulating research on the role of emotions in interactive behavior. In this respect, our work is also relevant to the study of emotions more generally. Moreover, self-reports seem to be the only way to get (direct) access to the expectations of subjects.

4.3   Design and Procedures

The game we are using is a simplified version of the Power-to-Take game (Bosman and van Winden, 2002). In this game one of the players - the "take authority" - is endowed with an initial income Y_{take} and the other player - the "responder" - with an initial income Y_{resp} (in the experiment, $Y_{take} = Y_{resp}$). The game is played once and consists of two stages. In the first, the randomly chosen take authority decides on a take rate t of either 20 or 80 percent of the responder's money Y_{resp}, which will be transferred to the take authority[3]. In the second stage, after being informed of the take rate t, the responder has to decide on a destruction rate d, which is the percentage of Y_{resp} that the responder destroys. After the destruction decision, the percentage t claimed by the take authority is transferred. Thus for the take authority the total payoff of the game is $Y_{take} + t(1-d)Y_{resp}$. For the responder, the total payoff equals $(1-t)(1-d)Y_{resp}$.

  In this game the responder can only destroy his or her own initial income (Y_{resp}) and not the initial income of the take authority (Y_{take}). Therefore the responder will earn at most $0.8 \times Y_{resp}$, while the take authority gets at least Y_{take}.

  Our experiment combined two methods of measuring emotions. First, as in Bosman and van Winden (2002), we measured emotions after the second stage of the game, when responders have taken their destruction decisions, by offering them a (paper and

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[2]Many other observations of costly punishment in economic games exist (Camerer, 2003; Fehr and Gaechter, 2002).

[3]In the game by Bosman and van Winden, the take rate could be chosen continuously out of the range [0,100]. Due to restrictions imposed by the physiological measurements, only a few data points could be collected per session and therefore the take authority's decision was restricted to a binary choice.

pencil) questionnaire with a list of emotion names (fear, jealousy, anger, sorrow, happiness, shame, rage, contempt, joy, surprise and frustration; see Appendix 4.B). Subjects were asked to indicate on a 7-point scale the intensity of each emotion as felt when they were informed about the take rate (with 1 on the scale representing "the emotion was not present at all", and 7 representing "the emotion was strongly present"). The second method was based on a measure of emotional arousal of the responder during the experiment. Specifically, skin conductance level (SCL) was continuously monitored throughout the experiment. SCL reflects emotional arousal and can therefore be used as a measure of emotional reaction to the take authority's decision. SCL is usually not controlled by the subject and in this respect can be considered more reliable and objective than self-reports. In contrast with self-reports, however, it cannot provide specific information about the content of the experienced emotions because it only measures the level of arousal. In our experiment, each session consisted of two pairs of subjects, that is, four players, one of which (a responder) was connected to the SC-device[4].

The experiment was conducted in the Laboratory of Cognitive Psychophysiology, at the Hebrew University of Jerusalem. Subjects were recruited via advertisements promising monetary reward and academic credit. In total, 99 sessions were conducted with four subjects participating in each session. Subjects were seated in four separate rooms, each of which was equipped with a computer, writing utensils, blank paper and a calculator. All computers were networked with a central master computer in the experimenter's office.

Upon entrance, each of the four subjects chose an envelope containing a 10 NIS (approximately \$2.25) show-up fee and a number that assigned the subject to one of four separate rooms. Each subject was given written instructions, which indicated that 100 points would be allotted to each subject as initial income, with each point being equivalent to 0.5 NIS (see Appendix 4.A for an English translation of the instructions). In addition, each room's door was left slightly open, and the experimenter read the instructions aloud while standing in the central hallway of the lab. Subsequently, the experimenter entered each room to answer questions and check a short quiz the subjects were asked to fill out.

Then one of the four subjects (always in the role of responder) was connected to the electrodes and given an explanation regarding the electrodermal measurement. The SCL was continuously monitored throughout the experiment by the master computer[5]. Following a two-minute rest period, the "start" page of the experiment appeared on all the subjects' computer screens and the experiment began (Figure 4.1).

At the first stage of the game, the computer screen offered each take authority the

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[4]Technical problems in some cases made it impossible to collect SC data. Furthermore, in some of the many sessions not all participants showed up, which made it necessary to use stand-ins. These subjects were never involved in the pairs from which the responder's SC was measured. To exclude any potential influence of advance knowledge, the data of these subjects were not considered in the analysis.

[5]Skin conductance was measured by a constant voltage system (0.5 V Atlas Researches) and two Ag/AgCl electrodes (0.8 cm diameter) were used with a 0.05 M NaCl electrolyte (Ben-Shakhar and Gati, 2003).
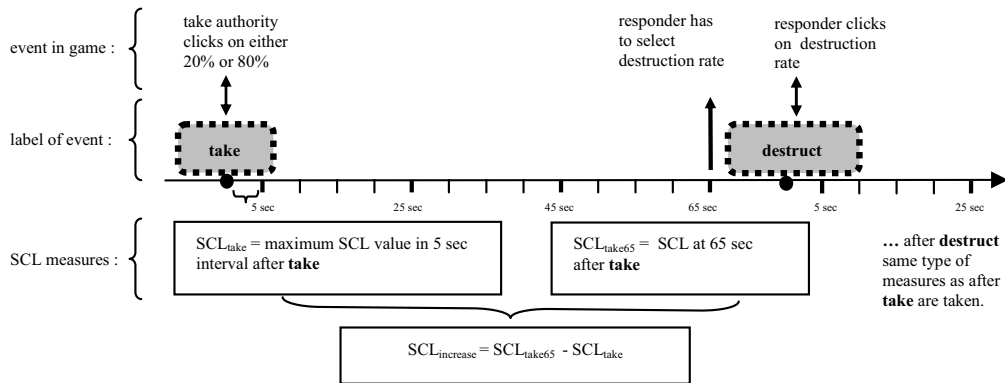
Figure 4.1: Order of SCL measures in the experiment. After the take and destroy event, respectively, four SCL measures were taken: the maximum SCL in the 5 sec. following the event and the SCL at 25, 45 and 65 sec. following the event.

option to claim either 20% or 80% of the responder's income in points. Each responder was immediately informed of their respective counterpart's decision. In the analysis this point in time was labelled *take*.

Sixty-five seconds after *take*, responders were given the opportunity to destroy any percentage of their own income (on a scale ranging from 0% to 100%) by typing the appropriate number on the keyboard. In the analysis the moment when the participant clicked on the percentage to be destroyed was labelled *destruct*.

During the 65 seconds following *take*, a timer appeared on the screen counting down the seconds, so that participants were well aware of the time they had to wait before being able to make their destruction decision.

Following the 65 seconds after *destruct*, all four players were presented with a screen informing them how much money (in points) they were left with.

At the end of the experiment, each of the two subjects in the role of responder was asked to fill out an emotion questionnaire. All subjects filled out an anonymous biographical data questionnaire. Then an experimenter entered each room separately and handed the subject an envelope containing his or her earnings (average experimental earnings were 47.20 NIS[6]). Subjects received a short oral debriefing from the experimenter and were asked to maintain confidentiality regarding the experiment.

In total, 358 subjects participated in the experiment, mostly undergraduate students at the Hebrew University (average age of 23 years). Of the participants 37% were male and 63% female; while 24% were students of either business or economics, the others came from a variety of fields.

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[6]The total average payment of 57 NIS (including the show-up fee) equaled approximately $13.

4.4 Results

Behavioral results regarding take rates and the percentage of responders who destroyed something, replicated earlier findings, except that the mean destruction rate was somewhat lower[7] (Figure 4.2). The take rate of 80 (20) was chosen 64.4% (35.5%) of the time, rendering a mean take rate of 58.6 percent. The mean destruction rates were 4.89% and 15.15% for take rates of 20 and 80, respectively, and overall 27.3% of the responders destroyed something.

Differences in destruction rates between SC and non-SC responders were small and not statistically significant (Mann-Whitney, $p > 0.790$). Similarly, no statistically significant differences in self-reported emotions were found between these two groups, suggesting that the application of the SC-device as such did not influence behavior. Therefore, from now on we will focus on the results only for responders connected to the SC-device[8].

We started our analysis using the following two variables as physiological measures: SCL_{take}, representing the maximum skin conductance level during the five-second interval after *take*, and $SCL_{increase}$, which stands for the difference between the skin conductance level measured at 65 seconds after *take* and SCL_{take}. $SCL_{increase}$ shows the change in arousal level of the responder in the one-minute waiting period before the destruction decision had to be typed in on the computer. First, we compared the average SCL values, taken during the two-minute rest period before the start of the game, of responders who destroyed money with those who did not (Figure 4.3), and found that the two groups had very similar levels of SCL during rest. However, once the take rate had been announced, a strikingly different pattern of physiological response emerged for these two groups. Initially, as indicated by SCL_{take}, a somewhat higher level was observed for subjects who did not destroy anything - which is also the case if we consider only subjects who faced a take rate of 80 - but these differences were not statistically significant (Mann-Whitney, $p > 0.685$). Following this initial increase, non-destroyers showed a continuously decreasing arousal level over the one-minute waiting period before they had to make their destruction decision, until it almost returned to the rest period base-rate. In sharp contrast, the arousal level of destroyers monotonically increased during the very same period. The difference between these two SCL patterns, which was measured by $SCL_{increase}$, was statistically significant (Mann-Whitney, $p = 0.005$). This qualitative difference in arousal pattern may be explained by a difference in the timing of the mental decision to destroy something. We suggest that whereas non-destroyers make their decision early on, destroyers delay their destruction decision and make it sometime during the waiting period. The decrease in SCL of non-destroyers during the waiting period reflects the fact that they had already made up their mind at that point. On the other hand, the increase in arousal

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[7]This may be due to the imposed binary choice of the take authority (Falk et al., 2003).

[8]These results are not qualitatively affected by the exclusion of the few subjects who reported that parts of the experiment were unclear or for whom the SC level deviated significantly from that of the others.
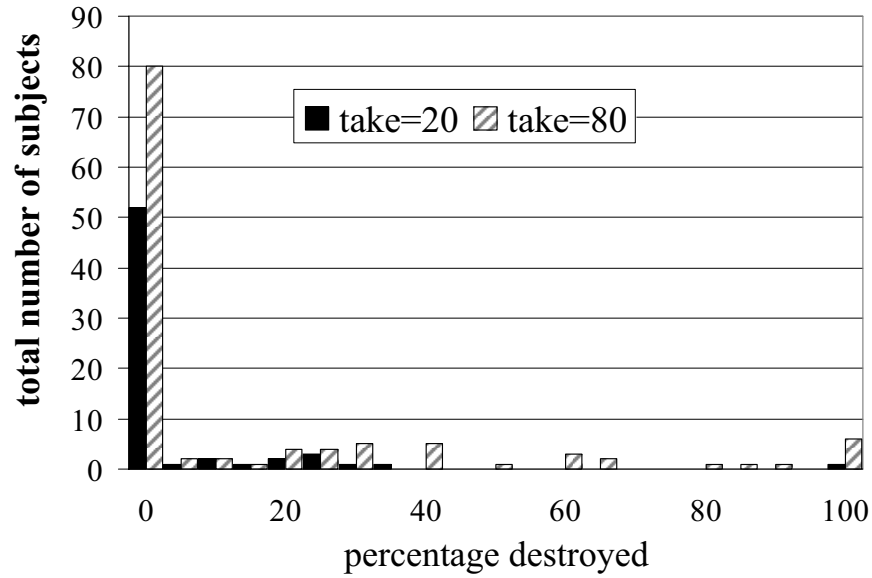
Figure 4.2: Histogram of the destruction rates for all responders - split over take rates.
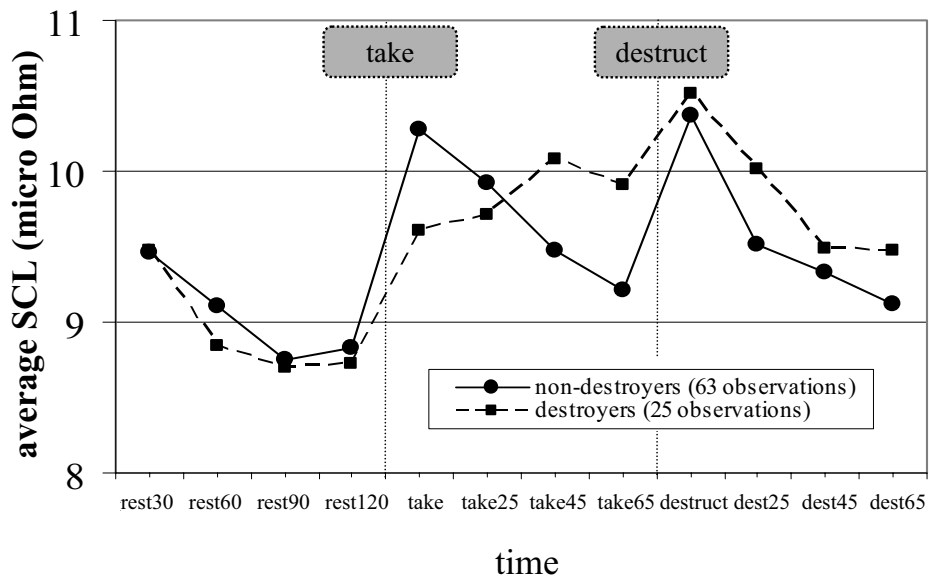
Figure 4.3: Timeline of SCL, for all responders connected to electrodes for measuring SC - split over destruction decision.
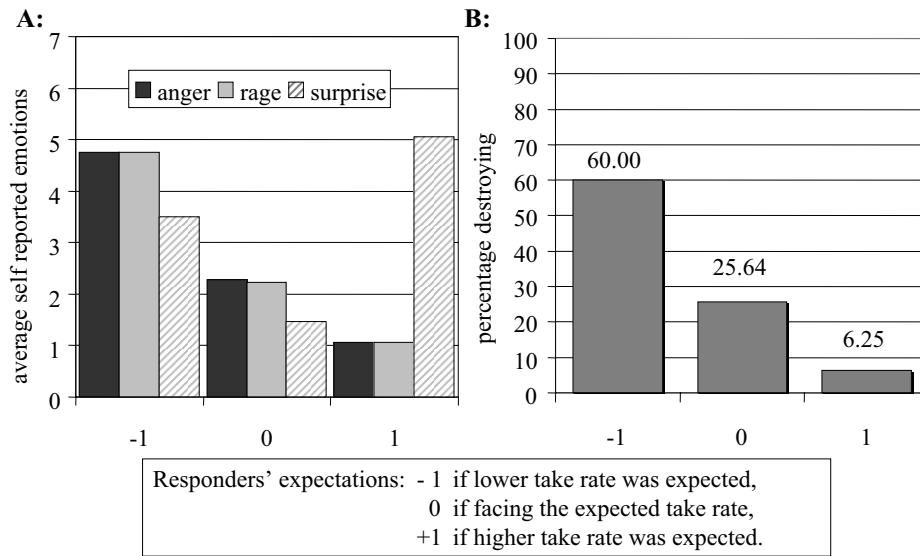
Figure 4.4: Influence of players' expectations. A: Average self-reported emotion values dependent on expectations. B: Percentage of players destroying something, dependent on expectations.

level observed for destroyers during the waiting period reflects the conflict they experienced between the (cognitive) interest to earn as much money as possible and the (emotional) urge to punish the take authority. It has been noted that such conflicts are associated with high arousal (Greene et al., 2001; Sanfey et al., 2003).

Once the game had ended, the difference in electrodermal level between destroyers and non-destroyers disappeared again. At first, both groups showed an increased SCL after their formal and irrevocable destruction decision, but then their SCL decreased (with destroyers staying at a slightly higher level). At the end of the one-minute waiting period following this decision, non-destroyers had once again returned to their baseline SCL.

Turning to the self-reported emotions, we first note that the mean score on the 7-point scale for any given emotion never exceeded 3. Also, the variances of the intensity scores were smaller than in previous findings[9]. Therefore the emotion scores were split into high and low values (with the median as the cutoff point). Consistent with earlier findings, destroyers reported significantly more anger than non-destroyers (Pearson chi-square, $p = 0.045$). For other emotions no statistically significant differences were found. However, anger, rage, and contempt produced significant intercorrelations ($p = 0.001$).

Our results, which are consistent with previous findings, suggest that destruction is related to negative emotions and frustrated expectations (when the actual take rate is

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[9]Again, this may be due to the restricted choice for the take authorities, but it may also be related to cultural differences (Manstead and Fischer, 2002).

higher than the expected take rate). Responders were asked after the game, which take rate they had expected[10], and subjects who expected a take rate lower than the actual take rate reported significantly more anger and rage (Figure 4.4:A)[11]. In addition, subjects whose expectations were not confirmed were significantly more surprised than subjects who had their expectations confirmed (Pearson chi-square, $p < 0.001$). Furthermore, destruction turned out to be significantly related to the actual take rate being higher than the expected take rate (Pearson chi-square, $p = 0.039$; see Figure 4.4:B).

Having found that both the physiological and the self-reported emotion measures were associated with destruction, we examined the relationship between the two types of measures. Interestingly, the intuitive hypothesis that negative emotions should be associated with high arousal immediately after observing the take rate was not confirmed. However, this hypothesis overlooks the fact that arousal can result from being pleasantly surprised when observing a lower than expected take rate. Finally, the experienced anger was related to $SCL_{increase}$. Specifically, subjects experiencing higher levels of anger also showed higher levels of $SCL_{increase}$ (Mann-Whitney, $p = 0.064$; $p = 0.029$ if restricted to a take rate of 80).

4.5 Conclusions

In this chapter we investigated the role of emotions and especially anger in the seemingly irrational decision to destroy one's own resources in the one-shot Power-to-Take game. Physiological measures of emotional arousal as well as self-report measures of emotional responses were employed. Since appropriation and reciprocity are social phenomena of major importance for all behavioral scientists, a better understanding of the role emotions play in reciprocative behavior should be of wide concern. Both of the measurement methods we used provided evidence for the role of anger-like emotions as well as frustrated expectations in the decision to punish through destruction. Moreover, the correlations between self-report measures of anger and the physiological measures provide further justification for the use of self-reports in the study of reciprocity.

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[10]Expected and actual take rates were not significantly correlated (Pearson chi-square, $p = 0.540$).

[11]Since not all subjects replied that they had an expectation of either 20% or 80%, our dataset for these observations is smaller.

Appendix 4.A   Instructions

Written Instructions (translation)

Welcome, this is an experiment in decision making. During the experiment, you will be asked to make decisions and so will the other participants. Your choice as well as the other participants' choices, will determine the sum of money you receive, according to the rules which will be explained shortly. The money will be paid to you in cash at the end of the experiment exactly according to the rules. You are asked to remain seated quietly during the experiment. If you have questions, please wait in your room and an experimenter will enter and answer them.

Four people are participating in the experiment (you and 3 others). The participants will be divided randomly into 2 pairs. Each participant in each pair will have an initial sum of 100 points (with every point worth half a NIS), that is, a 50 NIS sum for each participant.

In each pair, one player will be randomly assigned to be player A and the other player will be assigned to be player B. Player B can take a certain percentage of player A's money. Player B should decide whether to take 20% or 80% of player A's money. Player B cannot choose not to take any of player A's money, nor can he/she take all of player A's money. After player A is notified via the computer about player B's choice, player A can decide to destroy any percentage he/she chooses of his/her own money.

For example, if player B chooses to take 80% of player A's money, and player A decides to destroy 50% of his/her points, then player B would get 40 points of player A's money (in addition to the initial 100 points he/she was given at the beginning of the experiment), and player A would be left with 10 points.

Another example: if player B chooses to take 20% of player A's money, and player A decides to destroy all of his/her points, then player B would not get any of player A's money and would have only the initial 100 points, and player A would be left with no points.

Note: the game will be played only once, and there is only one decision to be made, so please consider your decision carefully.

After the experiment, participants will be given feedback about the overall sum of points they gained and these points will be converted into money, at the rate of one point = 0.5 NIS.

[A short quiz with 4 examples of possible decision scenarios was included. To make sure that the subjects understood the rules, each subject had to calculate the number of points each player would end up with.]

Appendix 4.B   Emotion Measures

We ask you to think back to the moment when you learned about the percentage chosen by participant A. We ask you to report the intensity of each emotion that you experienced.

	not at all				**very intensely**		
Fear	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Jealousy	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Anger	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sorrow	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Happiness	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Shame	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rage	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Contempt	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Joy	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Surprise	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Frustration	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Chapter 5

Envy and Fairness[*]

> *There's bad envy, which is when your friend has a bicycle and you don't, and you hope he breaks his neck going down a hill, and there's good envy, which is when you want a bike like his and work your butt off to be able to buy one, even a used one, and it's good envy that makes the world go round. And then there's another envy, which is justice envy, which is when you can't see any reason why a few people have everything and others are dying of hunger.*
>
> The mysterious flame of queen Loana (Eco, 2005)

In the previous chapter we have seen how unfairness induces anger and how this anger can influence people to reciprocate unfairness and to punish. In this chapter we will discuss the relation of such anger induced behavior to the "social" concept of envy and jealousy. These emotions are often mentioned in discussions of situations that allow for punishment. But rarely the use of "jealousy" and "envy" is based on psychological evidence of these two emotions. In the following we will present the two emotions, show that they should not be confused with reactions to unfairness and argue that behavioral consequences can be negative as well as positive.

5.1 What is Envy?

A discussion of the social emotions envy and jealousy, must start with the language. Envy and jealousy are especially tricky in this context, since they are often used as equivalents. This especially being true for the English language, where *jealousy* can be used as describing *envy*. However *envy* can usually not be used to describe *jealousy*. The two emotions are though two different concepts, which are closely related.

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[*]This chapter is based on: Hopfensitz (2005). Eifersucht: Eine Leidenschaft die Leiden schafft? In Blümle, G., editor, Kulturelle Ökonomik. LIT-Verlag.

In contrast to such basic emotions as anger or happiness, the experience of envy and jealousy is much more complex. These emotions are sometimes seen as referring to an emotion complex, which might include for example the primary emotions anger, sadness and fear (Sharpsteen, 1991). The specific combination of the experienced states is culturally different and the temporal pattern might vary. Further the involved primary emotions might be elicited and felt at the same time or consecutively, dependent on the phase of the "envy experience".

Since the actual experience can be subject to strong variations, a better approach might be to define the emotion through its triggers:

> Jealousy is not a mixture of anger and grief [...]. It is not a mixture at all. The emotion of jealousy consists of action readiness change - any action readiness change implying non-acceptance - elicited by a specific constellation of events, a specific "story," as Ekman phrases it. That story defines the emotion: it is that someone else enjoys something I have a claim to enjoyment upon, and which event is felt to interfere with satisfaction of this claim. Many different forms of action readiness change can spring from this constellation: mere upset, or excitement, or stupefaction; or the apathy of grief; or the impulse to undo the event, the impulse of anger. (Frijda, 1986, p.72)

The intensity of the "felt" emotion, is for envy as well as jealousy influenced by a series of factors. In the general structure of emotions by Ortony et al. (1988) the following four factors are mentioned:

1. The degree to which the desirable event for the other person is undesirable for oneself.

2. The degree to which the event is presumed to be desirable for the other person.

3. The degree to which the other person did not deserve the event.

4. The degree to which the other person is not liked.

To which degree each of these categories is fulfilled, defines the felt intensity of envy and jealousy. While this definition equally holds for envy and jealousy, it is necessary to point out the differences between the two emotions. Envy is usually related to the material advantage of someone else, jealousy mostly refers to romantic relationships (Ben-Ze'ev, 2000). "Romantic jealousy" is referring to a situation in which the loss of a loved person is feared. Jealousy exists though in general, when a third persons enters a relationship, that the jealous person wants to limit to himself. This form of jealousy is sometimes called "non-romantic jealousy" or "platonic jealousy" (Hill and Davis, 2000). This can be, for example, the jealousy concerning a colleague that has an exceptionally good relationship to a supervisor. The difference between jealousy

and envy is therefore the social relationship that is involved in the experience and elicitation of jealousy. Further jealousy is often experienced concerning a "loss", while envy can be experienced when no direct loss is feared but a "disadvantage". While jealousy is a purely social emotion in the sense that it stems from a disappointment over denied social contacts, envy is related to a distribution of goods. In many cases both emotions are elicited at the same time, which makes a separate analysis hard. Especially it seems true, that jealousy is often accompanied by the feeling of envy (Smith et al., 1988). Because of it's concentration on material differences, the impact of envy is more evident in many economic situations. We summarize that envy and jealousy are elicited in different situations: jealousy mainly concerning social relationships, and envy concerning an unequal distribution of assets. Because both emotions are based on a situation in which someone else's good fortune is threatening to the individual, their intensity is defined by the same (above defined) factors.

For a better understanding of the impact of emotions on behavior it is often necessary to be aware of their origin. When we know about the evolutionary advantage of a specific emotion, we can also conclude on the impact of this emotion on modern man.

The evolutionary origin of jealousy is not only a hot topic for glossy magazines, but also for psychologists. It is assumed that jealousy is an evolutionary mechanism, that increased the fitness of the individual experiencing the emotion. This advantage is often linked to the assumed gender differences in the experience of jealousy. This assumption is based on the belief that jealousy was developed by men, to avoid raising children that are not their own, while jealousy was used by women to secure their material protection. In many cases gender differences of jealousy are quoted as a prime example of an evolutionary formed behavior (Pinker, 1997). However a critical review of the empirical data, has shown that there does not exist any real evidence for gender differences (Harris, 2003).

Consistent with appraisal theory, evidence confirms though, that the experience of jealousy is dependent on culture. Since jealousy is always elicited when an important aspect of a social relationship is threatened, jealousy is elicited in different cultures by different behavior (Bryson, 1991; Parrott, 1991). Differences in the experience of jealousy are therefore mainly culturally and not gender dependent. Jealousy is a mechanism that brings our attention to areas that are necessary for our survival. Interestingly jealousy can already be observed for young infants (Hart and Carrington, 2002). In contrast, the expression of envy develops during childhood. In a recent experiment it was shown that children younger than four, did not show envy when another child received more of a desired product (in this case stickers) (Haidt, 2004). While young children also observed the difference only older children perceived the "unfairness" and started to complain. Later in development, norms and rules of behavior start to prevent the open expression and reaction to envy, which obscures the expression but not the experience of the emotion. The difference between envy and jealousy lies probably in the fact that the emotional tie to the mother is especially important for babies, while the comparison of possessions required for envy is not essential in early life.

Further it is interesting to note, that envy and jealousy do not only exist in humans. Also other animals do experience and react to these emotions. Evidence comes from an experiment in which cappuchine monkeys were rewarded with a price when showing a certain behavior (Brosnan and de Waal, 2003). Under normal circumstances the monkeys did as they were asked to, and received and accepted the price. This behavior changed dramatically when another monkey, separated, but still visible in another cage, received a "better" price. Obviously the monkeys regarded this behavior as unjust and reacted by refusing the food that was presented to them or by abstaining from fulfilling the expected behavior. This experiment nicely shows, that cappuchine monkeys recognize unfairness and react to it, even if the reaction is disadvantageous for them. This is a behavioral pattern strikingly similar to the human envy reaction. These results were further validated by a replication of the above experiment with chimpansees (de Waal, 2004). Here the same envy-like behavior was observed, but only when the animals did not know each other. Therefore the relation to the other seems to be essential part of the expressed behavior.

We conclude that envy does not only exist in homo sapiens. While he is suffering from envy and jealousy, Homo Economicus stays mostly unaffected. So at least in traditional utility models in which utility is solely seen as a function of own income. This is changed though when also social factors are considered.

5.2   Economic Models

For models of the impact of jealousy and envy, it is usually assumed that due to the ego threat, action tendencies will focus on reestablishing the ego. Which behavior will be elicited depends on the specific situation eliciting the emotion.

As we have discussed before, the own payoff based utility function has been extended to models that include among others altruism and intentions (Rabin, 1993; Ledyard, 1995). Some of these models explicitly concentrate on behavior induced by jealousy and envy. Since jealousy is crucially dependent on the social link between actors this would need to be considered for a model of jealousy. For example it has been observed that the structure of the social network influences experienced jealousy. In a study of American children, it was shown that jealous children had a more exclusive social network (Parker et al., 2002). Meaning that members of friendship circles that had many friends outside their group, experienced in general less jealousy. It is therefore necessary to be aware of the relationship structure of the involved participants, to predict the impact of jealousy in a specific situation.

Envy, which in contrast to jealousy depends on material differences, has been mathematically modelled as a function of these differences. Due to its categorization as a negative emotion, envy is usually assumed to decrease utility. The resulting impact on behavior can be seen as a useful or as a destructive force, dependent on the individual model. Brennan (1973) points out, that those experiencing envy can (while acting selfish) facilitate redistribution of the goods of the rich, since doing so will increase

their own utility. He concludes that: "All in all, it does appear as if malice and envy may not be wholly unmitigated evils - which is perhaps reassuring, since they do seem to exist in some abundance" (Brennan, 1973). Similarly Elster (1991) mentions that the prediction of envy can keep humans from seeking superiority, since this will avoid the elicitation of envy. However it is wrong to conclude that envy is always the trigger that leads to equalization of income. Because "A society that equalizes incomes might reduce envy, without having sought that goal" (Elster, 1991) .

In organizational behavior, where emotions have been neglected for long (Muchinsky, 2000), envy and jealousy are now also recognized as important forces. The so called "stress management", which is concerned with causes and consequences of stress at the work place, is becoming aware of the consequences of envy (Vecchio, 2000). According to surveys among employees, many experience envy at work and at the same time report that supervisors fail to react to it. Envy and jealousy also have a negative impact on work related self confidence (Pierce and Gardner, 2004). In a study among American employees it was shown that the feeling of jealousy is positively correlated with the probability of quitting the job (Vecchio, 2000). The emotions can further lead to aggression, stress and general dissatisfaction. A certain degree of competition can lead to productivity increases, however this requires a solid basis of solidarity and cooperation among employees (Dogan and Vecchio, 2001).

Formally the impact of jealousy has been modelled by Kirchsteiger (1994). In this model it is assumed that the utility of each player is not only dependent on his own income, but also on the income of another person. This is expressed by:

$$u = u(x, y), u_x > 0, u_y < 0$$

Where x and y represent the share of each player of a common pie. And $u(x, y)$ represents the utility function of the player with income x. The assumption that experienced envy might be decreasing with own income, can then for example be expressed as:

$$u(x, y) = x - e(x) \times y$$

Where $e(\cdot)$ is the "envy function", for which it must hold that:

$$e'(m) < 0, \qquad e(m) > 0 \qquad \forall m \geq 0$$

This means, that the decrease in utility by envy, is decreasing when income is rising, but will always stay positive. Similarly the model of inequality aversion (Fehr and Schmidt, 1999) is sometimes interpreted as representing the emotions of envy and guilt. In this model, utility does not only depend on own income, but additionally on positive and negative deviation of other peoples income from own income. The two parameters that are used to define the change in utility, can be interpreted as envy (positive income deviation) and guilt (negative income deviation). The utility for individual

i is defined as:

$$u_i = x_i - \frac{\alpha_i}{n-1} \sum_{j \neq i} \max(x_j - x_i, 0) - \frac{\beta_i}{n-1} \sum_{j \neq i} \max(x_i - x_j, 0)$$

where: x_i the income of individual *i*, α_i the "envy" parameter for individual *i* and β_i the "guilt" parameter for individual *i*. In this model the decrease in utility is therefore proportional to the sum of the individual income deviations.

These models are not the only ones that include inequality and thus in a way envy in the definition of the utility function (Brennan, 1973; Mui, 1995). Common to all of these models is, that "envy" is seen as decreasing utility and the emotion is unaffected by the specific relation to the envied.

5.3   Empirical Evidence

Empirical evidence suggests that envy indeed influences behavior even in anonymous economic experiments. In this section we want to give an overview of some of the empirical evidence. Generally envy is (as in the above models) assumed to be related to an unequal distributions of assets. Thus the impact of "envy" is often analyzed with experiments allowing for reactions to such distributions from the disadvantaged player. It has to be noted though, that in such observations fairness considerations and envy reactions blend together.

5.3.1   The Importance of Fairness

In most cultures the use of envy as motivation for behavior is a strong taboo. Jealousy is affected by this to a somewhat lesser extent (Vecchio, 2000). In contrast, worldwide in almost all cultures (different) fairness norms exist, and members of a culture are expected to adhere to these. If a norm is violated it is generally accepted and expected that people react to this. When experiencing envy and at the same time a fairness norm is violated, behavior can be comfortably explained as a reaction to the violation of this norm. The "justified" envy as reaction to unfair behavior offers the individual a way of moral justification against himself and society. Since justification and emotion can not be easily disentangled in observations, it is important to consider in a discussion of envy also fairness. For economic models including envy, it is essential to be aware of the existence and extend of such norms.

Behavior driven by violation of fairness norms or envy, can be observed for example with the ultimatum game (Gueth and Tietz, 1990). In the ultimatum game one of two players (A) is assigned a sum of money, which he is allowed to divide as he wants between himself and the other player. Formally player A decides on a percentage $s \in [0, 1]$ of the total sum, which he will offer player B. The second player (B) then gets the opportunity to accept the proposed split or to reject it. If he accepts he receives

s and the first mover $(1-s)$ of the total pie. If player B rejects the offer, the money is kept by the experimenters and both players receive nothing.

If the only goal in this game was receiving a monetary payout, player B should accept any fraction of the pie, no matter how small. He is willing to accept any percentage $s \in (0, 1]$ and is indifferent between acceptance and rejection of $s = 0$. Therefore it is an equilibrium if the first player offers $s = 0$ and this offer is accepted.

Experiments have shown, that this game is played, at least in western cultures, in a different way.[1] In various experiments it was observed that proposers usually offer between 40 and 50 percent and that offers under 20 percent are very rare and are rejected with high probability (Thaler, 1988; Gueth and Tietz, 1990; Camerer and Thaler, 1995). Accordingly most subjects view a division in two equal sized shares as fair.

In the ultimatum game responders only have the choice of accepting or rejecting the offer. Usually no communication is allowed and there is no channel of signaling the experienced anger, stemming from either fairness violations of envy. Therefore the only possible way of expressing these emotions is through rejection of the proposal. And indeed it has been observed that in ultimatum games, where responders get the opportunity to express their emotions by sending a message to the proposer (after having received the proposal), rejection rates of unfair offers decrease substantially (Xiao and Houser, 2005).

From a variation of the ultimatum game, the mini ultimatum game, it becomes apparent that rejections additionally depend on intentions. In this game, proposers get to choose from only two distributions. In experiments an "unfair" distribution (of $8/2$)[2] was less often rejected when the alternative would have been even more unfair (e.g. 10/0) than when the alternative was an equal split (i.e. 5/5) (Falk et al., 2003). Therefore we see that the responder is taking into account the intentions and options available to the proposer. In the experiment it was also observed that even in cases where a relatively "fair" offer was proposed, approximately 10 percent of these cases were rejected. These rejections are most likely caused by envy, since the reaction can in no way be related to unfairness. Envy is therefore influencing behavior, even if no norm is violated. But this impact is much weaker than the overall rejection rates.

It is therefore important for discussions of economic models including envy, to be aware of the difference between fairness and the elicited emotions. Envy and jealousy can be experienced in situations where a norm was either violated or not, but only when a norm was violated envy can coexist with the expression of anger about the violated fairness norm. In situations where no fairness norm was violated, envy will be clearly recognizable. But in any kind of ambiguous situation, where it is not clear which norm should apply, "moral indignation" can be used to cover up felt envy. The observation that a behavior is elicited by a violation of a norm, does neither prove nor disprove

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[1]These results refer to behavior which has been observed in experiments in Europe and North-America. In other cultures behavior can vary, which stresses again the importance of cultural differences (Henrich et al., 2001).

[2]Where a distribution of x/y means that the proposer will receive *x* and the responder *y*.

that envy was the elicitor. The behavior might or might not be a reaction to unfairness unrelated to envy. In this context it is interesting to note, that in the current discussion of the "Neidkultur" (culture of envy) in Germany, this is sometimes said to be "simply" a resentment against unfairness. On the other hand fairness considerations and moral behavior are often claimed to be based on envy or jealousy that is not expressed.[3] The difference between envy and fairness is in economic models usually not considered, which might lead to wrong conclusions.

5.3.2 Cross-cultural Existence

As has been noted, envy and jealousy greatly depend on the cultural context. Not only the existence of envy, but also the reaction to and evaluation of the emotion.

There exist strong evidence that envy is a cross-cultural phenomenon. Nevertheless the experience of the emotion can vary between cultures. This depends on the importance of the affected area in the specific culture (Hupka, 1981). Cultures with low envy are for example characterized by a relative indifference concerning ownership. Further, some societies see envy as a positive, motivational force, while for others envy is destructive and negative (Salovey and Rothman, 1991). Specific importance is ascribed to envy in the Arab culture by association with the "evil eye". In Ghosh (1983) the impact on behavior is described for the case of Egypt. The assumed bad fortune, that is elicited through the "evil eye" is in close connection with envy. Envious people are blamed to destroy property and contact with them is avoided. As a result cultural norms attempt to rule out any suspicion of envy. For example cattle, which is considered as especially vulnerable, is kept in the enclosure of houses and windows are small to keep property hidden. Further, visitors are expected to show no too open admiration of the possessions of others.

In a cross-cultural experiment on envy and fairness, Beckman et al. (2002) compared across cultures behavior when choosing from multiple alternatives distributions of income. In this experiment subjects were asked to choose between two income distributions for participants, where inequality between players was varied (see table 5.1 for three such decisions). Players had to choose one of the distributions, A or B, and the majority vote decided which option was implemented. Each of these decisions had to be made twice, once before players knew their assigned position and once after.

When players knew which income they had to expect, players that expected a low income were often voting for the distribution that was also going to give those with a higher payoff a relatively lower income. This behavior was elicited to a varying degree in the different cultures under observation. The experiment was run in China, Russia, Taiwan and the US. Chinese players showed more rejection than for example the US players. From these results the authors conclude that envy can be an important hurdle in developing countries. At the same time, this experiment showed that such behavior

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[3]This view is expresses in many popular quotes, for example: "Moral indignation is jealousy with a halo." (attributed to H.G. Wells)

round / alternative	position, defined through random mechanism				
	one	two	three	four	five
1 A	40	80	120	160	200
1 B	40	80	120	160	230
2 A	40	80	120	160	200
2 B	40	80	120	190	200
⋮	⋮				
⋮	⋮				
7 A	40	80	120	160	200
7 B	45	85	125	165	480

Table 5.1: Alternatives from a cross-cultural experiment (Beckman et al., 2002).

can be avoided, if all players receive little additional gains. Therefore a high gain for one player is eliciting less rejection when also all other players receive a gain, even a small one (see option 7 in table 5.1). In that case also players on low positions choose for option B. Similar results are observed by Cason and Mui (2002) in an experiment using a variation of the ultimatum game. Also here a slight redistribution of gains lead to relatively low rejection rates.

These observations show that economic models that want to include envy and fairness norms, should pay attention to cultural differences and the impact of relative (even little) income changes on behavior. To which extend envy is actually experienced, can not be deducted from these experiments. For a further understanding it is therefore essential to explicitly measure the experience of envy and jealousy in these kind of situations.

5.3.3 Experiments Measuring Envy

As discussed earlier the measurement of emotions is not easy. Because envy is lacking a clear physiological pattern, physiological measures are not an option. Thus we have to rely on self-reports, even though existing norms might influence subjects not to report their true feelings. Unfortunately concerning the experience of envy, an especially strong taboo exists and might influence measures.

Envy and jealousy have been measured through self-reports in a number of experiments. Let me discuss some interesting findings from the Power-to-Take game, discussed in chapter 4. Bosman and van Winden (2002) observe that a number of negative emotions, among which envy, are experienced strongly for high take rates. But while irritation and contempt are positively correlated with destruction rates, they observe that envy is not. Envy seems to be controlled by subjects or does not influence the decision to destruct. Similarly as reported earlier in chapter 4, in our variation of the Power-to-Take game, we observe that anger is related to both take rates and de-
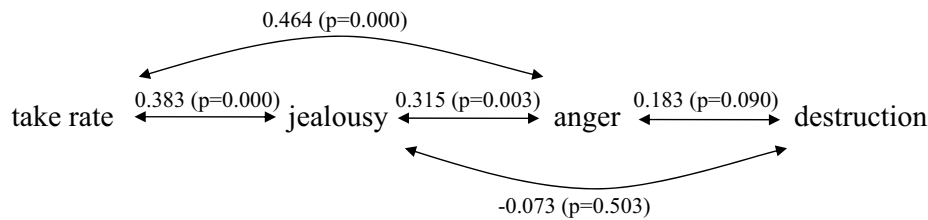
Figure 5.1: Spearman correlations between jealousy, anger and behavior in the Power-to-Take game

struction rates. A high rating of anger is significantly correlated with high take rates (Spearman, 0.464, $p = 0.000$) and marginally significantly with destruction (Spearman, 0.183, $p = 0.090$). For the measured emotion of jealousy we find a different pattern. Again high ratings of jealousy are significantly correlated with high take rates (Spearman, 0.383, $p = 0.000$) but we do not observe a correlation with destruction (Spearman, -0.073, $p = 0.503$). Where jealousy and anger are significantly positive correlated (Spearman, 0.315, $p = 0.003$) (see Figure 5.1).

We conclude that the impact on behavior (and destruction) is mainly influenced by the amount of anger. Anger can be a result of envy and jealousy. But anger can also be elicited when feeling treated unfairly, even if no envy or jealousy is elicited. The resulting experienced anger will influence behavior, but is only indirectly related to the experience of envy or jealousy.

5.4   Consequences

In the following I want to discuss the consequences of both envy and "envy-like" reactions to norm violations. As we have shown above envy as well as a violation of a fairness norm can lead to anger and to the ensuing action tendencies discussed in chapter 4. However envy does not need to wind up in anger but can lead to behavioral consequences aimed at changing the own disadvantaged situation.

If we assume that the experience of envy is seen as negative by the individual, it follows that avoidance of its experience is sought. This can be done either by the individual himself, by avoiding envy eliciting situations. If already facing such a situation the individual can try to change it in such a way that envy is not longer experienced. If we assume in addition that the behavioral consequences or envy are negative, societies as a whole might try to avoid constellations that will lead to envy in individuals.

If envy can be generally avoided is questionable. In principle a distribution is "envy free", if it is accepted from all players as fair. The results from the ultimatum game suggests that for this case this is a division in two approximately equal parts. The situation gets more complex for more than two players. A distribution is often considered as *envy free* if no player receives a set of items it considers inferior to a set

received by another player (Brams and King, 2005). The problem of "fairly" dividing a cake in *n* shares is not trivial (see e.g. Brams and Taylor, 1996) and the mathematical solutions are complex and not easily applicable. It seems though, that such a split is not essential to avoid envy. More important than a "fair distribution" is that all the participants feel "treated fairly", and this feeling greatly depends on how other players are valued. Intentions as well as merits play an important role and reactions to envy will depend on culture and personal characteristics.

In addition we have to question if envy and its behavioral consequences are generally negative. In general it seems to hold that the experience of envy is decreasing the individuals utility. Support comes from research on individual well-being. Subjective well-being depends accordingly not only on the absolute but also the relative income of the group of comparison in the own country (Hagerty, 2000). Countries with low income variance are characterized by higher values on happiness scales. Therefore there seems to be a measurable relation between an environment that is avoiding the experience of envy and the level of satisfaction in the population.

While the experience of the emotion is generally assumed to be negative, it is not clear what the consequences of envy are. Our results from the previous section suggest, that it is not envy or jealousy that is mainly related to destructive behavior. Indirectly these emotions play a role by influencing anger, but this experienced anger is also influenced by other factors. Indeed the consequences of envy might also be positive. The emotion can motivate subjects to change their unfavorable situation and the expression of envy can be seen as a sign of equality between parties. This was nicely expressed by Nietzsche:

> Tolerance in conduct angers your foes, but envy, when recognized, might almost appease them: because envy compares, sets equal, is an involuntary and groaning way of modesty. - Has maybe here and there, for the noted advantage, envy been used as a mask, by those that have not been envious? (Nietzsche, 1879, [2000], translation by the author)

Envy is indeed a sign of equality, because only those who can be compared will be envied. A fact that was already noted by Aristotle and other philosophers. As Bacon (1625, [1999]) writes: "envy is ever joined with the comparing of a mans self; and where there is no comparison, no envy; and therefore kings are not envied but by kings". A hypothesis which has been verified in modern investigations. Employees that did not get promoted in comparison to a colleague seen as equal, reported high envy and jealousy. While employees that were unfavored with respect to a colleague that was considered as very different, experienced only low degrees of these emotions (Schaubroek and Lam, 2004). The expression of envy might thus be used in a society to express that others are seen as equals.

Considering the behavioral consequences of envy we might want to distinguish between "group envy" and individual envy. Actually, first we have to answer if envy can also be experienced by groups. Competition and rivalry between groups is indeed

often explained by envy or jealousy, but the emotion is of course always experienced on an individual level. However the grouping of individuals and the belief in one group, that another is favored, can elicit envy between groups. This can lead to group efforts to change the envy eliciting situation. Indeed anger from individual experienced envy, can lead to collective actions against the cause of the anger, if support is expected from others (van Zomeren et al., 2004). Similarly on an individual level the experience of envy will lead to attempts to change the situation. This can be done either by reducing the benefits of the envied person or by improving the situation of the envious person. Redistribution, destruction but also increased effort might lead to this goal.

We conclude that envy can influence behavior in ways that are positive for a society. For example by motivating individuals that experience envy to change their situation. However envy can also hinder development and progress when leading to anger or apathy.

5.5 Conclusions

Even though psychologists have long known that envy influences our behavior, economists have long ignored this fact. Models including envy are still not stressing the difference between envy and reactions to unfairness, the two are usually grouped together. The impact of envy on behavior can be found on three different levels:

1. The utility of the individual is influenced directly through the experience of the emotion.

2. The emotion influences the behavior of the individual.

3. The individual has to predict if its behavior will induce envy in others and which reactions this will trigger.

Concerning the first point it is usually assumed that this will lead to reductions in utility. However the latter two can have positive effects.

Chapter 6

Shame and Retaliation*

> *They say that life is tit for tat,*
> *And that's the way I live...*
> *So, I deserve a lot of tat,*
> *For what I've got to give.*
> *Don't you know that this hand,*
> *Washes that one too.*
> *When you're good to Mama,*
> *Mama's good to you!*
>
> Chicago - The Musical (2002)

As we have seen in the previous chapters, anger is one of the motivations that can urge individuals to reciprocate unfairness and to be willing to punish norm defectors. The experience of anger can be due to envy but this does not need to be the case. In this chapter we will observe a further mechanism that can lead to experienced anger in social interactions, namely the fact of being punished. We have shown before that anger can lead subjects to show aggression against the person that elicited the anger provoking event. In this chapter we want to show, that this action tendency can be regulated by the experience of social emotions, namely guilt and shame.

6.1   What is Shame?

Moral behavior has been shown to be critically linked to the ability for emotional reactions (Anderson et al., 1999; Moll et al., 2002). While this is true for emotional reactivity in general, of particular importance are emotions that facilitate prosocial behavior (prosocial emotions such as shame, guilt and empathic emotions, e.g. Bowles and Gintis, 2003). They do so by inducing a feeling of discomfort when doing some-

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*This chapter is based on: Hopfensitz and Reuben (2005). The importance of emotions for the effectiveness of social punishment. *Tinbergen Institute Discussion Paper*, 2005-075/1.

thing that violates one's values or norms, or those of other agents whose opinion one cares about.

Shame and guilt are both "self-reproach" emotions elicited by the individuals' own blameworthy actions (Ortony et al., 1988). While they differ in multiple dimensions concerning elicitation and action tendency, they have many similarities and are often elicited at the same time. However as with the discussed concepts of envy and jealousy, we should be aware of their differences.

It is often assumed that shame and guilt differ by the visibility of behavior. Shame is said to be triggered in social situations in which actions are seen by others, whereas guilt is more related to internalized values and hence is not influenced by the presence of others. However, research by psychologists has shown that people feel shame even when their actions are unobserved (Tangney et al., 1996), and that the experience of guilt varies considerably depending on the interpersonal context (Baumeister et al., 1994).

The difference between shame and guilt seems to be mainly due to the focus. Guilt is felt when the focus is on the action, while shame is felt if agents feel that he or she is a "bad person" (Tangney and Dearing, 2002). Therefore the action tendencies of the two emotions differ. Since guilt is focused on behavior, the emotion can lead to compensation and to an active attempt to change the situation. Shame on the other hand can not lead to reparation, since it is implying that the person as such is bad. The action tendency of shame will be to hide and to get away from the situation. The difference between the emotions is that guilt can actually lead to appeasement, while shame might make matters worse.

Finally, as with all emotions, the influence of prosocial emotions is twofold. First, the anticipation and wish for avoidance of shame and guilt might induce norm-abiding behavior. Second, the experience of shame or guilt, after an action, might lead to behaviors to diminish the feeling. In a social dilemma, this may happen through re-payment, future cooperation or avoidance of future contact with the interaction partner. If the emotions are elicited through punishment of selfish behavior, they might inhibit retaliation and encourage individuals to act more cooperatively in the future.

6.2   Shame in a Social Dilemma

For cooperation in social dilemmas, the existence and enforcement of social norms seems to be an important mechanism. As shown by Fehr and Gaechter (2000), cooperative behavior can persist when there is an opportunity to punish defectors. However, even though punishment can have desirable consequences, it can also have a negative effect on welfare (Fehr and Rockenbach, 2003; Egas and Riedl, 2005; Gaechter and Herrmann, 2005). To correctly predict when punishment will have positive results, we must understand the behavior of individuals who punish as well as that of individuals who are punished.

The goal of this chapter is to understand the motivations behind the behavior of

both the punishers and the punished, and in particular, the type of motivations that must be present for punishment to be an effective institution for the promotion of cooperation. We concentrate on the role of social emotions, such as shame and guilt, as an essential component for the successful enforcement of cooperative norms.

As we have shown before, emotions motivate individuals to punish opportunistic behavior. In particular, anger has been shown to be of influence when subjects have to decide whether to punish or not. But anger cannot explain why punishment is actually effective. The effectiveness of punishment depends on the reaction of the individuals who are punished. If individuals feel anger after being punished, they may be motivated to retaliate towards the punisher. Therefore, anger alone may induce multiple rounds of punishment and retaliation and consequently a significant destruction of resources. What is missing to make punishment effective is a moral reaction of the punished. This implies that after receiving punishment the punished should act more cooperatively and abstain from retaliation. We will show that the social emotions of shame and guilt motivate individuals to react in precisely this way.

To test whether this is true, we study, by means of an experiment, cooperation and punishment behavior in a social dilemma game. We introduce a form of social punishment where individuals who are punished always have the opportunity to retaliate. After all, if there is access to a punishment technology, it is likely that both the punisher and the punished have access to it. We find that many individuals punish back after being punished. In various cases this escalates as individuals punish each other in turns, resulting in considerable welfare losses. Nevertheless, this punishment institution is still effective for sustaining cooperation.

In order to explain the behavior of both punishers and punished, we measure the emotional experience of "punishment-inducing" emotions such as anger and irritation and "norm-enforcing" emotions like shame and guilt. An important finding is that individuals that act unkindly do nevertheless feel considerably angry when punished. Consequently, punishment advances cooperation only when feelings of shame restrain the anger-induced desire to fight back. Finally, in order to observe the effect of punishment on future cooperative behavior, we had individuals play the game twice. We find that individuals are more likely to act kindly in the future only when punishment induces feelings of shame.

6.3 The Experiment

Lately, punishment mechanisms have been analyzed in the context of public good games (using the framework of Fehr and Gaechter, 2002). However, in this study we require a simpler setting where the causes and effects of emotions can be easily observed and analyzed. To study the impact of social emotions, we used a two-person social dilemma game with and without punishment opportunities. Our game is similar to many of the social dilemma games in the literature, such as, the sequential prisoners' dilemma, the investment game and the trust game.
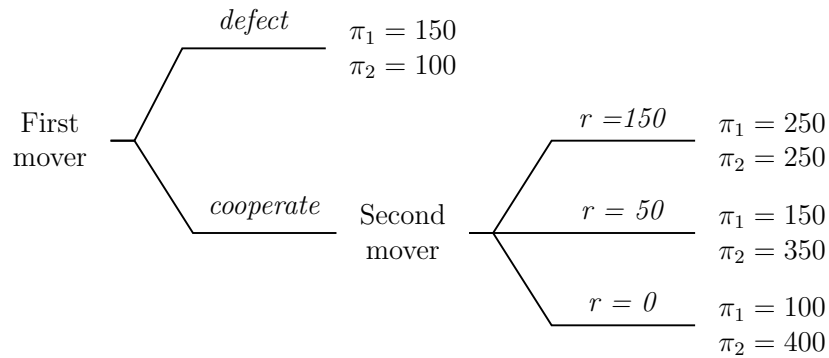
Figure 6.1: Game tree in the case of no punishment opportunities

6.3.1   The game

We first describe the game without punishment opportunities and then we explain how punishment is introduced. The game consists of two players taking part in a one-shot game. We will refer to these players as the "first mover" and the "second mover". At the start of the game, the first mover receives 150 points whereas the second mover receives 100 points (see Figure 6.1 for the game tree). In the first stage, the first mover decides to either defect or cooperate. If the first mover defects, he keeps his 150 points, the second mover keeps her 100 points, and the game ends. If the first mover cooperates, 50 of his 150 points are multiplied by six and transferred to the second mover. Thus the second mover receives 300 points while the first mover loses 50 points. In the second stage, the second mover returns an amount of points (r) back to the first mover. Specifically, she could return 150 points (an equal split of the gains), 50 points (returning exactly the points lost by the first mover) or 0 points. After the decision of the second mover the game ends. Hence, if the first mover cooperates his payoff is $\pi_1 = 100 + r$ and the payoff of the second mover is $\pi_2 = 100 + 6 \times 50 - r$. This describes the game without punishment.

In the game with punishment both players can assign punishment points. Doing so is costly for both players. We denote p_{it} as the amount of points assigned by player i (for $i \in 1, 2$) in punishment round t. After the second mover decides how much to return, the first round of punishment starts. First, the first mover gets the opportunity to assign a nonnegative amount of punishment points to the second mover (p_{11}). The first mover looses p_{11} points and the second mover looses $4 \times p_{11}$ points. In order to avoid large losses during the experiment, the first mover could assign punishment points only as long as the second mover had a positive number of points (i.e. $1/4(100 + 6 \times 50 - r) \geq p_{11} \geq 0$). If the first mover chooses $p_{11} = 0$ the game ends. However, if the first mover chooses $p_{11} > 0$ the second mover gets the opportunity to assign punishment points to the first mover (p_{21}). In order to avoid confusion, we will refer to punishment by the second mover as retaliation. Punishment by first movers and

retaliation by second movers had the same cost and did the same harm. Thus for each retaliation point assigned, the first mover looses four points. Like the first mover, the second mover could assign retaliation points only as long the first mover had a positive number of points (i.e. $1/4(100 + r - p_{11}) \geq p_{21} \geq 0$). If $p_{21} = 0$ the game ends, but if $p_{21} > 0$ the game continues with a second round of punishment. That is, the first mover gets the opportunity to assign additional punishment points to the second mover (p_{12}). Again, if $p_{12} = 0$ the game ends but if $p_{12} > 0$, the second mover gets the opportunity to assign additional retaliation points (p_{22}), and so on. The process repeats itself until either one of the players has zero points and therefore can not be punished further, or one of the players decides to assign zero punishment points. Therefore, if the first mover cooperates his payoff is $\pi_1 = 100 + r - \sum_t p_{1t} - 4 \times \sum_t p_{2t}$ and the payoff of the second mover is $\pi_2 = 100 + 6 \times 50 - r - \sum_t p_{2t} - 4 \times \sum_t p_{1t}$.

If we use the standard assumption of rational individuals with self-regarding preferences, the unique subgame perfect Nash equilibrium of the game with and without punishment, is for second movers to return zero points and thus for first movers not to cooperate.[1] The predictions can change if individuals possess other-regarding preferences such as a concern for unequal payoffs, efficient outcomes, and/or reciprocating kind and unkind actions.[2] In the game without punishment, if the frequency of selfish individuals is sufficiently low then there can be equilibria where some second movers return positive amounts and some first movers cooperate. In the game with punishment, in addition to individuals who are willing to act kindly, there might be individuals who are willing to punish selfish behavior. If punishment leads to higher returns from the second movers, it gives first movers a further incentive to cooperate. Certainly, the first movers' willingness to punish depends on the willingness of second movers to retaliate, which in turn depends on the willingness of first movers to punish once again, and so on. This, in our opinion is a more realistic way of modelling social punishment. If both the punisher and the punished have access to the punishment technology, the punished will always have the opportunity to retaliate. Moreover, both players have the option to avoid further interaction by deciding not to punish. To our knowledge there is no other study which examines the punishment behavior of individuals in such a setting.[3]

6.3.2 Experimental design and procedures

The computerized experiment was conducted in March 2005 in the CREED laboratory at the University of Amsterdam. In total 162 students from the University of Amsterdam participated in the experiment. Approximately 54% were students of economics

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[1]Note that since punishment is always costly, it is never credible at any stage.

[2]See Rabin (1993); Fehr and Schmidt (1999); Bolton and Ockenfels (2000); Falk and Fischbacher (2000); Charness and Rabin (2002); Dufwenberg and Kirchsteiger (2004)

[3]Nikiforakis (2004) studies punishment in a public good game in which retaliation was possible. However, in this case the punishment phase automatically ended after retaliation. As we will see, this restriction might have limited the amount of initial punishment.

and the rest came from a variety of fields such as biology, political science, law, and psychology. The average age was 22 years and 58% of the participants were male.

Each subject played twice the social dilemma game described in the previous section. We used a perfect strangers matching protocol to avoid any reputation effects. In total, 26 subjects participated in the baseline treatment, that is, the game without punishment opportunities. The remaining 136 subjects participated in the punishment treatment. Earnings were calculated in points and points were exchanged for money at a rate of 40 points for 1 euro. The average earnings were 10.55 euros (this includes a show-up fee of 1 euro). The whole experiment lasted about one hour. Subjects were recruited through the CREED recruitment website and the experiment was programmed with z-Tree (Fischbacher, 1999).

After arrival in the reception room, subjects were randomly assigned to a table in the lab. Once everyone was seated, subjects were given the instructions for the experiment (see Appendix 6.A). Subjects were told that the experiment consisted of two independent parts. We emphasized the fact that they would interact with different individuals in each part, and that their choices in the first part would not affect their earnings in the second part. After this, the one-shot social dilemma game was described as the first part of the experiment. When everybody had finished reading the instructions, subjects had to answer a few questions to ensure their understanding of the game. Subsequently, the subjects played the social dilemma game via the computer (part 1). At the end of the first part, instructions were distributed concerning the second part of the experiment. The instructions informed subjects that they were about to play the same game once again. Furthermore, they would be in the same position as in the first part (i.e. first or second mover), and with certainty, their partner would not be the same partner they had played with in the first part. After they played the second part of the experiment (part 2), subjects filled in a debriefing questionnaire and thereafter they were paid out their earnings in private and dismissed.

To observe if emotional reactions of shame and guilt influence behavior, we used self-reports to measure these and other emotions during the game. We also measured expectations concerning the behavior of the other player and fairness perceptions. Emotions were always measured after subjects observed the choice of the other player but before they made their own choice. Expectations about the behavior of the other player were asked after the subjects made their choice but before they observed the other player's actual choice. Finally, fairness perceptions were measured at the end of the experiment in the debriefing questionnaire.

Emotions and fairness perceptions were measured using seven-point scales, and expectations were measured by asking for a point estimate of the most likely action (see Appendix 6.B). We measured a variety of emotions to avoid prompting subjects in a particular direction. The measured emotions were: anger, gratitude, guilt, happiness, irritation, shame, and surprise. To validate our measures of shame and guilt, we additionally asked second movers in the baseline treatment to fill out the state shame
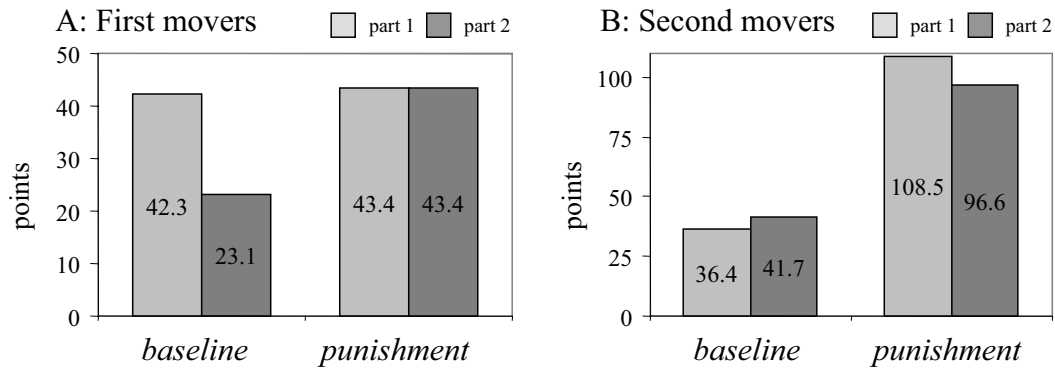
Figure 6.2: Cooperation by first movers and returns by second movers.
Note: A) Mean number of points sent by first movers in each part and treatment. B) Mean number of points returned by second movers in each part and treatment (For frequencies see Appendix 6.C).

and guilt scale (SSGS) (Tangney and Dearing, 2002) after having decided about their returns (see Appendix 6.B.2).

6.4 Observed Behavior

In this section, we give an overview and a brief discussion of the behavior of first and second movers. A summary of the behavioral data can be found in Appendix 6.C. We start by investigating how often first movers cooperate and, when given the opportunity, how much second movers return. Comparing the baseline and the punishment treatments allows us to observe the effect of the punishment institution on the subjects' behavior. Then, in order to explain any differences induced by punishment, we analyze the punishment behavior of first movers as well as the retaliatory behavior of second movers. Finally, we examine whether the opportunity to punish has an effect on how subjects adjust their behavior from part 1 to part 2.

6.4.1 Cooperation and Returns

Figure 6.2 summarizes the main differences between the baseline and the punishment treatment. Namely, first movers cooperate more often and second movers return more in the presence of punishment.

As can be seen in Figure 6.2:A, in both treatments, almost all first movers cooperate in the first part (more than 84.6%). However, in the absence of punishment, cooperation decreases substantially in the second part. If there are punishment opportunities, first movers cooperate equally often in both parts. Testing for differences between treatments confirms this observation. There is no significant difference in the

frequency of cooperation in the first part ($p = 0.837$) but a highly significant difference in the second ($p < 0.001$).[4] There is an even starker difference between treatments when we consider the behavior of second movers. That is, in each part, second movers return noticeably less in the absence of punishment ($p < 0.044$). Given this behavior of second movers, it is easy to understand the decrease in cooperation in the baseline treatment. Remember that first movers who cooperate send 50 points. In the baseline treatment, they receive on average a smaller amount in return. In contrast, first movers who cooperate in the punishment treatment receive back roughly twice the sent amount. It is clear that, even when it is possible to retaliate, punishment limits the opportunistic behavior of second movers. In the following paragraphs, we examine how subjects punish and retaliate.

6.4.2   Punishment and Retaliation

As Figure 6.3:A illustrates (see also Table 6.1), a large number of subjects are willing to spend some or all of their monetary gains in order to either punish second movers or retaliate against first movers. In fact, around one third of the cases in which first and second movers interact wind up in punishment by the first movers. If returns were less than 150 points, about two thirds of the interactions ended up in punishment (68.1%). When given the opportunity, retaliation by second movers is somewhat less frequent (40.0%). We even observe that, of the first movers who had the chance to punish second movers who retaliated, 55.6% decided to do so (we refer to this as "additional punishment").[5]

Figure 6.3:B shows that the amount spent on punishment by first movers who got back less than 150 points was clearly higher than the amount spent on retaliation by second movers who got punished ($p = 0.002$). Remember that punishment was limited by the earnings of the other player. Therefore, since the earnings of first movers when they faced retaliation were lower than the earnings of second movers when they faced punishment, the difference is partly explained by the ability of first movers to spend more on reducing the other's payoff. Still, if we normalize both punishment and retaliation using the maximum amount of points that an individual could assign to the other, we see that first movers are more aggressive punishers than second movers ($p = 0.080$).

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[4]Throughout the chapter, unless otherwise noted, we always use a two-sided Wilcoxon-Mann-Whitney test. We use each subject as an independent observation for tests concerning either part 1 or part 2. If we combine the data of both parts to perform a test, for each subject we first calculate the mean for the variable in question and then compute the test using these means as the independent observations. There are subjects from whom we have data from only one of the parts for various variables (e.g. a second mover who faces a first mover who cooperates in part 1 and a first mover who defects in part 2). In these cases, we take the data from the part for which we have information as that subjects mean.

[5]We only observe one case in which the second mover retaliated once again ($p_{22} > 0$). However, this is because in all the other pairs where the first mover punished a second time ($p_{12} > 0$) at least one of the players ended up with zero points and hence the punishment stage ended automatically.
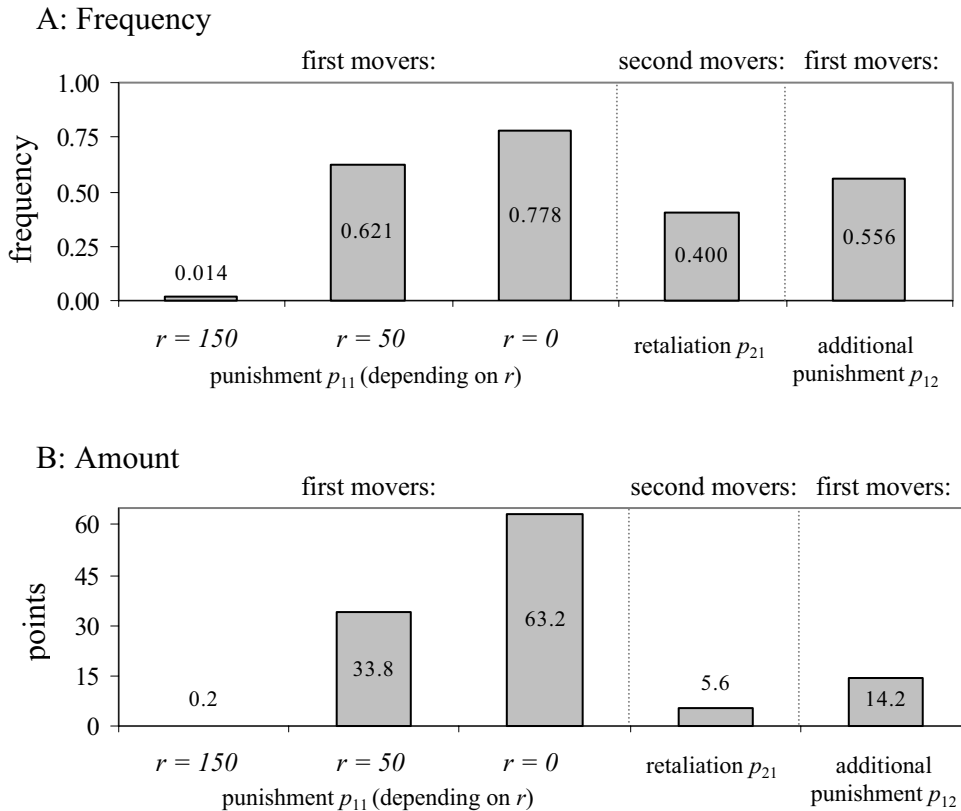
A: Frequency

B: Amount

Figure 6.3: Punishment and retaliation.
Note: A) Frequency of punishment (p_{11}), retaliation (p_{21}), and additional punishment (p_{12}) over both parts. B) Mean amount of points spent on punishment (p_{11}), retaliation (p_{21}), and additional punishment (p_{12}) over both parts.

Although it is not predicted by traditional economic theory (assuming own-payoff maximization), the punishment behavior of first movers is not surprising given that similar behavior has been observed in numerous experiments (see Camerer, 2003). Similarly it is consistent that the amount and frequency of punishment increases as the amount returned decreases.[6]

We find more unexpected the willingness of second movers to retaliate. After all, these subjects had behaved unkindly by returning less than 150 points. Furthermore, when they had to decide whether they wanted to retaliate, 65.0% of the second movers had earnings that were actually higher or equal to the earnings of the first mover. It is remarkable that 7 (i.e. 53.8%) of these 13 second movers chose a positive amount of

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[6]Comparing first movers who received 150 points with first movers who received 50 or 0 points gives a significant difference for both the amount and the frequency of punishment (in each part $p < 0.001$). If we compare the amount and frequency of punishment of first movers who received 50 points with that of those who received 0 points, we find a significant difference only for the amount of punishment in the second part ($p = 0.020$, and in all other cases $p > 0.193$).

retaliation. This behavior is akin to "misdirected" punishment in public good games, that is, punishment of high contributors by free-riders (Cinyabuguma et al., 2004; Gaechter and Herrmann, 2005). Unlike for first movers, the retaliatory behavior of second movers does not seem to depend on the actions of the other player. For instance, there is no significant difference in the amount or the frequency of retaliation between second movers who received a large amount of punishment and second movers who received a small amount (punishment above and below the median, $p > 0.621$).

It is instructive to calculate how retaliation affects the first movers' "real" cost of punishment. Whenever first movers punish, they not only incur the cost of reducing the second mover's earnings, but they also risk further losses if the second mover decides to retaliate.[7] If there is no retaliation, the cost of punishment is 0.250 points per point reduced. Including the actual losses due to retaliation shows that, on average, first movers lost an additional 0.149 points per point reduced. This is a substantial increase of 59.4% in the cost of punishment. A similar analysis for the real cost of retaliation (given losses due to additional punishment) gives that second movers incur an additional 0.763 points per point reduced. This is a remarkable 305.6% increase in the cost of retaliation.[8] We now turn to how first and second movers adjust their behavior from part 1 to part 2.

6.4.3   Dynamics

As already noted, the starkest difference between treatments concerning the behavior of first movers is the large decrease in cooperation from part 1 to part 2 in the baseline treatment compared to the punishment treatment. On closer inspection, this difference is due to two reasons. First, as shown in Figure 6.4, first movers in the baseline treatment who got back less than 150 points in part 1 were more likely to defect in part 2 compared to first movers in the punishment treatment ($p = 0.013$). Second, in the baseline treatment more second movers chose to return less than 150 points (81.8% in the baseline treatment compared to 35.6% in the punishment treatment, $p = 0.005$). Hence, it appears that punishment has two desirable effects. On one hand, second movers anticipate punishment and as a result increase the amount returned. On the other hand, after experiencing opportunistic behavior, first movers are more willing to keep on cooperating if they have the opportunity to punish. In fact, if we examine how first movers in the punishment treatment adjust their behavior, we find that, among the first movers who received less than 150 points, those who actually punished are less

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[7]The only case in which second movers cannot retaliate after being punished occurs when first movers who get back 0 points spend all of their remaining earnings punishing the second mover. In this case, both subjects end up with 0 points and no further retaliation is possible. Overall, 24.3% of the cases in which there was positive punishment fit this description.

[8]In fact, these calculations include pairs of subjects where no more punishment or retaliation was possible given that earnings were less than or equal to zero (e.g. see footnote 7.). Excluding these observations raises the cost of punishment by 0.196, a 78.4% increase, and the costs of retaliation by 0.849, a 339.5% increase.
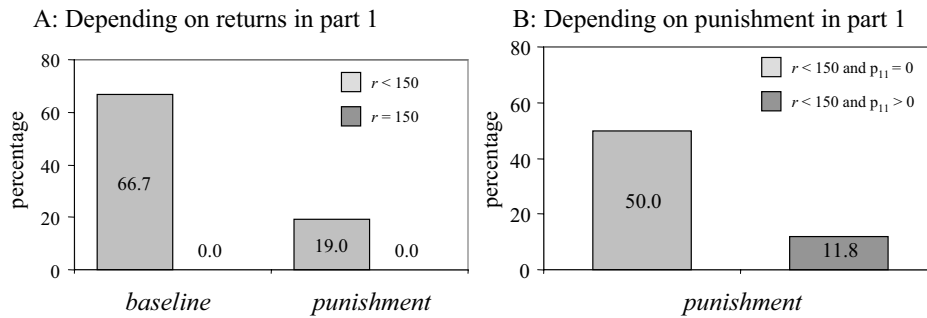
Figure 6.4: Defection in part 2, depending on events in part 1.
Note: A) Percentage of first movers who defect in part 2 depending on the amount returned by the second mover of part 1 in each treatment. B) Percentage of first movers who defect in part 2 depending on whether or not they punished the second mover of part 1 for returning less than 150 points.

likely to stop cooperating than those who did not punish ($p = 0.087$, see Figure 6.4).

We find a less clear pattern when we look at how second movers adjust their behavior. In both treatments, when given the opportunity, the majority of second movers choose the same action in both parts (80.0% in the baseline and 75.0% in the punishment treatment). Of those who change their decision, most of them decrease the amount returned (100.0% in the baseline and 84.6% in the punishment treatment). In order to look at the effect of punishment, we concentrate on second movers who had a good chance of being punished (i.e. those who returned less than 150). We find that, on average, second movers who were not punished decrease their returned amount by 25.0 points whereas those who were punished increase it by 10.0 points ($p = 0.113$). The main findings from the behavioral data can be summarized in the following result:

Result 6.1 *In the presence of punishment opportunities, cooperation is sustained at high levels. This is because, second movers return more and first movers who punish do not stop cooperating after experiencing opportunistic behavior. Punishment of opportunistic behavior is common despite the fact that in numerous cases punishment leads to multiple rounds of reducing each other's earnings.*

6.5 Emotions and Punishment

In this section, we first examine which of the first movers' emotions are related to punishment. We find that anger-like emotions explain why some first movers punish while others do not. Subsequently, we concentrate on anger and analyze what triggers first movers to feel high intensities of this emotion.
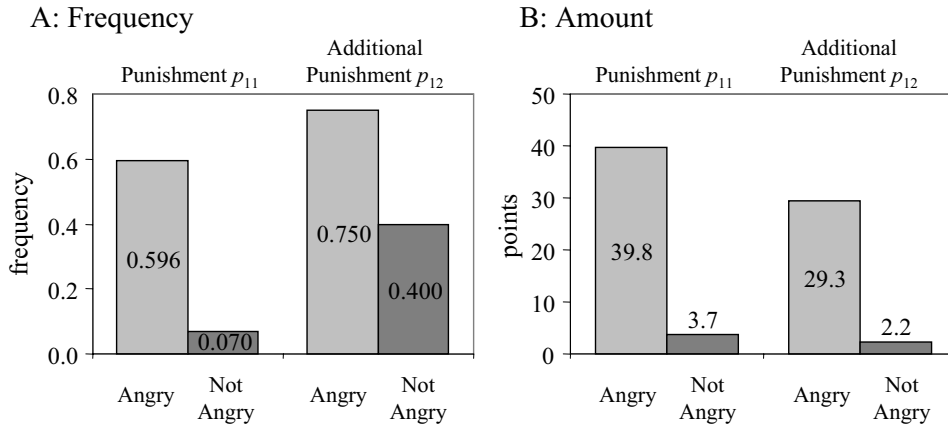
Figure 6.5: Anger and Punishment.
Note: A) Frequency of punishment by first movers depending on anger. B) Mean amount of points spent on punishment by first movers depending on anger.

6.5.1   Anger and Punishment

Throughout the experiment, first movers experienced a variety of emotions. However, we find that anger-like emotions are the only ones that are clearly related to the punishment decision. First movers that felt high intensities of anger-like emotions punish more than those who felt low intensities of these emotions. Furthermore, we also find that differences in anger-like emotions can explain why, after receiving retaliation, some first movers punish again while others do not.

As is illustrated in Figure 6.5, first movers who, after observing the amount that was returned by the second mover, felt high intensities of anger punish more and more often than first movers who felt low intensities of anger ($p < 0.001$ for both part 1 and 2)[9]. Similarly, on average, after observing the amount of retaliation assigned to them by the second mover, first movers who felt angry punish more and more often than first movers who did not feel as angry (the difference is marginally significant for the amount of additional punishment $p = 0.096$, but not for its frequency $p = 0.322$).[10]

Having found that punishment is related to experienced anger, the question arises what explains the different intensities of anger. We answer this question in the following subsection.

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[9]In the following analysis we will refer to a person feeling "angry" if the reported value for anger was above the median, and as feeling "not angry" if the value was below the median. Likewise for other emotions.

[10]Throughout this section, we report the results of tests done with the emotion of anger. However, we find very similar results and significance levels if we use irritation or (lack of) happiness.

6.5.2 Causes of Anger

Anger experienced after observing the amount sent back by the second mover is caused by returns of less than 150 points, especially if they were unexpected or considered unfair (the emotional reaction of first movers to the amount returned can be found in Appendix 6.C).

In both treatments, the most important trigger of high intensities of anger is simply receiving back less than 150 points. First movers in the punishment treatment who received 150 points felt lower intensities of anger than first movers who received either 50 or 0 points back ($p < 0.001$, see Table 6.3). Moreover, although on average first movers who received 0 points were angrier than those who received 50 points, the difference is marginally significant only in part 2 ($p = 0.328$ for part 1, and $p = 0.075$ for part 2).

In addition to the returned amount, the first movers' expectations have an effect on the intensity of anger. In particular, first movers who overestimated the amount returned by the second mover tended to be angrier than first movers who underestimated it. For example, if we control for the amount that was actually returned by concentrating on first movers who got back 50 points, we find that first movers who were expecting back 150 points were angrier than first movers who were expecting back 50 or 0 points (in each part $p < 0.043$).

Lastly, we also observe that fairness perceptions influence the amount of anger experienced by first movers. First movers who thought it is unfair to return low amounts were angrier than those who thought that it is fair to return low amounts (below or above median fairness). For instance, if we look again only at first movers who got back 50 points, we find that first movers who thought returning 50 was unfair were angrier than first movers who thought returning 50 was fair ($p = 0.004$).

Focusing on the emotional reaction of first movers to the amount of retaliation received from the second mover gives a comparable finding. Namely, first movers who faced no retaliation felt lower intensities of anger than first movers who faced positive retaliation (see Table 6.4, $p = 0.037$). Unfortunately, in this case we do not have enough observations to test for the effects of expectations and fairness perceptions. The findings of this section are summarized in the following result.

Result 6.2 *First movers who punish do so because they are angry. High intensities of anger are triggered by opportunistic behavior by the second mover, especially if it is unexpected and considered unfair. Retaliation by second movers also makes first movers angry and leads to additional punishment.*

6.6 Social Emotions and Retaliation

We now turn to the relationship between the emotions and behavior of second movers. To begin with, we investigate the relationship between the emotions of second movers and their decision to retaliate. We also analyze whether emotions influence how second

movers adjust their behavior over time. Finally, we try to explain the difference in the emotional reactions of second movers.

6.6.1   Shame and Retaliation

As with first movers, the emotional reaction of second movers seems to be clearly related to their behavior (the emotional reaction of second movers can be found in Table 6.5). In particular, second movers who felt no shame are more likely to retaliate than other second movers. Furthermore, we also find that, for second movers who were punished, experiencing shame induces them to correct their behavior. In this section we only report the results of tests using shame. However, for all findings in this section, we get very similar results and significance levels if we use guilt instead of shame.

As can be seen in Figure 6.6:A, second movers who felt no shame after being punished are more likely to retaliate than second movers who felt shame ($p = 0.045$). We also get a similar result if we test for differences in the amount of points spent on retaliation ($p = 0.091$).

Interestingly, we also find that anger has an effect on the second movers' decision to retaliate. However, in this case the effect is not as straightforward. A simple look at the relationship between anger and retaliation, suggests that second movers who are angry retaliate more and more often than second movers who are not angry (see Figure 6.5). However, these differences are not significant ($p = 0.739$ when testing for differences in the amount of retaliation and $p = 0.965$ for differences in frequency). The effect of anger becomes obvious once we examine the interaction of anger and shame. In this case, a clear result is obtained. Namely, second movers who were angry and felt no shame retaliate more and more frequently than angry second movers who felt shame ($p = 0.032$ and $p = 0.024$). For second movers who were not angry, there are no significant differences between those who felt shame and those who did not ($p > 0.637$).

In addition to retaliation, shame is also related to how second movers adjust their behavior from part 1 to part 2. In Section 6.4.3 it was shown that second movers who were punished tend to return more in the subsequent part than second movers who were not punished. However, this difference is not significant. The emotional reaction of second movers reveals that the propensity of second movers to adjust their behavior after being punished depends on whether they felt shame or not. On average, second movers who felt shame after being punished increase the amount returned by 35.7 points whereas those who felt no shame decrease the amount returned by 12.5 points ($p = 0.053$). Since most second movers who returned less then 150 points were punished, we do not have enough observations to test the effects of shame on subjects that were not punished.

In conclusion, our results suggest that high intensities of anger provide second movers with a motivation to retaliate and high intensities of shame restrain them from doing so. Furthermore, shame seems to be necessary for punishment to have an effect

A: Frequency
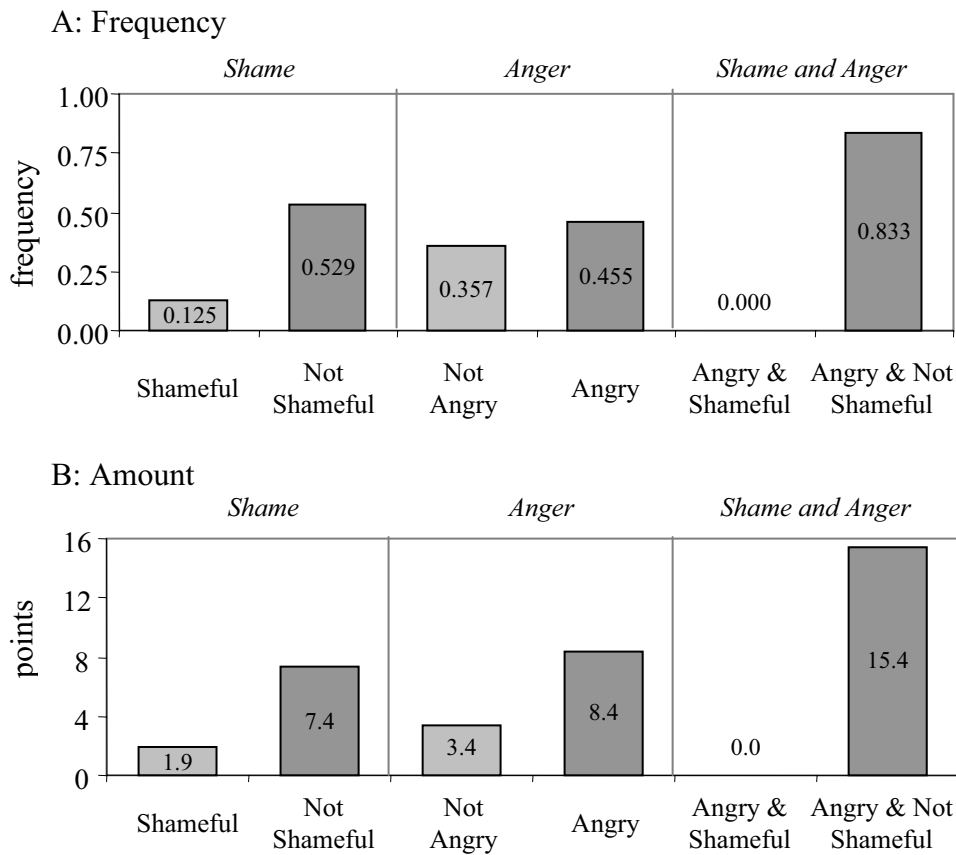
B: Amount

Figure 6.6: Shame, Anger and Retaliation.
Note: A) Frequency of retaliation by second movers depending on anger and shame. B) Mean amount of points spent on retaliation by second movers depending on anger and shameful.

on how second movers adjust their behavior. Next, we explain the differences in the intensities of anger and shame experienced by second movers.

6.6.2 Causes of Anger and Shame

The experience of anger among second movers depends on how many points they sent back to the first mover and on the amount of points the first mover spent punishing them. That is, second movers felt high intensities of anger if they received a high amount of punishment from the first mover. Furthermore, the intensity of anger is stronger the higher the amount they had returned before getting punished.

The most important reason why second movers get angry is simply receiving a positive amount of punishment (see Table 6.5). For example, second movers who were punished at least once reported significantly more anger than those who were never

punished ($p = 0.001$).[11] Interestingly, if we examine whether the amount of punishment has an effect on anger we do not find a significant result. For example, second movers who were punished by a very large amount were not significantly angrier than those who were punished by a very small amount (top versus bottom quartile, $p = 0.624$). However, once we take into account the amount the second mover returned, we find a clearer effect. Among second movers who returned 50 points, those who were punished by a very large amount were angrier than those who were punished by a very small amount (top versus bottom quartiles, $p = 0.133$). The same pattern exists for second movers who returned 0 points (this time, $p = 0.168$). For low amounts of punishment, second movers who returned 50 points were angrier than those who returned 0 points.[12]

More concisely, second movers became angry whenever they were punished, but if they had returned 50 instead of 0 points, they got angry at lower punishment amounts.[13] This is understandable given that second movers who returned 50 points not only behaved somewhat nicer than those who returned less, they also had lower earnings. Unlike first movers, we do not find that fairness perceptions or expectations (about the amount of punishment) have an effect on anger.

Unlike anger, it is not so clear what triggers different intensities of shame. We find that second movers who returned 150 points reported lower intensities of shame than those who returned less ($p = 0.001$). In the punishment treatment, this is true even when we control for whether or not the second mover faced punishment. Specifically, second movers who returned 150 points and were not punished felt lower intensities of shame than second movers who returned less and were also not punished ($p = 0.001$). Our control measures of shame and guilt in the baseline treatment (SSGS) support these findings. Second movers who returned 150 points report less SSGS-shame ($p = 0.056$) and SSGS-guilt ($p = 0.038$) than those that returned less. In fact, punishment seems to have little if any effect on shame. For example, among second movers who returned less than 150, there is no significant difference in the amount of shame reported by those who were punished and those who were not ($p = 0.602$). Again, we do not find an effect of expectations or fairness perceptions on the experience of shame.

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[11]This is also true if we restrict ourselves to second movers who returned less than 150 points (in this case, $p = 0.002$).

[12]For instance, among second movers who did not receive very high punishment (i.e. excluding the top quartile), second movers who returned 50 points were more likely to feel angry (above the median) than those who returned 0 points ($p = 0.083$).

[13]These effects are more clearly captured in a regression. We estimate anger using the following independent variables: the amount returned, the expected amount of punishment, the perceived fairness of returning 50 points, and three variables I^r for $r \in 0, 50, 150$ where $I^r = 0$ if the amount returned was different from r and $I^r =$ amount of punishment if the amount returned was r. We obtain positive and significant coefficients for I^0, I^{50}, and I^{150} ($p < 0.001$). Furthermore, the coefficients are all significantly different from each other, with the coefficient for I^0 being the smallest and the one for I^{150} being the largest (Wald tests, $p < 0.009$). This suggests that for a given amount of punishment, second movers are angrier the more they had returned. (Ordered probit estimates: see Table 6.6)

The findings of this section are summarized in the following result.

Result 6.3 *Second movers who retaliate do so because they are angry and do not feel shame. In addition, following the feeling of shame, second movers rectify their opportunistic behavior. High intensities of anger are triggered by punishment, especially if the second mover had returned a positive amount. High intensities of shame are triggered by opportunistic behavior and are not affected by punishment.*

6.7 Discussion and Conclusions

In this chapter, we have shown that a realistic punishment institution, in which multiple rounds of punishment and retaliation are possible, is an effective tool for the support of cooperative behavior. However, retaliation is a commonly observed behavior that often results in the extreme reduction of the payoffs of the individuals involved. Furthermore, we have confirmed, that anger-like emotions are an important motivation for punishment. Opportunistic behavior induces anger and thus increases the likelihood of punishment. Lastly, we have shown that the experience of prosocial emotions, namely shame and guilt, restrain angry individuals from retaliating. Therefore, prosocial emotions can be seen as a mechanism managing the behavioral reactions of anger.

Given that costly punishment has been shown to be an effective way of enforcing cooperative behavior, it is important to have a good understanding of the motivations and reactions of both the punishers and the punished. We find interesting that individuals who are willing to punish are also willing to keep on cooperating (see Result 6.1). This guaranties that, as long as these individuals have the opportunity to punish, cooperation can be sustained. Furthermore this kind of individuals might help cooperation emerge, even if it was initially rare. In addition, the same type of people is necessary to support punishment in the presence of retaliation. If retaliation deters individuals from using the punishment mechanism, cooperation can unravel (Nikiforakis, 2004). However, if the opportunity to punish back always exists, this could prevent retaliation from limiting the punishment of opportunistic behavior.[14]

As expected, we find that the main motivation for the punishment of opportunistic behavior is experiencing anger. Furthermore, we confirm that individuals feel angrier the more money the other player took (Bosman and van Winden, 2002), the more unexpected was the opportunistic behavior (see Chapter 4), and the more strongly the individual felt about fairness (Pillutla and Murnighan, 1996). In fact, our results show that each of these motivations has a separate effect on the intensity of anger and thus on the propensity to punish.

Knowing that punishment is triggered by the emotion of anger can help us model this type of behavior. Since the action tendency of anger is to attack (Lazarus, 1991),

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[14]Unfortunately, we do not have enough observations to determine if retaliation deters punishment. Only two first movers experienced both retaliation in part 1 and a second mover who returned less than 150 points in part 2. Given that both of these individuals punished the second mover in part 2, it appears that retaliation did not have much of an effect on them.

and thus to harm whoever is negatively affecting our interests, punishment can be seen as the consumption of a good from which pleasure is derived (Quervain et al., 2004). Interpreting punishment as simply another good allows us to apply standard theoretical economic analysis to an otherwise puzzling phenomenon (see Carpenter, 2004). It is important to point out that, even if anger was triggered by unfair behavior (e.g. deviations from equality or a maximin norm), the goal of angry individuals is to harm the other party, and not, through punishment, to correct unfair material outcomes. In this respect, as is argued by Carpenter and Matthews (2005), there is an important difference between anger-induced punishment by the affected individual and indignation-induced punishment by an unaffected third party. For example, if in our game first movers who got back 50 points used punishment to rectify an unfair distribution of income, they should not spend more than 66.67 points on punishment (this amount gives both players equal earnings). However, a substantial number of first movers punish more than this amount.[15] In this sense, outcome based models of social preferences such as Fehr and Schmidt (1999), and Bolton and Ockenfels (2000) miss an important characteristic of punishment behavior.

An important and yet overlooked aspect of punishment is the emotional reaction of the punished. As was shown in this chapter, prosocial emotions such as shame play a crucial role for the viability of punishment for the enforcement of social norms. In Section 6.6 we have shown that feeling shameful helps explain why some individuals who acted selfishly adjust their behavior whereas others do not. It has been observed that in public good games, the use of non-monetary punishment has a positive effect on contribution levels. For instance, Masclet et al. (2003) use symbolic punishment points and find that, in the short run, they work almost as well as real punishment points. Barr (2001) reports that the public blaming of the free-rider can increase cooperation in future rounds. However, our results indicate that it is the combination of feeling shame and receiving monetary punishment that has a significant effect on behavior. This suggests that shame alone will not have an effect if the cooperative norm is not actively enforced. Hence, although non-monetary punishment has the desirable property that it can affect behavior without destroying resources, the lack of real consequences for free-riders might make this effect deteriorate over time (Masclet et al., 2003). In this sense, as is shown by Noussair and Tucker (2005), the best performing punishment institution is one in which both symbolic and monetary punishments are available.

Another essential role for shame is the prevention of retaliation by punished individuals. As was shown in Section 6.5, even if they acted unkindly, individuals do feel angry when they are punished. However, it is only those individuals who are angry and do not feel shame that decide to retaliate. Therefore, if it were not for some individuals experiencing shame, retaliation would be much more common and punishment of selfish behavior much more costly. For example, if second movers who felt shame had behaved as second movers who felt no shame (controlling for anger) then

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[15]To be precise, 31.3% of the first movers who punished after receiving 50 points back punished, at least once, by more than 66.67 points.

retaliation would have been 42.6% more frequent and 50.6% higher. Furthermore, the decrease in the amount returned from part 1 to part 2 would have been 48.8% bigger. Social emotions like shame are thus essential for the effectiveness of a punishment institution. This fits the assumption that social emotions coevolved with institutions and anger-like emotions in order to limit antisocial actions (Bowles and Gintis, 2003). An interesting question for further exploration is the specific evolutionary mechanisms that lead to this situation.

Finally, even though we did not differentiate in our analysis between shame and guilt, we would like to stress again that the action tendencies of the two emotions are different (Tangney and Dearing, 2002). On one hand, shame is related to a devaluation of the self and therefore, the action tendency of shame is withdrawal and avoidance of further contact. On the other hand, guilt is related to the blameworthiness of an act and is thus more likely to result in reparation and action. Therefore, if an outside option is available in which the experience of shame can be avoided, anticipation of feeling shame might have undesired effects on the prevalence of prosocial behavior (Lazear et al., 2005). In other words, when trying to decrease the frequency of selfish behavior, the attempt to explicitly induce shame, might result in avoidance of further interaction instead of in more cooperation.

Appendix 6.A   Instructions

These are the instructions for the first movers used in the punishment treatment.

6.A.1   Instructions

Part 1

There are two types of participants in this part, participants A and participants B. Half of the persons participating in the experiment will be in the role of participant A, and the other half in that of participant B. **You are a participant A**.

In part 1 of the experiment, you will be randomly assigned a participant B. During this part, you will interact only with this participant B. Moreover, you will not interact again with this participant in part 2 of the experiment. Part 1 consists of three steps. In step one, you must decide whether you will transfer points to participant B or if you will retain the points for yourself. In step two, participant B will decide if he will transfer points to you or if he will keep them himself. In step three, both of you must again make a decision. There are various options in step three, which will be explained below. We will also describe the exact experimental procedure on the next pages.

Procedure for the three steps

At the beginning of part 1 you and participant B will each receive 100 points as earnings.

Step one

At the beginning of the first step you will receive 50 decision points. Participant B will receive no decision points. In step one, you must decide whether you want to transfer your 50 decision points to participant B or transfer no points to participant B. If you transfer the 50 points, they will be multiplied by six, meaning that participant B will receive $6 \times 50 = 300$ points. Then, step two begins. If you decide to transfer nothing part 1 will end here.

Step two

In step two, participant B has to decide whether he will transfer 150, 50 or 0 points to you. You will then receive exactly the number of points B transferred.

Therefore, four possibilities exist after the first two steps:

	Your additional earnings	B's additional earnings
You retain your decision points.	50 points	0 points
You transfer your decision points and B transfers 150 points.	150 points	150 points
You transfer your decision points and B transfers 50 points.	50 points	250 points
You transfer your decision points and B transfers nothing.	0 points	300 points

Hence, after step two your total earnings will be:

100 + the additional earnings from the table above.

Step three

In step three, you will be informed how many points participant B transferred to you. Now, you can assign penalty points to participant B. The assignment of penalty points has financial consequences for both participants, A and B. Each penalty point which you assign costs you one point, while four points are deducted from your participant B. If you assign three penalty points to participant B, this will cost you three points and participant B will have twelve points deducted.

You cannot deduct more points from participant B than his total earnings in that part (i.e. 100 + B's additional earnings). If participant B has 250 points after step 2, then with your assignment of penalty points you can reduce his earnings by at most 250 points. Hence, as long as your participant B has positive earnings, you can assign him as many penalty points as you want. You can also assign him no penalty points.

Participant B will then be informed how many penalty points you assigned him and how many points were deducted from his earnings. If you decided not to assign penalty points, part 1 will end here. If you assigned penalty points to participant B, he can decide to assign penalty points to you. The assignment of penalty points has the same financial consequences as described above. Each penalty point that participant B assigns to you costs him one point, while four points are deducted from your earnings. You can not be deducted more points than the total earnings you own at that moment. If participant B decides to assign no penalty points to you, part 1 will end here.

Note: Participant B can assign penalty points even if his earnings at that point are zero. If he does so, he will lose points in part 1 of the experiment.

If participant B assigned you penalty points, you and participant B will have the option to assign penalty points to each other in turns. Part 1 will end when either you or participant B decides to assign no penalty points, or if either you or participant B

can not be assigned penalty points because your or his earnings are zero or less. In other words, as long as one of you assigns a positive amount of penalty points, the other will have the opportunity to assign penalty points back.

Note that, you will be able to assign penalty points **even if your earnings at that point are zero**. Furthermore, you **can not** be assigned penalty points if **your own earnings are zero**.

Finally

Remember that, you participate in part 1 only **once**. Therefore consider your decisions carefully. At the end of part 1 you will receive instructions for part 2 of the experiment.

[Subjects then had to answer a couple of questions and calculate possible outcomes, to ensure their understanding of the instructions.]

Part 2

We will now give you the instructions for part 2 of the experiment. Also in this part there will be two types of participants, participants A and participants B. Every person participating in the experiment will be in the role they had in part 1. Therefore, you are a participant A.

As in part 1 you will be randomly assigned a participant B. During this part, you will interact only with this participant B. You can be certain that this participant B is not the same person as in part 1.

This part will consist of the same three steps as part 1. Therefore exactly the same instructions apply for part 2 as for part 1. Remember that you will participate in this part only once. Therefore consider your decisions carefully.

Appendix 6.B   Self-Report Measures

6.B.1   To measure emotions:

Indicate how intensely you feel each of the following emotions *right now*, after knowing the amount that B transferred to you?

	not at all				very intensely		
Anger	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Gratitude	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Guilt	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Happiness	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Irritation	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Shame	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Surprise	(1)	(2)	(3)	(4)	(5)	(6)	(7)

6.B.2   State Shame and Guilt Scale (Tangney and Dearing, 2002):

The following are some statements which may or may not describe how you are feeling *right now*. Please rate each statement using the 5-point scale below. Remember to rate each statement based on how you are feeling *right at this moment*.

		not at all		very intensely		
P	I feel good about myself.	(1)	(2)	(3)	(4)	(5)
S	I want to sink into the floor and disappear.	(1)	(2)	(3)	(4)	(5)
G	I feel remorse, regret.	(1)	(2)	(3)	(4)	(5)
P	I feel worthwhile, valuable.	(1)	(2)	(3)	(4)	(5)
S	I feel small.	(1)	(2)	(3)	(4)	(5)
G	I feel tension about something I have done.	(1)	(2)	(3)	(4)	(5)
P	I feel capable, useful.	(1)	(2)	(3)	(4)	(5)
S	I feel like I am a bad person.	(1)	(2)	(3)	(4)	(5)
G	I cannot stop thinking about something bad I have done.	(1)	(2)	(3)	(4)	(5)
P	I feel proud.	(1)	(2)	(3)	(4)	(5)
S	I feel humiliated, disgraced.	(1)	(2)	(3)	(4)	(5)
G	I feel like apologizing, confessing.	(1)	(2)	(3)	(4)	(5)
P	I feel pleased about something I have done.	(1)	(2)	(3)	(4)	(5)
S	I feel worthless, powerless.	(1)	(2)	(3)	(4)	(5)
G	I feel bad about something I have done.	(1)	(2)	(3)	(4)	(5)

[Items are used to calculate SSGS-shame [S], SSGS-guilt [G] and SSGS-pride [P], respectively.]

6.B.3   To measure expectations:

Player A can now assign you penalty points. How many penalty points do you think A will assign to you?
[The subject then entered a point estimate.]

6.B.4   To measure fairness perceptions:

Suppose that participant A transfers the 50 decision points to participant B. Participant B has to choose to transfer back either 150 points, 50 points or 0 points. In your opinion, how fair do you believe is each of these choices: If participant B transfers back 150 (50, 0) points this choice is ... ?
[The subject then filled in three seven-point scales (one for each choice) that ranged from "very unfair" (1) to "very fair" (7).]

Appendix 6.C Tables

Table 6.1: Summary of the behavioral data in the *punishment* treatment

Mean	Part 1	Part 2	Both parts
Points sent (cooperation)	43.4	43.4	43.4
standard deviation	(17.1)	(17.1)	(14.7)
Frequency of cooperation	86.4	86.4	86.4
Number of observations	68	68	68
Points returned	108.5	96.6	103.4
standard deviation	(58.1)	(62.9)	(57.5)
Frequency of returning 150	0.644	0.559	0.614
Frequency of returning 50	0.237	0.254	0.227
Frequency of returning 0	0.119	0.186	0.159
Number of observations	59	59	66
Points spent on punishment	17.3	18.7	18.1
standard deviation	(31.4)	(35.5)	(26.2)
Frequency of punishment	0.305	0.254	0.278
Number of observations	59	59	63
Points spent on retaliation	5.5	5.9	5.2
standard deviation	(8.7)	(10.0)	(8.2)
Frequency of retaliation	0.375	0.444	0.400
Number of observations	16	9	20
Points spent on additional punishment	6.2	24.3	14.2
standard deviation	(8.8)	(28.0)	(20.6)
Frequency of additional punishment	0.600	0.500	0.556
Number of observations	5	4	9

Note: The data in the column "both parts", is the mean behavior of each subject across both parts. In other words, first we take the mean behavior across parts for each subject and then we take the mean across all subjects. In the cases where a subject had only one opportunity to take an action, we take the data from that part as that subjects mean.

Table 6.2: Summary of the behavioral data in the *baseline* treatment

Mean	Part 1	Part 2	Both parts
Points sent (cooperation)	42.3	23.1	32.7
standard deviation	(18.8)	(25.9)	(15.8)
Frequency of cooperation	84.6	46.2	65.4
Number of observations	13	13	13
Points returned	36.4	41.7	35.4
standard deviation	(59.5)	(58.5)	(56.9)
Frequency of returning 150	0.182	0.167	0.167
Frequency of returning 50	0.182	0.333	0.208
Frequency of returning 0	0.636	0.500	0.625
Number of observations	11	6	12

Table 6.3: Mean emotional intensity of *first movers* after observing the amount returned by the second mover in the *punishment* treatment

Emotions	Got back 150 ($N = 53$)	Got back 50 ($N = 27$)	Got back 0 ($N = 17$)
Anger	1.1	4.5	5.8
standard deviation	(0.5)	(1.9)	(1.5)
Irritation	1.2	5.0	6.1
standard deviation	(0.7)	(1.5)	(1.5)
Happiness	6.1	2.3	1.8
standard deviation	(1.0)	(1.4)	(1.1)
Gratitude	4.9	2.4	1.6
standard deviation	(1.8)	(1.7)	(1.1)
Shame	1.2	1.9	2.9
standard deviation	(0.5)	(1.6)	(2.3)
Guilt	1.1	1.3	1.8
standard deviation	(0.5)	(0.9)	(1.7)
Surprise	4.2	3.9	4.5
standard deviation	(1.6)	(1.7)	(2.5)

Table 6.4: Mean emotional intensity of *first movers* after observing the amount of retaliation they received from the second mover

Emotions	No Retaliation ($N = 14$)	Positive Retaliation ($N = 10$)
Anger	1.9	3.6
standard deviation	(1.5)	(2.2)
Irritation	2.4	4.7
standard deviation	(1.7)	(2.2)
Happiness	3.4	2.6
standard deviation	(1.8)	(1.3)
Gratitude	2.4	2.7
standard deviation	(2.0)	(1.9)
Shame	2.1	1.3
standard deviation	(1.8)	(0.9)
Guilt	2.1	1.5
standard deviation	(1.9)	(1.1)
Surprise	4.8	2.3
standard deviation	(1.9)	(1.6)

Note: The emotional reaction of first movers, as summarized in Tables 6.3 and 6.4, concerns data from the punishment treatment. However, in the baseline treatment, the emotional reaction of first movers was statistically indistinguishable from the one in the punishment treatment. It seems that the opportunity to punish does not affect how first movers feel about the amount returned to them by second movers.

Table 6.5: Mean emotional intensity of *second movers* after observing the amount of punishment received from the first mover in the punishment treatment

Emotions	No Punishment	Below Median Punishment	Above Median Punishment
	($N = 55$)	($N = 14$)	($N = 13$)
Anger	1.1	3.6	3.9
standard deviation	(0.8)	(2.2)	(1.9)
Irritation	1.3	3.5	4.8
standard deviation	(1.2)	(2.3)	(2.3)
Happiness	5.0	2.4	1.5
standard deviation	(1.6)	(1.4)	(0.8)
Gratitude	4.0	2.5	2.3
standard deviation	(2.0)	(1.5)	(1.7)
Shame	1.2	1.3	1.7
standard deviation	(0.9)	(0.6)	(1.1)
Guilt	1.4	1.8	1.9
standard deviation	(1.1)	(1.3)	(1.3)
Surprise	2.5	4.0	5.2
standard deviation	(1.9)	(2.1)	(2.1)

Table 6.6: Ordered Probit model estimating second movers anger (using robust standard errors and clustering on each subject)

Variable	Coefficient	Std. Error	*p* Value
Return	-0.349	0.263	0.185
Punishment if Return = 150	0.228	0.062	0.000
Punishment if Return = 50	0.038	0.006	0.000
Punishment if Return = 0	0.024	0.005	0.000
Expected Punishment	-0.004	0.003	0.185
Fairness of Returning 50	-0.101	0.137	0.460
Economist	-0.199	0.315	0.528
Female	0.272	0.353	0.441
$N = 118$		$\chi^2(8) = 132.23$	
Log likelihood $= -82.549$		Prob $> \chi^2 = 0.000$	

Note: [*Return*]: $= 0$ if the return was 0 points, $= 1$ if return was 50 points, $= 2$ if return was 150 points.
[*Punishment if Return $= x$*]: $=$ amount of punishment if return was x, $= 0$ otherwise.

Chapter 7

Prospect Based Emotions and Risk*

> *Two roads diverged in a yellow wood*
> *and sorry I could not travel both*
> *And be one traveller, long I stood*
> *and looked down one as far as I could*
> *to where it bent in the undergrowth;*
>
> *Then took the other, as just as fair,*
> *and having perhaps the better claim*
> *because it was grassy and wanted wear;*
> *though as for that, the passing there*
> *had worn them really about the same,*
> *...*
> *I shall be telling this with a sigh*
> *Somewhere ages and ages hence:*
> *Two roads diverged in a wood, and I–*
> *I took the one less travelled by,*
> *and that has made all the difference.*
>
> Robert Frost (1915, [1993])

In the previous chapters we showed that experienced emotions influence behavior in the Power-to-Take game and in a social dilemma. We will now turn to the influence of anticipated emotions on behavior. Specifically we will concentrate on the anticipation but also on the experience of prospect based emotions.

In a number of theories of risky choice, the anticipation of emotions is assumed to influence the behavior of the decision makers. Theories referred for example to regret (Bell, 1982; Loomes and Sugden, 1982), disappointment (Bell, 1985; Loomes and Sugden, 1986) and anxiety (Wu, 1999; Caplin and Leahy, 2001). In these it is assumed that agents attempt to optimize their anticipated emotional experience. The empirical

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*This chapter is based on joint work in progress with Frans van Winden.

question to be answered is if indeed emotions are anticipated and taken into account and if the answer is yes, whether the anticipation is correct. Further and even more important is *which* emotions are anticipated. As we already have seen any situation will lead to the experience of a multitude of emotions. If only some of these are anticipated, the specific selection will be crucial for defining behavior. Experiments show that agents are certainly not perfect in anticipating future emotional states (Zeelenberg, 1999). Loewenstein and Schkade (1999) consider three reasons for such errors. First, errors might be caused by erroneous theories about feelings. Second, they may result from unexpected shifts in the salience of events in the future. And third, errors might be due to problems in predicting the impact of visceral factors caused by the so called hot-cold empathy gap. This gap may lead to the underestimation of future visceral factors but may also lead humans to overestimate their future feelings (Gilbert and Wilson, 2000).

There is also some evidence for the impact of experienced emotions on decision making under risk. Especially it has been noted that good and bad moods influence risk behavior in laboratories (Isen, 2001) and in the real world (Kliger and Levy, 2003). Furthermore, it has been observed that induced anxiety appears to increase individuals preferences for low-risk, low-reward options (Raghunathan and Pham, 1999). If indeed the anticipation of emotional states is not perfect, actual experienced emotions might influence behavior in a way that could not have been foreseen by the decision maker, which might lead to time inconsistencies. To get to know these effects, a thorough analysis of both anticipated and experienced emotions related to decision making under risk and uncertainty is needed.

In this chapter we will present three experiments designed to systematically investigate the interaction between anticipated emotions, behavior, and experienced emotions, in a setting involving decision making under risk. For simplicity we will consider a simple one-person and one-shot investment game. Decisions concern the allocation of real money to two projects, one of which is safe while the other is risky. Changes in investment behavior are studied, when a "global risk", that is, a risk threatening any investment, is included. Investment behavior is especially interesting in this context, since emotions are frequently claimed to influence investors (see e.g. Sacco et al. (2003) on the emotional impact of global terrorism on investment). However, these claims are typically grounded on anecdotal evidence.

Global risk is clearly separate from the decision risk in our experiment. Subjects should therefore be well aware of the two risk stages they are about to face. It seems that such two-stage gambles are perceived differently when the risk from the two stages is combined and the lottery is presented with the joint probabilities (Kahneman and Tversky, 1979). However our interest lies further in the question if the order of these stages will influence choices. In real life decision problems the order of such stages might vary (Cubitt and Sugden, 2001). To our knowledge the effects of a systematic shift of a global risk from a time before the decision, to after the announcement of outcomes has not yet been studied. Further our experiment differs from many earlier investigations of risky choices, by not only considering binary gambles but giving

subjects a much wider choice of investment. Real-world risk is seldom limited to two outcomes (Lopes, 1987) but also rarely to two choices. Continuous investment has been investigated before by Bosman and van Winden (2005). In this study global risk was resolved after the outcome of the investment was known to subjects. We will extend this analysis to different timing variants of the global risk and will include more refined measures of the emotions that Bosman and van Winden (2005) had earlier observed to be influential for the investment decision.

7.1 What are Prospect Based Emotions?

In this chapter we will discuss prospect based emotions (see Figure 2.3). These are a number of different emotions that are all characterized as either reactions to the prospect of an event or to the resolution of the prospect of that event (Ortony et al., 1988). Prospect based emotions are for example hope and anxiety that are elicited by a situation with uncertain outcome, the anticipation and experience of disappointment or elation and if the situation involves decisions: regret or rejoicing. The interplay of these experienced and anticipated emotions will influence decision making.

Regret and rejoicing concern the comparison between two states of the world: the actual outcome and an outcome that might have been. Regret is felt when this other outcome would have been preferable and rejoicing if the realized outcome is the preferred situation.[1] In this they are related to disappointment. But while disappointment is the negative feeling from imagining what might have been, had another state of the world occurred, regret is directed at the decision that led to that outcome. Therefore the experience and anticipation of regret and rejoicing is a highly cognitive process. If we are not aware of the impact of our behavior, we will attribute good or bad outcomes to "chance" and feel happy or disappointed, but no rejoicing or regret. Regret is thus a negative emotion that is elicited when we are aware that outcomes would have been better had we acted differently.[2]

A simplified definition is used by regret theory (Bell, 1982; Loomes and Sugden, 1982). Regret is seen as the situation where "after making a decision a person might learn that another alternative would have been preferable" and regret is assumed to be represented by the "difference in value between the assets actually received and the highest level of assets produced by other alternatives" (Bell, 1982). This definition implies that regret is a simple function of this difference in assets and that positive as well as negative levels of regret can be experienced. In Bell (1982) it is further assumed that decision makers act according to the von Neuman and Morgenstern axioms and in this base their decision on their final asset and the foregone asset.

In laboratory and field experiments it has been shown that outcomes and what

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[1]It seems that regret and rejoicing are not simply opposites of each other (Connolly and Zeelenberg, 2002). In our experiment we will therefore measure both emotions.

[2]Interesting to note is that regret is not only caused by actions but can also be caused by omission of action (Gilovich and Medvec, 1995).

"could have been" indeed elicit regret and disappointment (Mellers and McGraw, 2001; Camille et al., 2004; Zeelenberg and Pieters, 2004). The interesting question is how the anticipation of regret is influencing decisions. Further, complex real life situations might exclude the possibility of not experiencing any regret. For example, when facing the decision about their social security savings, no matter which decision is taken, investors might also learn about the outcome from the other options. Thus independent of their decision, investors might experience regret (Loewenstein, 1999). This regret might be focused at either having not invested enough or having invested too little. If regret is anticipated from all choices, it is important to find out *which* regret people focus on when making their decisions.

The anticipation of regret and thus the dread of a bad outcome is linked to the feeling of anxiety. Anxiety is one of a number of fear emotions as for example nervousness, fear and feeling worried (Ortony et al., 1988). The difference to fear is that fear is related to a specific event or situation that people are usually aware of. The cause of anxiety is usually vague and not very specific and people are often unaware of it. Anxiety can be seen as a "caution" or "inhibition" response, protecting us from unacceptable risk (Frijda, 1986). "Anxiety" is very often also used as synonym for "anxiety disorder". Anxiety disorders are the extreme case when any situation can lead to anxious reactions and thus normal behavior is not longer possible. Similar to the anticipation of regret, the experience of or disposition for anxiety might influence risk taking, for example through focusing attention on the anxiety evoking event (Oatley and Jenkins, 1996).

Similar to regret, anxiety has been modelled by including its negative hedonic value in the utility function (Wu, 1999; Caplin and Leahy, 2001). For example Caplin and Leahy (2001) expand the standard prize space to include anticipatory emotions as anxiety, assuming that anxiety is a negative emotion that subjects try to avoid.

Irritation is an emotion that can be associated with the experience of anxiety but is also linked to the feeling of anger (Parrott, 2001). While anxiety might be related to more risk aversion, anger has been found to be related to more risk seeking behavior (Lerner and Keltner, 2001). Irritation is thus an interesting emotion to observe, since its experience might lead to more as well as less risk taking.

Finally we will also observe hope in our experiments. Hope somewhat contrary to anxiety is the feeling of pleasure about the prospect of a desirable event (Ortony et al., 1988). Hope has been shown to be essential to deal with stressful events (Lazarus, 1999) and the extent of its experience might be related to the willingness to take risk in financial situations (Lopes, 1987).

7.2 Emotions in an Investment Dilemma

The fact that risk can only partially be controlled, is one of the challenges of most real life investment decisions. While part of an investment decision is always a decision

about how much risk an investor is willing to take, often a further risk is looming that threatens the outcome, no matter what the decision of the investor. Global terrorism and political instability are only two examples of such uncontrollable risk (e.g. Brueck and Wickstroem, 2004; Drakos, 2004; Eldor and Melnick, 2004).

In this chapter we want to study how the existence and the timing of such risk will influence investment behavior. The choice problem we study concerns the distribution of an amount of money over a safe option and a risky option when a "global risk", that is, a chance of losing all earnings, is present. Whether such risk threatens earnings or capital before profits are realized, might influence investment behavior, if regret is anticipated. We therefore analyze treatments, where we vary the timing of the global risk. To observe the impact of these variations on the perception of the decision problem, we measure anticipated and experienced emotions during the task.

Our results show that investment behavior is roughly quite similar in all treatments involving global risk. At the same time affective reactions across treatments differ. Anticipation of regret and rejoicing are to a varying degree taken into account and experience of anxiety, hope and irritation influence behavior. This can help explain variations of investment that have previously been observed in experiments and some of the variations we observe. Framing and presentation of the investment problem can vary the extent of the emotional impact on behavior and only if emotions are measured we can start to understand the underlying reactions leading to behavior.

We will discuss in this chapter, first the influence of the presence of global risk on investment (Experiment I). Then we will turn to variations in the timing of the resolution of the global risk, relative to the resolution of the decision risk and the time of decision (Experiment II). Finally we will extend this analysis in combination with a discussion of the impact of stake size and emotion measures (Experiment III).

7.3 Experiment I: Global Risk and Emotions

In our first experiment we investigate investment behavior when a global risk is either present or absent. Besides being interested in behavioral differences, we are interested in the relation of experienced and anticipated prospect based emotions to investment. To account for these we measure anxiety, regret, rejoicing, hope and irritation.[3].

7.3.1 Decision problem

In the *baseline* problem, subjects have to allocate once and for real, an amount of money z to two options, one of which is safe while the other is risky. The safe option returns the investment with certainty, therefore yielding neither gains nor losses. The risky option returns 2.5 times the amount invested with probability $p = 1/2$, and with

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[3]Specifically we measure anxiety trait, anxiety state before and after the decision, anticipated and experienced regret, rejoicing and disappointment, and further before the decision the experience of a number of emotions including hope and irritation. For an overview see Appendix 7.A.
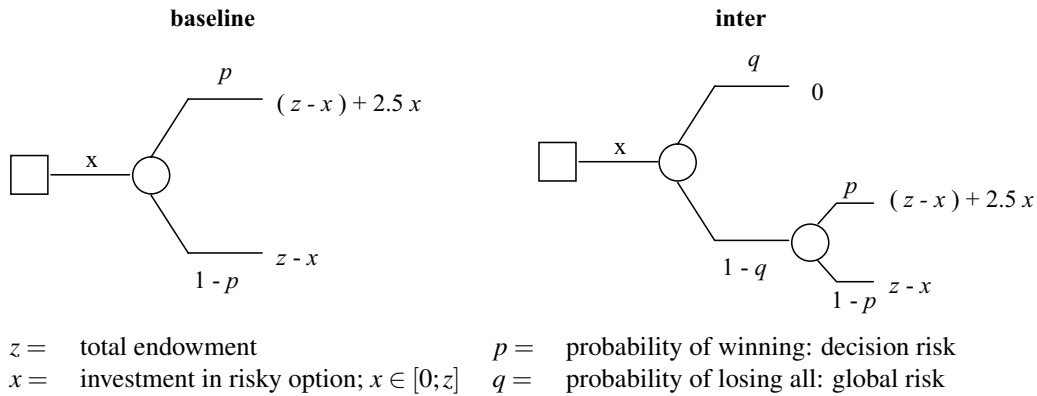
Figure 7.1: Game trees for *baseline* and *inter*.

probability $(1 - p) = 1/2$ nothing (decision risk). In the following we will only speak of investment $(= x)$, when the money is allocated to the risky option.

We will compare this *baseline* problem with treatment *inter*, where we included a global risk. This means that subjects lose all their earnings (i.e. the returns from the safe and the risky option) with probability $q = 1/3$. This "global risk" is resolved independently for each participant. The global risk was resolved before subjects knew the outcome of the risky project. With *inter* we refer to a situation where global risk was resolved *in between* the taking of the investment decision and the resolution of the global risk. Thus, subjects who lost due to the global risk did not learn about the outcome of the risky project. Figure 7.1 presents the decision trees. Note that in our experiment the investment decision was *not* a binary choice between a safe prospect (A):$(z, 1)$ and a risky prospect (B):$(2.5 \times z, 0.5)$. Subjects had the opportunity to split their total endowment over the two projects in the way they preferred. A binary representation would make sense if only extreme choices are made by subjects, but as we will see in the following, many subjects chose for intermediate investment. Therefore a binary choice might obscure the actual preferences for investment.

We will compare our observations from *inter* with *baseline* to account for investment and emotion-investment interaction differences when global risk was present. It has been observed that in binary choices a common probability of losing, included in a set of prospects, is shifting investment behavior to more risk seeking choices (common ratio effect) (e.g. Allais, 1953; Camerer, 1995). But interestingly this is not the case if prospects are decomposed and the common component of the risk of losing is presented separately (Kahneman and Tversky, 1979; Cubitt et al., 1998). According to the isolation effect, a risky stage that is shared by all prospects, is ignored by subjects and only the remaining decision problem is considered. Our treatment *inter* is similar to the binary choice problem ("Problem 10") investigated by Kahneman and Tversky (1979) and the identical "Precommitment" problem of Cubitt et al. (1998). Common is, that also in these problems after a choice is made, there is a first stage where with a certain probability the game ends, and a second stage where the risk of the gam-

ble is resolved. In an investment problem in which subjects could decide on which fraction of their endowment they want to invest, Bosman and van Winden (2005) find that global risk is leading to less investment. Specifically they observe that two counteracting forces seem to influence investment under global risk. Namely anxiety that decreases investment and irritation that increases investment. However the resolution of the global risk was in this case after the resolution of the decision risk.

The existence of a global risk does not influence investment according to classical expected utility theory. Theories including a probability weighting function, e.g. rank-dependent utility theory and cumulative prospect theory (Quiggin, 1982; Tversky and Kahneman, 1992), can predict changes in behavior under global risk. In these theories the common risk does not cancel out and using an inverse-S shaped probability weighting function, we should observe more investment under global risk. This being the case if the reference point is taken as either zero or z. Dependent on the chosen utility function, both theories can also predict intermediate investment. For a more detailed discussion of the application of these theories to our investment situation, see the formal discussion in Bosman and van Winden (2005).

In the experiment both experienced and anticipated emotions were measured by self-reports. To measure anticipated emotions it is necessary to ask subjects to rate their feelings for a hypothetical future outcome. Experienced emotions are measured by having subjects indicate how they feel at the very moment. For an overview of the measurements see Table 7.1 and Figure 7.2.

To measure anxiety we used the well known and validated Spielberger state trait anxiety inventory, abbreviated as STAI (Spielberger et al., 1970). The Spielberger scale is considered as an "excellent measure of both types [state and trait] of anxiety" (Kline, 1993) and is widely used. The scale consists of two sets of 20 questions which are answered on a four point scale (see Appendix 7.A.1). A general score is computed from the detailed answers, which represents either the general disposition for anxiety (trait scale) or the experienced anxiety at the moment when the questionnaire is filled out (state scale). Anxiety state was measured before and after the investment decision was taken, while anxiety trait was measured before the start of the experiment.

Theories accounting for the anticipation of anxiety would expect more risk averse choices if high levels of anxiety are anticipated (Wu, 1999; Caplin and Leahy, 2001). We do not explicitly measure anticipated anxiety in our experiment. However the assumption that people with a strong disposition for anxiety (high anxiety trait) are more likely to experience and to anticipate anxiety, would lead us to expect risk averse investment for subjects with high anxiety trait.

Experienced and anticipated regret were measured in three different ways (see Appendix 7.A.2). First, the anticipation of regret and rejoicing while making the decision was measured.[4] Second, subjects were asked to imagine a hypothetical scenario where they lose their actual investment, because of a negative outcome of the risky project.

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[4]Only subjects that indicated that they took their emotions into account while making their decision (variable: importance emotions), were asked about anticipated regret and rejoicing.

Table 7.1: Emotion measures used in the experiment.

| Variable name:	Moment of measure:	Comments:
anxiety		
STAI-trait	Before start of experiment.	General disposition to anxiety.
STAI1	Before decision was made.	Experienced anxiety prior to decision.
STAI2 (see Appendix 7.A.1)	After decision was made.	Experienced anxiety after taking of decision.
regret, rejoicing and disappointment		
regret-B rejoicing-A rejoicing-B regret-A	After decision was made.	Anticipated regret and rejoicing Regret as motivation for project B. Rejoicing as motivation for project A. Rejoicing as motivation for project B. Regret as motivation for project A.
regretR rejoicingR		Relative measure of regret (rejoicing) regret-A - regret-B rejoicing-B - rejoicing-A
regretE disappointmentE	After decision was made.	Estimation of regret (disappointment)
regretX disappointmentX (see Appendix 7.A.2)	After outcome was known.	Experienced regret (disappointment) after outcome.
other measures		
importance emotions	After decision was made.	Importance of emotions for decision
hope1 irritation1 (see Appendix 7.A.3)	Before decision was made.	Experienced hope (irritation) before the decision.
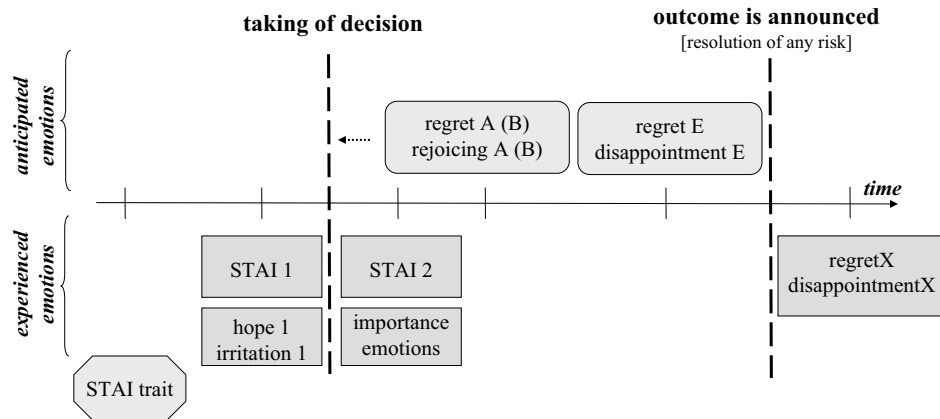
Figure 7.2: Time-line of emotion measures and their respective point of reference.

Participants had to indicate their estimated level of regret (regretE) and disappointment (disappointmentE) on a scale adopted from Zeelenberg et al. (1998). The items of the scale were previously found to be significantly correlated with the two emotions. Because of the quick succession of two questions regarding regret, this indirect measure was chosen, thus minimizing the probability that subjects try to be consistent in their answers. Both anticipated and estimated regret were asked after subjects had made their decision. Finally, experienced regret (regretX) and disappointment (disappointmentX) were measured at the end of the experiment. In *inter* this was after the outcome from both risks was known and in *baseline* after the resolution of the decision risk.

Theories of regret would predict that the decision is made from which the lowest level of regret is anticipated (Bell, 1982; Loomes and Sugden, 1982). Our measure of anticipated regret and rejoicing informs us about the relative importance subjects assign to the experience of these emotions. We therefore expect that a high level of regret expected from a choice, will lead to behavior that will try to avoid this outcome.

To control for the experience of other emotions, we measured the experience of surprise, hope, sadness, happiness and irritation before the taking of the decision. Because of their specific relevance for the situation at hand, we will in the following concentrate on the results for hope and irritation (hope1, irritation1).

Because the experiment consisted of only one decision situation, we will discuss the effects of emotions on behavior from an "inter-individual" point of view. Therefore, treatment effects will be investigated across different groups of subjects. The limitation of this approach is that we have to assume that the emotional mechanisms are the same across subjects. But an "intra-individual" comparison might involve even

greater complications, due to uncontrollable spillover effects of emotions from one game situation to another.

7.3.2   Experimental procedures

Upon entering the reception room, subjects were handed the STAI trait scale, which they filled out in quiet. When everybody had finished, the questionnaires were collected and subjects where invited to enter the computer lab. Neither names nor any other information was recorded in combination with the questionnaire. Questionnaires were later linked through the seat number subjects had randomly chosen when entering the lab. Thus all information was confidential and anonymous. After subjects were seated in the lab, each participant received an envelope with 15 euro in coins and bills, and was informed that this would form their working money for the following experiment. Subjects were told that if they would lose money in the game (i.e. their earnings in the experiment are less than 15 euro), they would have to pay back the difference to the experimenters after the session. If their earnings turn out to be more than 15 euros, the additional amount would be paid out to them after the experiment. After subjects had controlled the content of their envelops, instructions were handed out and read aloud by the experimenter and any questions were answered. The instructions informed subjects about the investment decision they had to make (for a translation see Appendix 7.B.2). The experiment was explained as consisting of three phases. In the first phase instructions were given, in the second phase the decision had to be made and in the third phase the outcome of the projects was decided. Subjects were informed that they have to allocate their working money to two projects, one of which returned the investment with certainty, while the other had a probability of $p = 1/2$ to return 2.5 times the investment and a probability of $(1 - p) = 1/2$ of returning nothing. Subjects were told that they would have to determine the outcome of the risky project themselves, by rolling a dice. In treatment *inter* subjects were additionally informed before the general instructions were given, that they were to face a risk of $q = 1/3$ to lose all their possible earnings in the experiment (Appendix 7.B.1). Each subject would have to determine the outcome of this risk for himself by rolling a second dice in the presence of the experimenter. When no further questions were asked, subjects were informed that they had to make their investment decision and fill in their choice in a computerized form. From this point on, subjects went individually through the questions of the experiment and were not further interrupted.

The first computerized form presented to subjects was the STAI-state scale. Then subjects had to rate to which degree they felt: hopeful, surprised, sad, happy and irritated, at that point in time. After they had filled out the questionnaires, they were asked to fill in their investment decision for the two projects, which were labelled A and B (investment_t1). The fractions allocated to the two projects could be any multiple of 50 cent and had to add up to 15 euro. Upon pushing a button to continue in the experiment, subjects were presented again with the questions of the STAI-state scale. Now they were asked to record their anxiety after they had made their investment decision

but still before they knew the outcome of the gamble. They were then asked if they had taken their future emotions into account when they made their decision and to which extent the anticipation of regret and rejoicing influenced their decision. Next subjects had to estimate to which degree they would experience regret and disappointment in case they lose their investment. Finally subjects had to confirm their decision and were given the option to alter their decision if they wanted (investment_t2). When all subjects had made their final decision, the experimenters went through the room to have each subject resolve the decision risk by rolling a (white) dice and to record the result. In *inter* this was preceded by rolling a (red) dice to resolve the global risk. In *inter* subjects that lost due to the global risk did not roll the white dice and therefore did not learn about the outcome of their investment. After subjects learned the outcome of their investment and of the global risk, they were asked some general questions including the question if they felt regret about their decision or disappointment about the outcome. Subjects were then paid out one by one. If subjects earned less than their working money they were required to pay back the difference to the experimenters.

The experiment took about one hour and was conducted in the CREED laboratory at the University of Amsterdam, in May 2003. Subjects were recruited from various fields and in total 76 students participated in the experiment. Participants received 2.50 euro as show up fee. Average total earnings were 18 euro (approximately $ 22).

7.3.3 Results

Investment

Figure 7.3 presents the investment decisions. In *inter* significantly higher investment is observed than in *baseline* (Mann-Whitney, $p = 0.011$). Further, note that in *inter* many subjects decided to invest all their money (approximately 23 %). Thus even though the global risk was clearly separated in our experiment, investment behavior is in *inter* not the same as in *baseline*. In contrast to Kahneman and Tversky (1979) and Cubitt et al. (1998) we find no evidence for the isolation effect. Overall, age, field of study (economics or not) and previous experience with economic experiments do not influence investment. In total only three subjects changed their investment decision when given the opportunity. Therefore, we will in the following report only results from investment_t1.

Emotions and Behavior

Global risk shifted investment to higher values. Now we want to see if this is correlated with the experience and anticipation of emotions. To observe the importance of emotions for the investment decision, we present regressions of investment on anxiety state, anxiety trait, experienced hope, irritation and a measure of the importance of re-
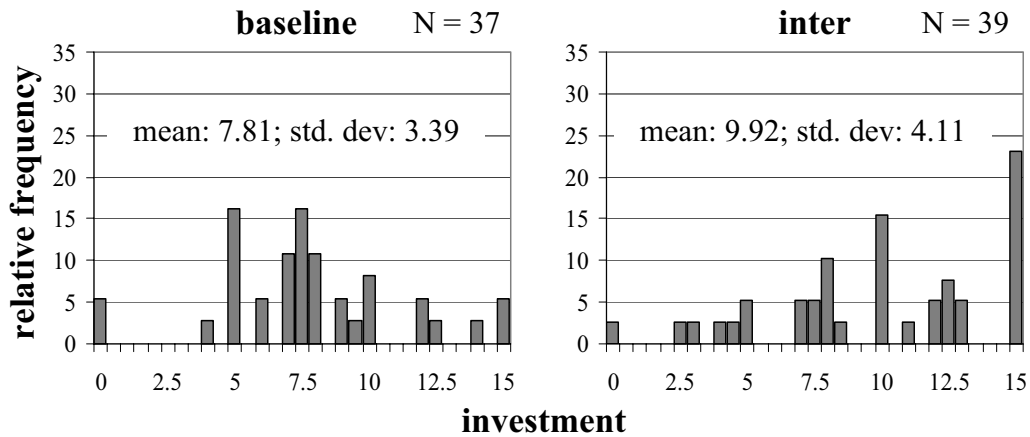
Figure 7.3: Histograms of investment (time t1).

joicing[5]. We do not include regretR because in both treatments regretR and rejoicingR are negatively correlated (Spearman, -0.560, $p = 0.000$). As we will see later both variables can account for the same effect.

We hypothesize a negative impact of anxiety, according to the psychological evidence that anxiety is leading to more risk averse behavior (Raghunathan and Pham, 1999; Lerner and Keltner, 2001; Loewenstein et al., 2001). Because we expect STAI trait and STAI state to be strongly correlated we can not predict which of the two variables will be more influential. Concerning irritation we might expect a positive or a negative impact. If irritation is related to anxiety (Bosman and van Winden, 2005) the impact could be negative but if irritation is related to anger we might expect a positive relation with investment (Leith and Baumeister, 1996). For both hope and rejoicing we expect a positive relation with investment.

Across the two treatments we observe very similar regression results (Table 7.2), specifically none of the coefficients is significant different across treatments (F-test, $p > 0.299$). When pooling observations from the two treatments, we observe significantly higher investment in *inter* (dummy for inter: Coef. $+1.950$, $p = 0.024$). Our predictions concerning the impact of emotions on investment are partially confirmed. Hope shows a significantly positive coefficient. The effect of hope is especially interesting considering that a positive correlation between risk preferences and being hopeful seems to be a widely shared intuition but could for example not be confirmed by Chew and Ho (1994). Further, the relative importance of rejoicing leads to more investment if expected rejoicing from investment is high. If we include regretR in place of rejoicingR in the regression, we observe a weaker and opposed effect (regretR: Coef.

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[5]The relative importance of rejoicing is the difference of the two anticipated rejoicing measures. That is rejoicingR = rejoicing-B - rejoicing-A. Anticipated rejoicing was only measured for subjects responding "yes" to *importance emotion*. If the answer was "no" rejoicingR is set equal to zero.

Table 7.2: Censored tobit regressions of investment on emotions.

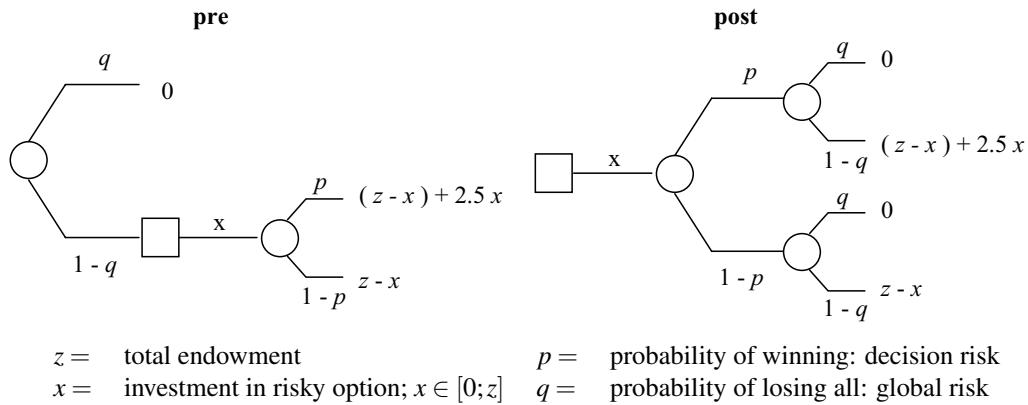| Part A: *baseline*				Part B: *inter*			
2 obs. left-censored;				1 obs. left-censored;			
2 obs. right-censored				9 obs. right-censored			
Number of obs		=	37	Number of obs		=	39
LR $\chi^2(5)$		=	22.89	LR $\chi^2(5)$		=	20.46
Prob $> \chi^2$		=	0.000	Prob $> \chi^2$		=	0.001
Pseudo R^2		=	0.120	Pseudo R^2		=	0.103
invest t1	Coef.	Std. Err.	$P > |t|$	invest t1	Coef.	Std. Err.	$P > |t|$
STAI-trait	-0.055	0.069	0.433	STAI-trait	-0.038	0.108	0.728
STAI1	0.049	0.078	0.532	STAI1	-0.004	0.068	0.952
hope1	3.742	0.857	0.000	hope1	2.529	0.999	0.016
irritation1	-1.506	0.779	0.062	irritation1	-1.818	0.757	0.022
rejoicingR	1.618	0.462	0.001	rejoicingR	1.884	0.567	0.002
Intercept	-1.120	3.848	0.773	Intercept	6.469	4.701	0.178

-0.993, $p = 0.026$). Anxiety state and trait do not show a significant impact on investment. The two variables are strongly correlated (Spearman, 0.558, $p = 0.000$), but even when either one of the two variables is left out of the regression, neither anxiety state nor trait are significant. This is surprising given the widespread opinion that anxiety should influence risk taking and recent evidence of a relation of activation in the anterior insula (which is claimed to be related to self-reported anxiety) and risk aversion (Kuhnen and Knutson, 2005). Interestingly, irritation shows a negative coefficient and is indeed correlated with STAI1 (Spearman, 0.244, $p = 0.034$).

We summarize that in both treatments emotions are related to investment in a very similar way. Higher investment in *inter* is to some extent due to factors that we can not explain with the emotions we measured. But further the absolute difference in emotions influences investment. We observe that experienced hope, one of the most influential emotions in this model, is significantly higher in *inter* (Mann-Whitney, $p = 0.018$).[6] Irritation and the amount of relative rejoicing are not significantly different. We summarize the findings from this section as:

Result 7.1

1. *In* inter *investment is higher and more extreme than in* baseline. *In contrast to other studies we therefore do* not *find evidence for the isolation effect.*

2. *The interaction of emotions and investment is very similar across treatments. Hope and the anticipation of rejoicing are related to more investment. Anticipated regret and rejoicing are correlated and regret has a weaker and opposed*

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[6]Mean for hope 1: *baseline*, 2.946; *inter*, 3.282

| $z =$ | total endowment | $p =$ | probability of winning: decision risk |
| $x =$ | investment in risky option; $x \in [0;z]$ | $q =$ | probability of losing all: global risk |

Figure 7.4: Game trees for *pre* and *post*.

effect on investment than rejoicing. Neither anxiety state nor anxiety trait are significantly related to investment. However for experienced irritation, a correlate of anxiety state, we observe a negative relation.

7.4 Experiment II: The Timing of Global Risk

In our investment problem global risk led to more extreme investment. Furthermore hope, irritation and anticipation of rejoicing and regret seem to play a role when deciding about investment. We now want to investigate whether the investment changes in *inter* are due to the existence or the timing of the global risk. Specifically we want to see if changes in the timing of the global risk will influence emotions and if these in turn influence decision making. Specifically in our second experiment we will discuss two timing variants.

7.4.1 Decision problem

In treatment *pre*, the global risk was resolved before subjects had to make their investment decision. Therefore subjects for whom the global risk ended well, were basically confronted with the same decision problem as subjects in *baseline*. Subjects who lost due to the global risk, knew that they would not be able to earn money in the experiment and were simply asked to answer the questions hypothetically. In treatment *post*, the global risk was resolved after subjects knew their earnings from the risky project (see Figure 7.4).

Concerning these additional treatments, we will compare how the experience of anxiety and hope is influenced by the timing of the risk, and further how regret, rejoicing and disappointment are influenced by the prospect to experience either emotion. The theories of regret (Bell, 1982; Loomes and Sugden, 1982) and disappointment

(Bell, 1985; Loomes and Sugden, 1986) assume that decision makers will act to avoid the experience of these emotions. Dependent on whether the resolution of the global risk is either before or after the resolution of the decision risk, average experienced regret and disappointment might vary. Therefore, in treatment *inter* (where regret will less often be experienced) the anticipation of regret might be less important for the decision, compared to *post*.

Finally the existence of global risk might not be the only factor influencing investment. Specifically it has been noted that a violation of timing independence can lead to lower investment when the outcome of the global risk is already known, than when the risk is still threatening (Cubitt et al., 1998).[7] This is related to the hypothesis that a "survival" of the global risk might lead to an increase in happiness, which according to the mood maintenance hypothesis (e.g. Isen and Simmonds, 1978) can lead to risk averse behavior. We will compare treatment *pre* with treatments *inter* and *post* to account for such an effect.

Theoretical predictions from rank dependent utility theory and cumulative prospect theory would predict no differences between *inter* and *post*. If we allow for different probability weighting functions, dependent on the affective strength of the situation (Rottenstreich and Hsee, 2001), we might expect more investment for the more affect-rich situation. Finally if we expect that *pre* will shift the reference point from zero to z, we might expect (e.g. for a loss aversion parameter of $\lambda = 2$) less investment compared to *baseline*.

7.4.2   Experimental procedures

The experimental procedures were the same as for *baseline* and *inter*. The sole difference was that in treatment *pre* the experimenters went through the room to have each subject roll the red dice (to determine the outcome of the global-risk) *before* subjects made their investment decision (Appendix 7.B.1). Subjects were then asked to make their investment decisions, where subjects that lost were asked to remain seated till the experiment was over and answer the investment questions hypothetically. In *post*, the global risk was resolved after subjects knew the outcome of the global risk. Experienced regret and disappointment were measured after both risks were resolved to subjects.

The experiment lasted about one hour and was conducted in the CREED-laboratory at the University of Amsterdam, during May and September of 2003. Subjects were recruited from various fields and in total 116 students participated in the experiment.

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[7]*Timing independence* is defined as a situation where "an agent, if required to precommit to an action to be taken conditional on a prior act of nature, precommits to the action which would be chosen if the moment of choice was delayed until after that act of nature." (Cubitt et al., 1998, p.1366)
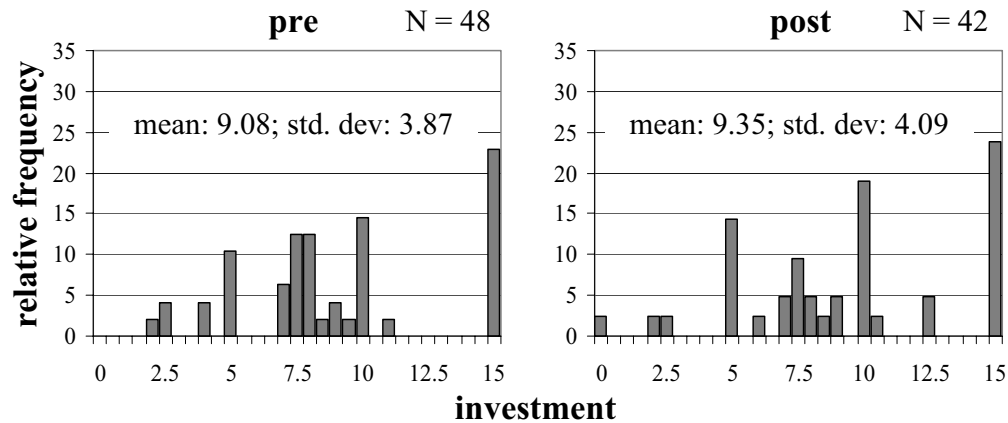
Figure 7.5: Histograms of investment (time t1).

Participants received 2.50 euro as show up fee. Average total earnings were 12.75 euro (approximately \$ 16).

7.4.3   Results

Investment

In Figure 7.5 we present investment from treatments *pre* and *post*. Observations for *pre* are only for subjects that did not lose their working money.[8] Overall the two treatments show very similar investment (Mann-Whitney, $p = 0.653$). If we also include treatments *baseline* and *inter* from Experiment I in the analysis, we observe that all the treatments involving global risk show similar investment (Mann-Whitney, $p > 0.247$). Therefore *pre* does not seem to result in a reference point shift leading to less investment and we also do not observe the violation of timing independence noted by Cubitt et al. (1998). A violation of timing independence would suggest similar behavior in *baseline* and *pre* and a significant difference between *pre* and *inter*. However the difference to *baseline* is more pronounced for *inter* and *post* than for *pre* (for an overview of tests see Table 7.8 in Appendix 7.C).

In all treatments involving global risk we observe a very similar proportion of maximum investment (approx. 23%), which is significantly higher than the maximum investment in *baseline* (Pearson χ^2, $p < 0.029$). Interestingly Bosman and van Winden (2005) found a similar high proportion of extreme investment as well for their baseline treatment as for their global risk treatment. Further we do not observe the shift of non-extreme investors to less investment under global risk, as noted by Bosman and van Winden (2005). If we restrict our analysis to subjects that invested only part of their

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[8]Investment of subjects in *pre* that lost due to the global risk and gave only hypothetical answers is higher (mean: 10.212, std. dev: 3.975), but this difference is not significant (Mann-Whitney, $p = 0.266$).

working money (i.e. investment < 15) we observe no difference in mean investment between *baseline* and the global risk treatments (Mann-Whitney, $p > 0.122$). This suggests that the higher observed mean is mainly due to more subjects changing from intermediate to full investment. Only six subjects chose to adjust their investment when given the opportunity. Therefore, we will in the following report only results from investment_t1.[9]

Emotions and Behavior

It seems that the existence of the global risk, independent of its timing, is leading to more (extreme) investment. This might be because full investment is a simpler choice than to decide on a way to split up the working money and that in stressful situations (i.e. under global risk) simple choices are preferred. Also, full or no investment are the only two options that give the possibility to reduce the experience of regret at the end. Specifically, no investment should only lead to regret when the investment risk ends positive and extreme investment only when the investment is lost. If intermediate amounts are invested, regret might be experienced if the investment returns profits (regret for not having invested more) but also when the investment returns no profits (regret for not having invested less). We will discuss this possibility in the following. Finally if people are influenced more by possibilities than by probabilities (e.g. Kahneman and Tversky, 1979; Camerer, 2000), the fact that under global risk no choice was safe might have lead to the high percentage of full investment. In the following we will discuss whether the measures of emotions confirm or disconfirm that global risk treatments are perceived as the same.

In our experiment emotions are not externally induced but elicited by a natural occurring situation.[10] Therefore two levels of analysis are necessary. On the one hand, the timing of risk might result in variations of the strength of the emotional reactions. On the other hand, the impact of emotions on behavior (independent of their strength) might be influenced. The impact of emotions on behavior is often to some extent controlled (Elster, 1996) and we will thus not always observe the same impact of the same emotions. Indeed, it turns out that the Tobit model of the influence of emotions on behavior (as presented in section 7.3.3) is not significant for *pre* and *post* (Tobit regression: $\chi^2 > 0.152$, Pseudo $R^2 < 0.033$; see Appendix 7.C). For a better understanding of the differences across treatments, we will thus analyze emotions separately. We will compare *pre* and *post* with results from *baseline* and *inter* from Experiment I.

One of our hypothesis is, that global risk will lead to higher experienced anxiety, compared to *baseline*. While we observe only very little variation in anxiety trait[11],

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[9]While for *post* we observe no relation between studies and behavior, in *pre* higher investment is observed for economics majors.

[10]Externally elicited emotions may have different effects on behavior than naturally occurring emotions (see e.g. Zeelenberg and Pieters, 2005).

[11]The distribution of STAI trait in our experiment was representative. Specifically, the observations from a sample of 493 subjects taken during a psychology experiment at the same university (mean:

[with the highest difference between *pre* and *post* (Mann-Whitney: $p > 0.099$)], we observe higher experienced anxiety in treatments *pre* and *inter* (see Table 7.3: A). This becomes apparent when we control for trait, by comparing across treatment the difference in experienced anxiety compared to trait [i.e. STAI difference = STAI1 - STAI-trait]. Compared to *baseline* and *post* the difference is higher in *pre* (Mann-Whitney, $p < 0.028$) and *inter* (Mann-Whitney, $p < 0.134$). This means, that anxiety is elicited to a similar degree if the global risk was just experienced, as when it is to be experienced in the close future. And somewhat surprisingly this difference in anxiety is low in *post*, where global risk is threatening to destroy all income at the very end of the experiment. We conclude that anxiety is mostly elicited by actions that just happened or are about to happen soon and less by the prospect of loss expected for the future. We find a similar relationship for hope. Compared to *baseline* and *post* experienced hope is higher in *pre* (Mann-Whitney, $p < 0.016$) and *inter* (Mann-Whitney, $p < 0.075$) (see Table 7.3: A). This suggests that even though behavior is very similar when global risk is present, treatments are perceived differently. Interestingly, even though *pre* and *inter* differ in their prospect of the global risk, they elicit hope and anxiety to a very similar degree. At the same time *post* which is only a slight variation of *inter*, differs. A further difference might be found concerning the emotions regret and disappointment.

Since in *inter* global risk is resolved before the decision risk, subjects won't learn in 1/3 of the cases if they made the "right" decision or not. Thus *on average* the anticipation of regret may be expected to be less related to investment in *inter* than in *post*. Anticipation of regret (rejoicing) was measured by asking about the importance of avoiding (seeking), regret (rejoicing) when making the investment decision. The statements to be rated (concerning project A, for project B see 7.A.2) were:

> To which extent are the following remarks for your decision applicable?
>
> 1. I did not put more money in B, because I did not want to feel bad when project B returns nothing (loses). [regret-A]
>
> 2. I did not put less money in A, because I will feel really good if project B returns nothing (loses). [rejoicing-A]

From the answers we can see if subjects took the possibility into account not to have to experience regret. First we observe that averages for these questions were not significant different across treatments.[12] Therefore subjects report to an equal degree in all treatment to have thought about regret and rejoicing. However not in all treatments these answers are correlated to an equal degree with their investment decisions. Correlation coefficients with investment (Table 7.3: B) suggest that across treatments the focus concerning regret and rejoicing differed. For all treatments we observe that

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35.29, std. dev:9.69) was very similar to our observations (all treatments: mean: 35.74, std. dev: 8.16) (t-test, $p = 0.569$).

[12]We can not reject that regret-A (B) and rejoicing-A (B) come from the same population across treatments (Kruskal-Wallis, $p > 0.180$).

Table 7.3: Correlations and averages of emotions.

A: Averages experienced and estimated emotions (std. deviation in parentheses)								
	baseline		*pre*		*inter*		*post*	
STAI trait	35.43	(8.26)	34.42	(8.84)	35.10	(7.18)	37.24	(7.72)
STAI 1	35.76	(7.29)	40.13	(10.08)	40.49	(11.94)	38.14	(8.48)
STAI difference	0.32	(7.40)	5.71	(9.55)	5.39	(10.28)	0.91	(9.14)
hope 1	2.95	(0.57)	3.35	(0.64)	3.28	(0.65)	3.02	(0.64)
irritated 1	1.46	(0.65)	1.40	(0.64)	1.85	(0.93)	1.57	(0.80)
regret A	2.65	(1.17)	2.70	(1.18)	2.80	(1.15)	2.75	(1.11)
rejoicing A	2.47	(1.18)	1.97	(1.01)	2.30	(1.08)	2.29	(0.95)
regret B	2.18	(1.13)	2.00	(1.08)	2.35	(1.14)	2.58	(0.93)
rejoicing B	2.88	(1.11)	3.03	(1.01)	2.75	(1.21)	3.17	(0.82)
regretE	6.16	(2.15)	5.42	(2.28)	5.69	(2.18)	5.98	(2.05)
disappointE	6.86	(2.17)	6.77	(2.15)	7.18	(1.73)	7.02	(1.92)
regretX	1.57	(0.80)	1.42	(0.71)	1.51	(0.76)	1.36	(0.53)
disappointX	1.92	(1.16)	2.13	(1.18)	2.49	(1.27)	2.40	(1.19)

B: (Spearman) correlation coefficients of investment with:				
	regret-A		rejoicing-A	
baseline	-0.554	$p = 0.021$	-0.377	$p = 0.136$
pre	-0.432	$p = 0.008$	-0.304	$p = 0.068$
inter	-0.528	$p = 0.017$	-0.707	$p = 0.001$
post	-0.249	$p = 0.241$	-0.277	$p = 0.190$
	regret-B		rejoicing-B	
baseline	-0.235	$p = 0.364$	0.134	$p = 0.609$
pre	-0.303	$p = 0.068$	0.440	$p = 0.006$
inter	0.222	$p = 0.347$	0.383	$p = 0.096$
post	0.070	$p = 0.744$	0.530	$p = 0.008$

C: (Spearman) correlation coefficients of estimated and experienced:				
	disappointment		regret	
baseline	0.200	$p = 0.457$	0.660	$p = 0.005$
pre	-0.031	$p = 0.885$	0.410	$p = 0.042$
inter	0.252	$p = 0.430$	0.537	$p = 0.072$
post	0.349	$p = 0.324$	0.618	$p = 0.057$

regret-A is stronger correlated with investment than regret-B. Thus concerning regret all treatments lead to a stronger focus on the safe project. But concerning rejoicing we see variations across treatments. In both *baseline* and *inter*, rejoicing-A is stronger correlated with investment than rejoicing-B. Suggesting that in these treatments also concerning rejoicing, safe investment is preferred. However for both *pre* and *post* we see that for rejoicing the focus seems to be now on project B. Also note that in *baseline* only regret-A is significantly correlated with investment. While in all treatments involving global risk also some correlation with rejoicing-B can be observed. We conclude that under global risk, emotions concerning more as well as less investment are anticipated and related to investment. Finally we observe a correlation of regret with investment only in treatments where regret was expected to be experienced at the very end of the experiment (i.e. not in *post*). We can relate this finding to the evidence that a patients' memory of pain is mainly influenced by the maximum and last experienced pain intensity and not by the overall amount of experienced pain. This evidence suggests that the memory of utility is set by the so called "peak-end" rule, which means that strongest intensity and final experience set the memory of the utility of a situation (e.g. Kahneman et al., 1993; Schreiber and Kahneman, 2000; Kahneman, 2000). Assuming that this effect does not only exist for the memory but also for the anticipation of utility might explain our observations. Therefore *inter*, through its timing of risk, might lead to more anxiety and hope and a stronger focus on regret and rejoicing, compared to *post*.

Despite these differences between *inter* and *post*, subjects estimation of how much regret and disappointment they will experience does not differ across treatments (Table 7.3: A). Subjects were asked to estimate regret (disappointment) for the imagined scenario of loss from the decision risk (Appendix 7.A.2). Averages across treatments show no significant differences (Mann-Whitney, regretE: $p > 0.108$; disappointmentE: $p > 0.364$). Estimation of regret is in all treatments correlated with actual experienced regret if indeed the decision risk meant loss.[13] Because the loss from decision risk should not be related to disappointment we expect no correlations for disappointment. And indeed we observe in all treatments a significant positive correlation of estimated and experienced regret but no correlation of estimated and experienced disappointment (see Table 7.3: C).[14] In all cases the extent of experienced regret is overestimated.[15]

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[13]For the correlations of estimated and experienced regret and disappointment, we consider only subjects for which project B actually lost and who survived global risk.

[14]Interesting to note is that experienced regret (disappointment) is related to the foregone payout due to the negative outcome of the decision (global) risk. We can see this by observing correlations of both experienced regret and disappointment with the amount of money the player "lost" due to decision (global) risk. For all treatments we see that if money was lost due to the decision risk, regret is experienced (Spearman, ≈ 0.35, $p < 0.064$). For *inter* and *post* correlations can also be observed between disappointment and the fact of losing money due to the global risk (Spearman, ≈ 0.55, $p < 0.000$). These effects are though mainly due to differences between the subjects losing and those not losing either due to decision or global risk.

[15]Coefficients of a regression of experienced regret on estimated regret are < 1.

So far we have shown, that *inter* and *post* differ in the elicitation of anxiety and hope and their correlation of regret and investment. *Pre* and *baseline* show similarities concerning anticipated regret but in *pre*, anxiety and hope are experienced to a similar high degree as in *inter*. This suggests that the experience of *pre* is in between that of *baseline* and *inter*.[16] Our hypothesis that in *pre* the survival of the global risk induces higher experienced happiness, is not confirmed (Kruskal-Wallis, $p = 0.932$). In all treatments subjects report an experienced happiness of approximately 2.8 on a scale from 1 to 4. Further happiness is not correlated with investment in *pre* (Spearman, 0.172, $p = 0.244$).[17] Interestingly though we observe that sadness is negatively correlated with investment in *pre* (Spearman, -0.379, $p = 0.008$).[18]

We summarize the findings from this section in the following result:

Result 7.2

1. *All treatments with global risk show similar investment, with a high proportion of "maximum" investment. We observe* no *evidence for a violation of timing independence.*

2. *For* pre *and* post, *the interaction between emotions and investment can not be captured by the model observed for* baseline *and* inter.

3. *Experienced hope and anxiety are highest in* pre *and* inter

4. *Average anticipated regret and rejoicing does not differ across treatments, but the correlation with investment does. In* baseline *and* inter *subjects focus mainly on the safe project. While in* pre *and* post *their focus is (also) on the risky project.*

5. *Under global risk anticipated rejoicing from earnings from investment as well as anticipated rejoicing from cautious behavior, is correlated with investment.*

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[16]That *inter* and *pre* result in such similar behavior is striking especially in the light of earlier research (Cubitt et al., 1998) that found violations of timing independence. A violation of timing independence would suggest a difference in behavior if risk is already resolved or still threatening. One observation hints that behavior in *pre* and *inter* is also in our experiment different. As we had noted before (see footnote 9) behavior in *pre* is related to field of study. Indeed we observe a significant difference for economics majors and majors from other disciplines (Mann-Whitney, $p = 0.034$). Where economics majors behave more like subjects in *inter* and *post* and non-economist majors behave more like subjects in *baseline*. But neither concerning experienced nor anticipated emotions, the subjects from the different fields differ.

[17]Also in the other treatments no correlation between happiness and investment is observed (Spearman, approx. -0.02, $p > 0.829$)

[18]In the other treatments no correlation of sadness and investment is observed (Spearman, approx. -0.06, $p > 0.597$)

7.5 Experiment III: Extensions

In experiments I and II we observed that emotions are elicited to a varying degree in the three variations of the global risk situation and that the anticipation of regret and rejoicing is related to the investment decision. To validate these results we will address in this section two possible problems with our previous treatments. First, self-reports of emotions might focus subjects on their emotional experience and such a focus might influence behavior. Considering that social psychology uses statements of emotions that have to be read and contemplated by subjects to induce certain moods (Velten, 1968), the completion of the emotion scale prior to the decision might have had a similar effect. Namely to strengthen or create anxiety, hope or irritation in subjects. To control for this we replicate two treatments from experiment I and II (*baseline* and *post*) where self-reports prior to the taking of the decision are omitted. Another problem with our previous treatments might have been, that the amount of working money was relatively low. Expected returns from the safe option might have been too low and thus extreme investment under global risk, might be due to a limiting effect of stake size. We therefore replicate treatments *baseline* and *post* for increased stakes.

We will combine results from these new treatments with our earlier observations to check for the robustness of our findings concerning the impact of global risk on affective reactions.

7.5.1 Decision Problem

Concerning high stakes we will consider treatments *baseline-high* and *post-high*. These are equivalent to decision problems *baseline* and *post* from experiment I and II, with the sole difference that subjects had to allocate 30 euro (instead of 15 euro) over the two projects. The money could be allocated in steps of 1 euro to the projects, resulting (as for low stakes) in 31 different choice options.

Further, we will analyze treatments *baseline-without* and *post-without* which are the same as decision problems *baseline* and *post*, with the sole difference that experienced emotion before the investment decision were not measured. We will in the following label the decision problems from the earlier experiments as *baseline-low* and *post-low*. The labels *baseline* and *post* will be used when observations from all three treatments are grouped.

7.5.2 Experimental Procedures

The experimental procedures were the same as for *baseline-low* and *post-low*. Subject had 30 euro of working money in treatments *high* and were asked to allocate them in multiples of 1 euro to the two projects. In treatments *without* subjects saw after the instructions immediately the decision screen and did not have to fill out the STAI1 questionnaire and were not asked about experienced emotions before the decision.
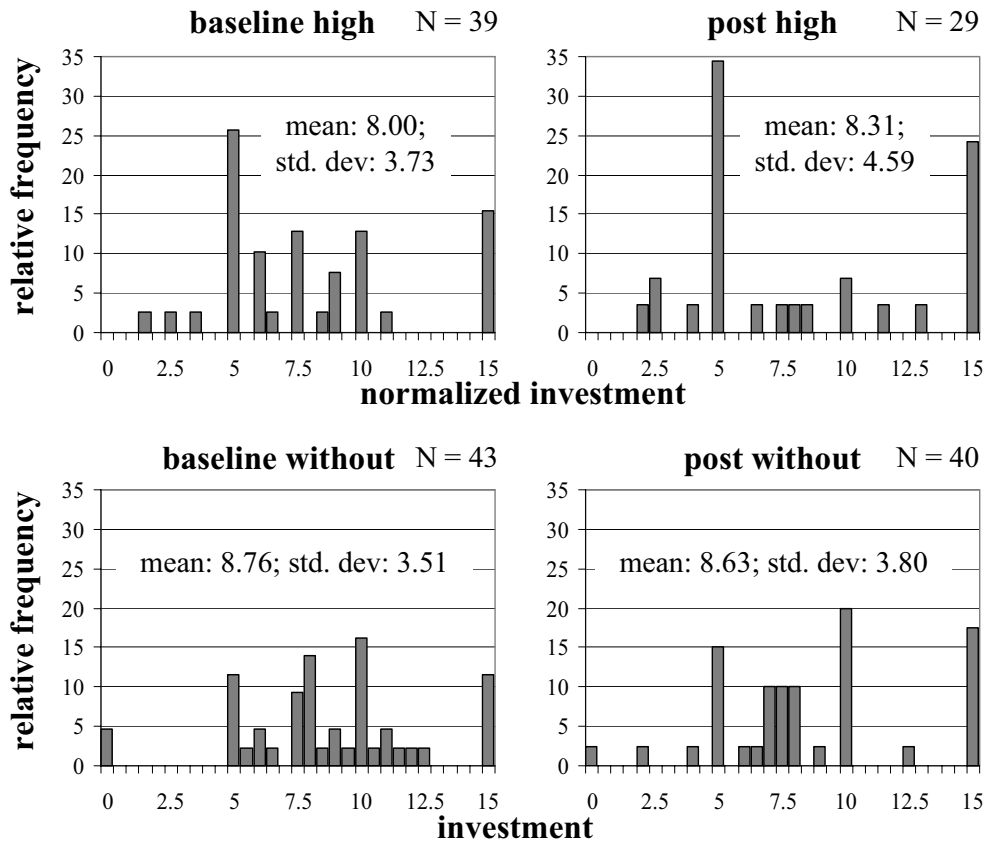
Figure 7.6: Histograms of investment (time t1).

The experiment lasted about one hour and was conducted in the CREED-laboratory at the University of Amsterdam, in September 2003. Subjects were recruited from various fields and in total 151 students participated in the experiment. Participants received 2.50 euro as show up fee. Average earnings in the *without* treatments were 14 euro (approximately \$ 17) and in the *high* treatments 36 euro (approximately \$ 44).

7.5.3 Results

Investment behavior is presented in Figure 7.6. Investment in treatments *without* is not significantly different from earlier obtained results (Mann-Whitney, $p > 0.105$). But the earlier observed effects of global risk, are less pronounced for treatments *without*. We still see more maximum investment, but this difference is not significant (Pearson χ^2, $p = 0.447$). A comparison of investment when maximum investment is excluded, even suggests less investment in *post-without* compared to *baseline-without* (Mann-Whitney, $p = 0.166$). As noted earlier, irritation might be related to as well more

or less investment. Therefore if the emotion questionnaires elicited higher irritation in subjects, then contingent on the characteristics of this irritation we might observe higher or lower investment. If irritation was for example related to fear (*baseline*) this might have resulted in a decrease in investment, while irritation related to anger (e.g. anger on the global risk situation) might have resulted in higher investment (*post*).

For treatments with high stakes, we normalized maximum investment to 15, so that investment can be easily compared to the results from earlier treatments. Assuming constant relative risk aversion, we would expect investment of the same share of their working money for subjects with low and high wealth. Average normalized investment in treatment *high* is not significantly different from *low*, neither for *baseline* (Mann-Whitney, $p = 0.859$) nor for *post* (Mann-Whitney, $p = 0.196$). However we observe a shift in distributions to lower investment choices (i.e. the new mode is at 5) and also to the extreme choice of 15, while intermediate investment in the range from 5 to 15 is less often chosen. Mean investment is not significantly different in *baseline-high* and *post-high* (Mann-Whitney, $p = 0.830$) and observing only not-maximal investment suggests lower investment in *post-high* (Mann-Whitney, $p = 0.241$). We conclude that the earlier observed high percentage of full investment, is not due to a limiting effect of stake size but gets rather strengthened when stakes are higher. Investment behavior from all treatments and test statistics are summarized in Table 7.8 (Appendix 7.C).

Although mean normalized investment does not change when stakes are increased, we note that distributions differ.[19] This difference is due to a shift to as well lower as higher investment. While this is apparent for continuous investment, the effect is less clear when observations are grouped. This is important to note, considering that many experiments offer subjects only a binary choice between gambles. Specifically we want to point out that investment in *post* would seem very different when observed in a binary way (see Figure 7.7). In Figure 7.7 we group subjects investing more than half of their working money as *risky* and others as *safe*. Framed in such a binary way, *post-low* would show clearly more risky choices compared to *baseline-low*. In contrast, binary framing suggests in *post-high* a majority of safe choices. Thus such presentation of investment might suggest that for high stakes subjects do isolate the effect of global risk, while for low stakes they do not. However this interpretation would ignore the observed effects of shifts to high as well as low investment. From such binary analysis it would not be apparent, that actually for high stakes the percentage of extreme investment increased, and that the shift is due to two tendencies opposing each other.

Summarizing, the effect of high stakes is, on the one hand, to increase investment by inducing more subjects to choose the maximum level. On the other hand, this effect seems to be counterbalanced by a tendency to lower investment choices by other players, this tendency being more pronounced under global risk. The dominance of

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[19]We find marginal significance for *post* treatments (Kolmogorov Smirnov: *baseline-high* vs. *baseline-low*: $p = 0.600$; *post-high* vs. *post-low*: $p = 0.092$).
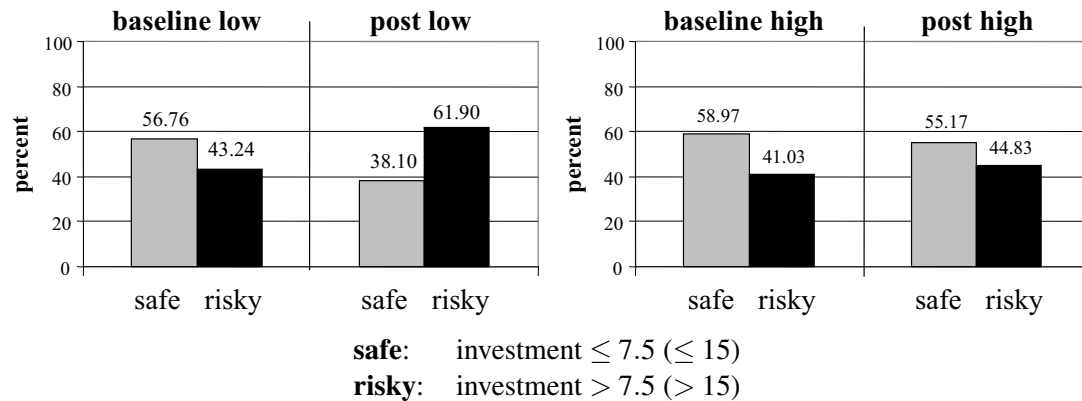
safe: investment ≤ 7.5 (≤ 15)
risky: investment > 7.5 (> 15)

Figure 7.7: Simulated binary investment.

non-extreme investment choices shows that binary choice procedures can be misleading.[20]

Emotions and Behavior

As we have seen before, the anticipation of regret and rejoicing is influenced by the type of treatment and in its turn influences behavior. We will now use our additional observations, to further investigate the relation between anticipated regret, rejoicing and investment. In addition, we will discuss which project subjects focused on when anticipating these emotions: project A or project B. Note that only with the extreme choices of full or zero investment, subjects can exclude the experience of one of the two types of regret.[21] If subjects decide to invest intermediate amounts, they can experience regret whatever the experienced outcome is. Therefore it is of interest to find out which kind of regret particularly influences the investment decision. As holds for regret, rejoicing can be a motivation for more or less investment.[22]

The four questions concerning anticipated regret (Appendix 7.A.2), relate to these two kinds of regret and rejoicing.[23] We present correlations with investment in Table 7.4. Both regret-A as well as rejoicing-A are significantly correlated with investment

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[20]Due to the observed dominance of non-extreme investment choices, we think that intermediate investors have to be distinguished from high or low investors. When grouping investment choices we will in the following distinguish between these three categories: low, medium and high.

[21]This is why in theories of regret in binary choice problems, no attention is paid to this dual form of regret.

[22]Since average behavior does not differ for treatments *low*, *high* and *without* we will in the following compare the grouped observations from *baseline-low*, *baseline-high* and *baseline-without* with the grouped observations of *post-low*, *post-high* and *post-without*. In the following we will motivate for each variable in question why we think a grouping is adequate.

[23]For *baseline-low*, *baseline-high* and *baseline-without* we can not reject that regret-A(-B), rejoicing-A(-B) are drawn from the same population, we therefore group the observations as *baseline* (Kruskal-Wallis, $p > 0.125$). For *post-low*, *post-high* and *post-without* we can not reject that regret-A, rejoicing-

Table 7.4: Spearman correlation coefficients of investment

	regret-A	rejoicing-A	regret-B	rejoicing-B
baseline	-0.416	-0.318	-0.058	0.292
	(0.000)	(0.001)	(0.567)	(0.003)
post	-0.412	-0.483	0.278*	0.644
	(0.000)	(0.000)	(0.021)	(0.000)

* Not including observations from *post-low*

in *baseline* and *post*. In *post* we observe in addition, significant positive correlations for regret-B and rejoicing-B. The relatively strong correlation for rejoicing-B can be related to the notion of "attraction to chance" (Pope, 1998) which stands for the positive valuation of suspense.

The correlations for regret-A and rejoicing-A, suggest that the focus of subjects is on the negative event of a loss from project B. Interestingly in *post* subjects behavior is in addition correlated with anticipated regret and rejoicing from too risk-averse behavior, that is, from observing that B wins and not having invested "enough" into this project. Thus, in *post* two counteracting forces concerning the anticipation of regret and rejoicing seem at work. If subjects' anticipation of regret for both more and less investment is equally strong, this can result in intermediate investment amounts. If one regret value outweighs the other, the higher one may determine the outcome. To see if this is true we compare the two regret and rejoicing measures and construct a relative measure.[24] We define:

$$\text{rejoicingR} = (\text{rejoicing-B} - \text{rejoicing-A})$$
$$\text{regretR} = (\text{regret-A} - \text{regret-B})$$

Indeed both variables are significantly correlated with investment (see Figure 7.8)[25] and can for *high* account for most of the variance in investment (see regression results in Appendix 7.C). If one tendency of regret or rejoicing is clearly outweighing the other, the resulting investment decision is defined by the higher value. When both tendencies are present this is likely to result in intermediate investment. We also observe that regretR is more important for players investing *low* amounts, while rejoicingR is of higher importance for players investing *high* amounts. The absolute values for rejoicingR and regretR differ for low as well as high investors in *baseline* and *post*

A(-B) are drawn from the same population (Kruskal-Wallis, $p > 0.290$), we therefore group observations as *post*. Only for regret-B we observe higher values in *post-low* (Kruskal-Wallis, $p = 0.019$). We will group observations for regret-B for *post-high* and *post-without*.

[24]We group observations for regretR and rejoicingR for *baseline* and *post*, because we observe no differences across *low*, *high* and *without* (Kruskal-Wallis, $p > 0.496$)

[25]Correlation coefficients are: regretR (Spearman, *baseline*: -0.316, $p = 0.001$; *post*: -0.470, $p = 0.000$); rejoicingR (Spearman, *baseline*: 0.464, $p = 0.000$; *post*: 0.714, $p = 0.000$).
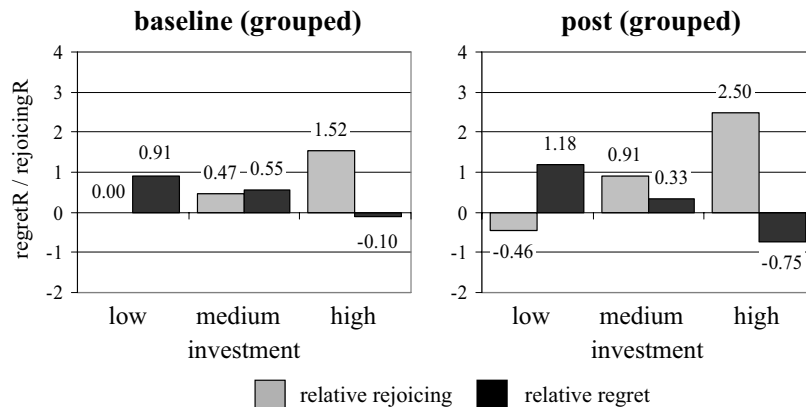
Figure 7.8: Relation of rejoicingR and regretR to investment.

(Wilcoxon sign-rank, $p < 0.037$). Thus overall the motivation for high investment is the motivation to feel good afterwards. While the motivation for low investment is "not to feel bad" at the end.

Because there was no "right" or "wrong" behavior in our experiment, subjects could always experience regret. Connolly and Zeelenberg (2002) suggest that the experience of regret depends not only on a bad outcome but also on "the feeling of self-blame for having made a poor choice". Indeed we find that experienced regret is correlated with the answers of a debriefing question that asked to rate the statement: "When I was taking my decision I actually had no clue how to distribute my money over the two projects". Agreeing with this statement was significantly correlated with the amount of experienced regret (Spearman, *baseline*: 0.357, $p = 0.001$; *post*: 0.201, $p = 0.098$). These correlations get even stronger if we only consider subjects that were not losing their investment.

We now turn to anxiety.[26] As we have seen earlier anxiety trait and experienced anxiety were similar in *baseline low* and *post low* and we find the same pattern for *high*.[27] For each *baseline* treatment individually we find a negative correlation of STAI-trait with categorized investment, but this correlation never reaches significance ($p > 0.244$). If we combine our observations from *baseline* we find a weakly significant correlation (Spearman, -0.171, $p = 0.064$), that is participants with higher STAI-trait chose to invest less. In contrast, no such relationship can be found for *post* (Spearman, -0.017, $p = 0.857$). Thus, although this gives us some evidence that STAI-trait can influence decision making, the effect is limited to *baseline* where risk

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[26]Neither STAI trait nor STAI state are significantly different for *low*, *high* or *without*, we therefore group observations to *baseline* and *post* (Kruskal-Wallis, $p > 0.202$).

[27]The increase in anxiety (STAI 1 - STAI trait) is on average higher in treatments *high*: *baseline low* (0.324); *baseline high* (2.410); *post low* (0.905); *post high* (2.966)

Table 7.5: Influence of anxiety on final investment choice (invest_t2)

A: linear regression for *baseline* [six subjects changed]

	N	76			N	119	
	$F_{(2,73)}$	5028.73			$F_{(2,116)}$	1406.74	
	R^2	0.993			R^2	0.960	
	adj. R^2	0.993			adj. R^2	0.960	
invest_t2	Coef.	Std. err.	$P > \lvert t \rvert$	invest_t2	Coef.	Std. err.	$P > \lvert t \rvert$
invest_t1	1.007	0.010	0.000	invest_t1	0.966	0.018	0.000
STAI 1	-0.006	0.004	0.128	STAI 2	-0.024	0.007	0.000
Intercept	0.145	0.170	0.396	Intercept	1.103	0.295	0.000

B: linear regression for *post* [six subjects changed]

	N	71			N	111	
	$F_{(2,68)}$	1405.33			$F_{(2,108)}$	3069.54	
	R^2	0.976			R^2	0.983	
	adj. R^2	0.976			adj. R^2	0.982	
invest_t2	Coef.	Std. err.	$P > \lvert t \rvert$	invest_t2	Coef.	Std. err.	$P > \lvert t \rvert$
invest_t1	0.993	0.019	0.000	invest_t1	1.000	0.013	0.000
STAI 1	-0.007	0.010	0.473	STAI 2	-0.011	0.005	0.046
Intercept	0.451	0.422	0.289	Intercept	0.492	0.240	0.042

could be controlled by subjects.

We further hypothesized that anxiety experienced after the investment decision, influences how subjects perceive their choice. Since subjects got the opportunity to review their decision after having recorded their emotions, we can observe if changes in decisions are related to this experienced anxiety. As noted before only very few subjects decided to change investment. Including the additional treatments from this experiment we observe six subjects changing investment in both *baseline* and *post*. That only few subjects changed their decision, could point at a correct anticipation of anxiety, but may also be due to an avoidance of cognitive dissonance.

In Table 7.5 we show regressions of invest_t2 on invest_t1 and STAI2 for *baseline* and *post*. And indeed we find that STAI2 explains part of the changes in investment. Low experienced anxiety after the decision, leads to the highest increase in investment. Comparing the regression including STAI1 with the regression including STAI2, we see that the experienced anxiety before the decision can not account for the same effect.

We conclude that trait anxiety may influence how much people invest and that ex-

perienced anxiety after the decision influences subsequent behavior, that is final invest-ment. But both effects are only weak and the effect of trait anxiety is only apparent in *baseline*. That we find some effect is consistent with psychological findings of a correlation between anxiety and risk aversion (Eisenberg et al., 1996) and might be related to an attentional bias due to anxiety (Luu et al., 1998). It further shows that in situations where risk and thus anxiety can not be avoided the effect of anxiety trait on investment might disappear.

As we have seen earlier (Experiment I), experienced hope and irritation are related to behavior. While anxiety is triggered by the threat of a future harm (Lazarus, 1991), *hope* is related to the possibility to overcome that harm while *irritation* may be gen-erated by the apprehension of that harm. Indeed hope is negatively correlated with anxiety in *baseline* but not in *post* (see Table 7.7 in Appendix 7.C).[28] Further irritation is positively correlated with anxiety in *baseline*. Irritation1 is not significant different in *baseline-low* and *baseline-high* (Mann Whitney, $p = 0.107$). However in *post* we observe that irritation1 is significantly higher in *post-low* than *post-high* (Mann Whit-ney, $p = 0.033$), and therefore we do not group the variables in this case. For both treatments we observe no correlation of irritation with anxiety.

Because of these relationships we were especially interested in hope and irrita-tion.[29] We find that experienced hope is positively correlated with the amount invested in *baseline* (Spearman, 0.359, $p = 0.002$), whereas no correlation is observed in *post* (Spearman, 0.139, $p = 0.248$). The opposite pattern is observed for experienced ir-ritation. No correlation of investment and irritation is found for *baseline* (Spearman, -0.074, $p = 0.528$) while a marginally significant positive correlation is observed in *post-low* (Spearman, 0.259, $p = 0.098$). Note, that in our earlier results from section 7.3, we found that for *inter* the correlation of investment with irritation was *negative* (Spearman, -0.268, $p = 0.099$). However for *post-high* we observe no correlation (Spearman, 0.196, $p = 0.307$). Irritation in *post-low* might be related to the discrep-ancy between the two opposed tendencies of regret and rejoicing. Therefore if irritation is related to a stronger focus on rejoicing from winning, irritation will also be related to more investment.

We summarize the findings from this section as:

Result 7.3

1. *Mean (normalized) investment is not influenced by high stakes or the omittance of emotion measures. However high stakes shift investment both to lower as well as higher values. The effects of global-risk on mean investment are less clear in* high *and* without.

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[28]Hope 1 is not significant different in *high* and *low* (Mann Whitney, $p > 0.182$). We therefore group to *baseline* and *post*

[29]For surprised, happy and sad no consistent patterns were observed.

2. *Regret and rejoicing with respect to more and less investment are anticipated. This is more the case in* post *than in* baseline. *High investors in both treatments, focus more on rejoicing, while low investors focus more on regret.*

3. *In* baseline *high anxiety trait is related to lower investment. If investment is changed during confirmation, low experienced anxiety* after *the decision is related to the highest increase in investment. Only the latter effect is also observed in* post.

4. *Experienced hope is correlated with investment in* baseline *but not in* post. *Irritation shows no correlation with investment in* baseline, *but a positive correlation in* post-low.

7.6   Discussion

Our analysis of three different timing variants of the resolution of a "global risk" (Experiment I and Experiment II) has shown no significant differences in mean investment behavior as long as global risk is present. However the distributions of choices suggest differences across treatments. In all treatments many subjects choose intermediate investment between zero and 15. Intermediate investment under global risk is not different from that in *baseline*, but under global risk more subjects decide for full investment. Further not all treatments involving global risk are experienced the same. From our emotion measures we see that global risk treatments are perceived differently. For experienced emotions we observe higher values of anxiety and hope in *pre* and *inter* and low values in *post-low*. Thus contrary to our initial assumptions, of the global risk treatments *post-low* is actually the least likely to elicit anxiety. Experienced hope is related to more investment in *baseline* and *inter* but not in *post*. Also irritation shows different relations to investment across treatments. While irritation has a negative impact on investment in *baseline-low* and *inter*, a positive correlation is observed in *post-low*. This hints at the ambiguous role of the experience of irritation. Finally, global risk is characterized by subjects anticipating regret and rejoicing from too little as well as too much investment. This problem arises whenever not everything is invested in the same option. Whenever investors have to split their investment over a portfolio, the gains for one item and losses for another item might elicit regret for not having decided for a different composition. Indeed in most real life investment problems rarely extreme investment is possible. Thus it is not only important to know *if* people anticipate regret but also *which* regret.

For *baseline* we have further seen that STAI trait is related to investment. When changing their investment choice in *baseline* and *post*, low experienced anxiety leads subjects to increase their investment. However the experienced anxiety after the decision is not correlated with the initial amount of investment. This does not imply that no relation exists. As we will show in the following the relationship between emotions and behavior does not necessarily need to be linear.
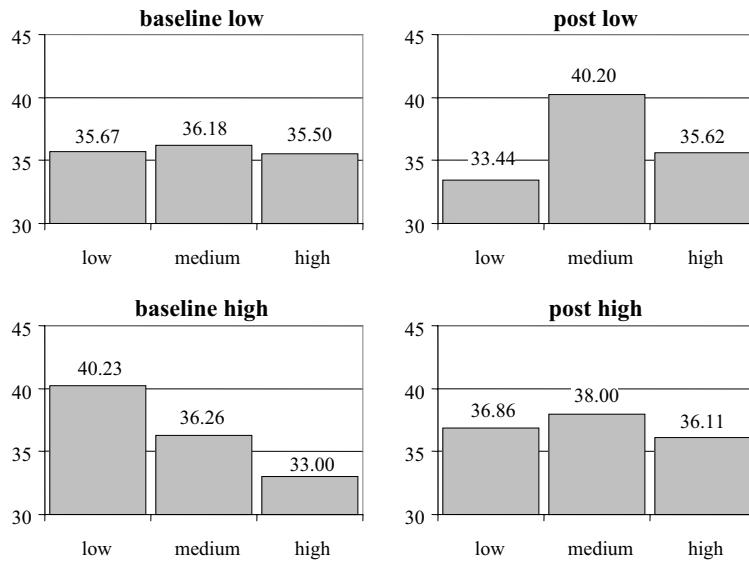
(a) Experienced anxiety after decision (STAI 2) dependent on investment.
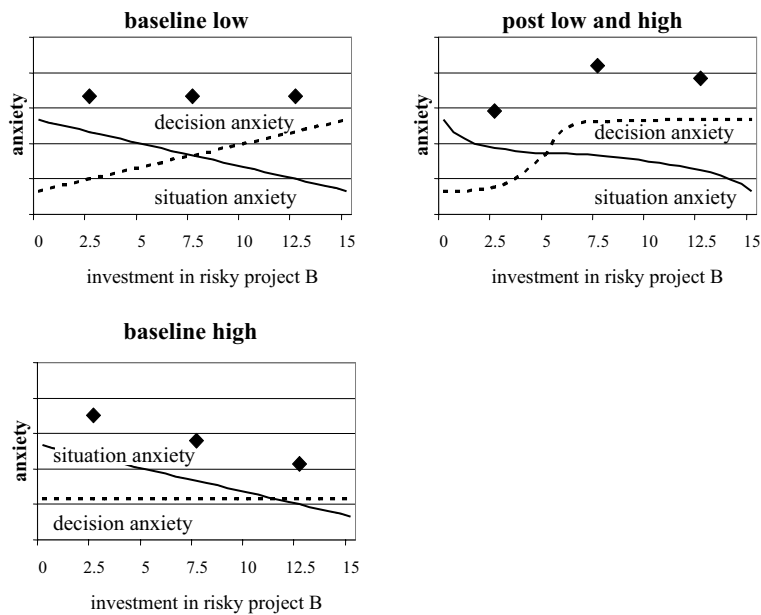
(b) Hypothetical interaction of situation and decision anxiety across treatments. Dots show the sum of both types of anxiety for low, medium and high investment.

Figure 7.9: Interaction and results of two kinds of anxiety.

We will discuss this issue for the example of experienced anxiety after investment. In Figure 7.9(a) we present average STAI 2 for different investment levels. We observe no consistent interaction pattern across treatments. But we have to take into account that our measure might be a compound of two effects. According to Bosman and van Winden (2005) situation anxiety and decision anxiety might interact. Situation anxiety refers to the anxiety elicited by the specific situation that the subject is exposed to and decision anxiety to the additional anxiety the subject experiences due to the amount of money invested. Decision anxiety *can* be anticipated by agents when making their decision, but it is not clear if this is the case.

In Figure 7.9(b) we present a hypothetical model of the underlying situation and decision anxiety. It seems reasonable that investment is decreasing in situation anxiety, which means that subjects with higher anxiety tend to invest less. Decision anxiety in contrast should be increasing in investment. Due to these two counteracting forces, we see that indeed we should observe in treatment *baseline-low* approximately the same level of anxiety across investment decisions.

For *baseline-high* anxiety is decreasing in investment. This might be because in *baseline-high*, the valence of the situation was so low that decision anxiety was more or less constant for any investment chosen. This would, as shown in Figure 7.9(b), explain the downward slope of anxiety.

More puzzling seem the observations for anxiety in treatment *post*. We observe a non-linear relationship of anxiety across investment. This being more pronounced in treatment *post-low* than in *post-high*. We can speculate, that especially for a situation of high arousal, situation anxiety might have a critical value, above which only very low investment is chosen. Further, for decision anxiety we can imagine the S shape presented in Figure 7.9(b). The assumptions behind this shape is that starting from a critical value of investment, decision anxiety is at it's maximum, which leaves no room to increase for even higher levels of investment. From a combination of these two anxiety functions, we would then indeed observe the highest anxiety for medium investment and slightly lower levels for high and low investors.

Finally we want to discuss, how it is possible that across treatments involving global risk, behavior can not be clearly differentiated. One reason might be that the emotion questionnaires focused subjects on their feelings and thus influenced behavior by subjects counteracting. Indeed investment in *baseline-without* is higher than in *baseline-low* where the difference comes close to significance at the ten percent level (Mann-Whitney, $p = 0.105$). Because in *baseline* risk was under the full control of subjects, the awareness of anxiety might have led to decreased investment decisions. In contrast under global-risk the awareness of anxiety and the experience of irritation in combination with the realization that no decision is safe, might have led subjects to decide for full investment. Interestingly Bosman and van Winden (2005) who did not measure emotions before the investment decision, find in their global risk treatment even lower investment choices. Their treatments are similar to *baseline-without* and *post-without*. In fact for these treatments we also observe a slight decrease in

mean investment under global risk (see Figure 7.6), which is in our case however not significant.

The observed affective differences hint that indeed timing differences of global risk can lead to different reactions. Behavior might be different if investment is a binary choice and not a continuous decision as in our experiment. During a binary choice subjects might feel less responsible for their decision, because the two given options already limit behavior. Also as noted earlier, regret can not be avoided for intermediate choices. Therefore the anticipation of this conflict in combination with a higher feeling of responsibility might have elicited irritation. This irritation might have been missing in experiments of binary choices were the isolation effect was previously observed. Further, the fact that two counteracting affective forces motivate investment, might explain the lower observed investment by Bosman and van Winden (2005). Dependent on which of the two forces is dominating, investment might either be higher or lower. An important next step in this line of research is therefore to disentangle the various emotions motivating investment decisions. Further not only the order of the resolution of risk but also the time intervals between them might be of influence. A long waiting time between the decision and global risk will presumably focus subjects stronger on the order and might therefore result in stronger reactions to variations. For a better understanding of the underlying mechanisms it is therefore necessary to extend our analysis to binary choices, more refined emotions measures focusing also on ambiguous emotions as irritation and variations of risk resolution in time.

7.7 Conclusion

In this chapter we have analyzed and discussed how emotions influence behavior in an investment experiment under three timing variants of global risk. It has been suggested that behavior is not independent from the timing of such risk. We therefore systematically investigate the impact of a shift of the global risk from before the decision is made, to after the outcome of the risky project is known. In all treatments we observe many subjects choosing intermediate investment. Thus it might be misleading to observe preferences of subjects with binary representations of such decision problems. In all treatments involving global risk we further observe a similar high percentage of subjects deciding to invest all their working money. The quite similar investment pattern for the global risk treatments, suggest that subjects do not violate timing independence. Finally mean investment is higher in the global risk treatments, compared to baseline. Therefore the presence of the global risk influences investment behavior even though the resolution of the global risk was clearly disconnected from the resolution of the decision risk. We therefore do *not* observe the isolation effect. This is surprising given the experimental evidence that suggests that a common risk in a separate stage is "isolated" and ignored by subjects.

We suggest that what is differentiating existing experiments that have shown various patterns of behavior under global risk, are the individuals affective reactions. De-

pendent on which emotions are experienced and anticipated, different behavior might result. Our analysis of experienced and anticipated emotions can thus help us understand what influences investment decisions. The analysis of the prospect based emotions experienced and anticipated in our experiment, shows that experienced hope and irritation are related to investment. Irritation might lead to high or low investment, dependent on the circumstances. Further we observe that both anticipated regret and rejoicing are related to investment and that both emotions can be linked to more as well as less investment. Under global risk these two counteracting forces might thus lead to higher as well as lower levels of investment. We suggest that dependent on which emotions are anticipated, global risk might have different effects for investment. Finally, we do observe only very weak effects of experienced anxiety and trait anxiety. This is surprising given the widespread belief that anxiety should influence investment decisions. We especially show that while there is still some correlation of trait anxiety with investment in baseline, no such correlation is observed under global risk. However the experienced level of anxiety after a decision, can influence subsequent behavior.

One limitation of our design is that we could not go as deeply into the anticipation of anxiety as we did for regret. To measure and analyze anticipated anxiety and to compare it with experienced anxiety might prove helpful in explaining the differences in the impact of anxiety across treatments. Further, irritation, which seems interesting due to its ambiguous role, was measured in our experiment only in a very simple way. It seems important to disentangle the different motivational forces that might stem from the experience of irritation. Finally, it seems inevitable to also consider repeated investment games, to study the emotional spillover effects from one game to the next. Real investment situations are usually not only a one shot experience and experienced outcomes might influence anticipated emotions in later situations. The interactions of emotions and behavior in repeated situations will be quite complex. However we think that theories ignoring the dynamics of emotions will fail to arrive at a satisfactory explanation of investment behavior.

Appendix 7.A Emotion measures

All emotion measures translated from the Dutch.

7.A.1 State Trait Anxiety Inventory (Spielberger et al., 1970)

STAI-trait

A number of statements which people have used to describe themselves are given below. Read each statement and then choose the appropriate number to the right of the statement to indicate how you *generally* feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

		almost never		**almost always**	
1.	I feel pleasant	(1)	(2)	(3)	(4)
2.	I tire quickly	(1)	(2)	(3)	(4)
3.	I feel like crying	(1)	(2)	(3)	(4)
4.	I wish I could be as happy as others seem to be	(1)	(2)	(3)	(4)
5.	I am losing out on things because I can't make up my mind soon enough	(1)	(2)	(3)	(4)
6.	I feel rested	(1)	(2)	(3)	(4)
7.	I am "calm, cool and collected"	(1)	(2)	(3)	(4)
8.	I feel that difficulties are piling up so that I cannot overcome them	(1)	(2)	(3)	(4)
9.	I worry too much over something that really doesn't matter	(1)	(2)	(3)	(4)
10.	I am happy	(1)	(2)	(3)	(4)
11.	I am inclined to take things hard	(1)	(2)	(3)	(4)
12.	I lack self-confidence	(1)	(2)	(3)	(4)
13.	I feel secure	(1)	(2)	(3)	(4)
14.	I try to avoid facing a crisis or difficulty	(1)	(2)	(3)	(4)
15.	I feel blue	(1)	(2)	(3)	(4)
16.	I am content	(1)	(2)	(3)	(4)
17.	Some unimportant thought runs through my mind and bothers me	(1)	(2)	(3)	(4)
18.	I take disappointments so keenly that I can't put them out of my mind	(1)	(2)	(3)	(4)
19.	I am a steady person	(1)	(2)	(3)	(4)
20.	I get in a state of tension or turmoil as I think over my recent concerns and interests	(1)	(2)	(3)	(4)

Note: The answers are used to calculate a value between 20 and 80, representing the anxiety trait of the subject [STAI-trait].

In the experiment the validated Dutch translation of the STAI was used (van der Ploeg et al., 1980).

STAI-state

A number of statements which people have used to describe themselves are given below. Read each statement and then choose the appropriate number to the right of the statement to indicate how you *feel* right now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

		not at all		**very much so**	
1.	I feel calm	(1)	(2)	(3)	(4)
2.	I feel secure	(1)	(2)	(3)	(4)
3.	I am tense	(1)	(2)	(3)	(4)
4.	I am regretful	(1)	(2)	(3)	(4)
5.	I feel at ease	(1)	(2)	(3)	(4)
6.	I feel upset	(1)	(2)	(3)	(4)
7.	I am presently worrying over possible misfortunes	(1)	(2)	(3)	(4)
8.	I feel rested	(1)	(2)	(3)	(4)
9.	I feel anxious	(1)	(2)	(3)	(4)
10.	I feel comfortable	(1)	(2)	(3)	(4)
11.	I feel self-confident	(1)	(2)	(3)	(4)
12.	I feel nervous	(1)	(2)	(3)	(4)
13.	I am jittery	(1)	(2)	(3)	(4)
14.	I feel "high strung"	(1)	(2)	(3)	(4)
15.	I am relaxed	(1)	(2)	(3)	(4)
16.	I feel content	(1)	(2)	(3)	(4)
17.	I am worried	(1)	(2)	(3)	(4)
18.	I feel over-excited and "rattled"	(1)	(2)	(3)	(4)
19.	I feel joyful	(1)	(2)	(3)	(4)
20.	I feel pleasant	(1)	(2)	(3)	(4)

Note: The answers are used to calculate a value between 20 and 80, representing the anxiety state at that moment in time. [STAI1][STAI2]

7.A.2 Regret

Anticipated regret and rejoicing

To which extent are the following remarks for your decision applicable?

	not at all		very much so	
1. For project A: I did not put more money in A, because I did not want to feel bad when project B ends well (wins). *regret as motivation for project B* [regret-B]	(1)	(2)	(3)	(4)
2. For project A: I did not put less money in A, because I will feel really good if project B returns nothing (loses). *rejoicing as motivation for project A* [rejoicing-A]	(1)	(2)	(3)	(4)
3. For project B: I did not put less money in B, because I will feel really good if project B ends well (wins). *rejoicing as motivation for project B* [rejoicing-B]	(1)	(2)	(3)	(4)
4. For project B: I did not put more money in B, because I did not want to feel bad when project B returns nothing (loses). *regret as motivation for project A* [regret-A]	(1)	(2)	(3)	(4)

Note: Comments in italics and brackets were not included in the questionnaire and refer to the descriptions made in the text.

To account for relative importance of regret and rejoicing we define:

$$[regretR] = regret\text{-}A - regret\text{-}B$$
$$[rejoicingR] = rejoicing\text{-}B - rejoicing\text{-}A$$

Estimated regret and disappointment (Zeelenberg et al., 1998)

We ask you now to think about the money that you invested in project B (no matter how much it was). Imagine that you roll the white dice and that you get a 5. Which means that you lost the money that you had invested in project B. How do you feel then?

		not at all		**very much so**	
1.	Feel powerless?	(1)	(2)	(3)	(4)
2.	Feel that you should have known better?	(1)	(2)	(3)	(4)
3.	Feel the tendency to kick myself?	(1)	(2)	(3)	(4)
4.	Feel the tendency to get away from the situation?	(1)	(2)	(3)	(4)
5.	Want to undo the event?	(1)	(2)	(3)	(4)
6.	Want to do nothing?	(1)	(2)	(3)	(4)

Note: Items 2, 3 and 5 measured [regretE], the remaining items measured [disappointmentE].

Experienced regret

Please answer the following questions:

		not at all		**very much so**	
1.	Are you disappointed by the outcome?	(1)	(2)	(3)	(4)
2.	Do you regret your decision?	(1)	(2)	(3)	(4)

Note: The answers give [regretX] and [disappointmentX].

7.A.3   Other Emotions

Experienced emotions:

A number of statements which people have used to describe themselves are given below. Read each statement and then choose the appropriate number to the right of the statement to indicate how you *feel* right now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

		not at all		**very much so**	
1.	I feel surprised	(1)	(2)	(3)	(4)
2.	I feel hopeful	(1)	(2)	(3)	(4)
3.	I feel sad	(1)	(2)	(3)	(4)
4.	I feel happy	(1)	(2)	(3)	(4)
5.	I feel irritated	(1)	(2)	(3)	(4)

Importance of emotions for decision

At the end of the second questionnaire for STAI state, the following question was asked, to determine if subjects took emotions into account when making their decision:

Was your decision influenced by how you might feel after the rolling of the white dice, which will determine the outcome of project B? [Importance emotions]

Appendix 7.B Instructions

Translated from the Dutch

7.B.1 Announcement of Global Risk

pre

Announcement earnings

At the start of phase 2 of this experiment there is a chance of $1/3$ **that you will lose** *all* **your working money and thus can't earn money.**

Each participant has received with this announcement a red die. At the start of phase 2, thus **before** *deciding about the distribution of the working money*, each participant will be asked to roll this die a single time under supervision. If the die shows 5 or 6, you will lose **all your working money**. If the die shows 1, 2, 3 or 4, you will keep your working money. Please note, your earnings depend on the decision that you will take now, in phase 2, and on you keeping your working money.

inter

Announcement earnings

At the start of phase 3 of this experiment there is a chance of $1/3$ **that you will lose** *all* **your possible earnings.**

Each participant has received with this announcement a red die. At the start of phase 3, thus **before** *the outcome of the projects is determined*, each participant will be asked to roll this die a single time under supervision. If the die shows 5 or 6, you will lose **all your possible earnings**. If the die shows 1, 2, 3 or 4, you will keep your possible earnings. Please note, your earnings depend on the decision that you will take now, in phase 2.

post

Announcement earnings

At the end of phase 3 of this experiment there is a chance of $1/3$ **that you will lose** *all* **your earnings.**

Each participant has received with this announcement a red die. After the end of the phase 3, thus **after** *the outcome of the projects is determined*, each participant will be asked to roll this die a single time under supervision. If the die shows 5 or 6, you will lose **all your earnings**. If the die shows 1, 2, 3 or 4, you will keep your earnings. Please note, your earnings depend on the decision that you will take now, in phase 2.

7.B.2   General instructions

Information about projects

In this phase you have to make a *single* decision concerning your working money. You have to allocate the 15 euro [30 euro] that you received over two projects. These projects will be labelled on the computer screen, when you make your decision, with the letters A and B.

In project A you will get for every euro that you put into this project, one euro. Thus, project A always gives a certain return. For the amount that you put in project B the following holds. With probability one half (1/2) you will lose this amount and with probability one half (1/2) you will receive two and a half (2 1/2) times this amount.

You can allocate your working money in multiples of 50 eurocent [1 euro] over the projects A and B in any possible combination that sums up to 15 euro [30 euro]. The table below shows for each possible combination that you can choose the returns and corresponding probabilities. All values are in euros.

baseline

In the following phase, chance will determine for you the returns of project B. Each participant has just received a white die. In the next phase everyone will be asked to throw this die a single time under supervision. Also if you have put nothing in project B, you will have to throw the die. If the die shows 1, 2 or 3, you will receive two and a half (2 1/2) times the amount that you put in project B. If the die shows 4, 5 or 6, you will lose the amount that you have put in project B.

pre

Before you will take your decision, you will be confronted with the risk of losing all your working money. Note: if this happens to you we still ask you to take a decision concerning the distribution of your working money over the projects (but you will not be paid out the earnings from the projects).

In the following phase, chance will determine for you the returns of project B. Each participant has just received a white die. In the next phase everyone will be asked to throw this die a single time under supervision. Also if you have put nothing in project B, you will have to throw the die. If the die shows 1, 2 or 3, you will receive two and a half (2 1/2) times the amount that you put in project B. If the die shows 4, 5 or 6, you will lose the amount that you have put in project B.

inter

At the beginning of the following phase, thus after you made your decision but before the outcome of projects is determined, you will be confronted with the risk of losing all your earnings. Only for those that keep their possible earnings the following will then hold: Chance will determine for you the returns of project B. Each participant has

just received a white die. In the next phase everyone will be asked to throw this die a single time under supervision. Also if you have put nothing in project B, you will have to throw the die. If the die shows 1, 2 or 3, you will receive two and a half (2 1/2) times the amount that you put in project B. If the die shows 4, 5 or 6, you will lose the amount that you have put in project B.

post

In the following phase, chance will determine for you the returns of project B. Each participant has just received a white die. In the next phase everyone will be asked to throw this die a single time under supervision. Also if you have put nothing in project B, you will have to throw the die. If the die shows 1, 2 or 3, you will receive two and a half (2 1/2) times the amount that you put in project B. If the die shows 4, 5 or 6, you will lose the amount that you have put in project B.

At the end of the following phase, thus after the outcome from the projects is decided, you will be confronted with the risk of losing all your earnings.

Money in project A:	Money in project B:	Certain return	Chance of 1/2 for extra earnings of	Money in project A:	Money in project B:	Certain return	Chance of 1/2 for extra earnings of
0.00	15.00	0.00	37.50	8.00	7.00	8.00	17.50
0.50	14.50	0.50	36.25	8.50	6.50	8.50	16.25
1.00	14.00	1.00	35.00	9.00	6.00	9.00	15.00
1.50	13.50	1.50	33.75	9.50	5.50	9.50	13.75
2.00	13.00	2.00	32.50	10.00	5.00	10.00	12.50
2.50	12.50	2.50	31.25	10.50	4.50	10.50	11.25
3.00	12.00	3.00	30.00	11.00	4.00	11.00	10.00
3.50	11.50	3.50	28.75	11.50	3.50	11.50	8.75
4.00	11.00	4.00	27.50	12.00	3.00	12.00	7.50
4.50	10.50	4.50	26.25	12.50	2.50	12.50	6.25
5.00	10.00	5.00	25.00	13.00	2.00	13.00	5.00
5.50	9.50	5.50	23.75	13.50	1.50	13.50	3.75
6.00	9.00	6.00	22.50	14.00	1.00	14.00	2.50
6.50	8.50	6.50	21.25	14.50	0.50	14.50	1.25
7.00	8.00	7.00	20.00	15.00	0.00	15.00	0.00
7.50	7.50	7.50	18.75				

Appendix 7.C   Tables

Table 7.6: Censored tobit regressions of investment on emotions

Part A: *pre*				Part B: *post low*			
1 obs. left-censored; 11 obs. right-censored				1 obs. left-censored; 10 obs. right-censored			
Number of obs		=	48	Number of obs		=	42
LR $\chi^2(5)$		=	8.08	LR $\chi^2(5)$		=	6.40
Prob $> \chi^2$		=	0.152	Prob $> \chi^2$		=	0.269
Pseudo R^2		=	0.033	Pseudo R^2		=	0.030
invest t1	Coef.	Std. Err.	$P > |t|$	invest t1	Coef.	Std. Err.	$P > |t|$
STAI-trait	-0.044	0.094	0.645	STAI-trait	0.053	0.112	0.641
STAI1	-0.032	0.082	0.701	STAI1	-0.033	0.104	0.753
hope1	0.781	1.222	0.526	hope1	1.178	1.322	0.378
irritation1	-0.559	1.217	0.649	irritation1	1.945	1.073	0.078
rejoicingR	1.204	0.515	0.024	rejoicingR	1.199	0.751	0.119
Intercept	9.570	6.522	0.150	Intercept	2.049	6.686	0.761
Part C: *baseline high*				Part D: *post high*			
1 obs. left-censored; 6 obs. right-censored				1 obs. left-censored; 7 obs. right-censored			
Number of obs		=	39	Number of obs		=	29
LR $\chi^2(5)$		=	10.35	LR $\chi^2(5)$		=	23.75
Prob $> \chi^2$		=	0.066	Prob $> \chi^2$		=	0.000
Pseudo R^2		=	0.051	Pseudo R^2		=	0.156
invest t1	Coef.	Std. Err.	$P > |t|$		Coef.	Std. Err.	$P > |t|$
STAI-trait	0.019	0.093	0.841	STAI-trait	-0.032	0.098	0.746
STAI1	0.051	0.084	0.547	STAI1	0.000	0.093	0.999
hope1	3.512	1.322	0.012	hope1	1.237	1.209	0.317
irritation1	-0.205	1.489	0.891	irritation1	1.990	1.510	0.200
rejoicingR	1.623	0.625	0.014	rejoicingR	2.288	0.416	0.000
Intercept	-5.919	6.704	0.383	Intercept	1.780	6.646	0.791

Table 7.7: Spearman correlations for anxiety, hope and irritation

baseline grouped	STAI trait	STAI 1	hope 1
STAI 1	0.539		
	$(p = 0.000)$		
hope 1	-0.237	-0.391	
	$(p = 0.039)$	$(p = 0.001)$	
irritation 1	0.253	0.333	-0.187
	$(p = 0.028)$	$(p = 0.003)$	$(p = 0.106)$
post grouped	STAI trait	STAI 1	hope 1
STAI 1	0.320		
	$(p = 0.007)$		
hope 1	-0.181	0.010	
	$(p = 0.132)$	$(p = 0.932)$	
irritation 1	0.239	0.212	-0.340
post-low	$(p = 0.212)$	$(p = 0.178)$	$(p = 0.027)$
irritation 1	0.246	0.153	-0.128
post-high	$(p = 0.116)$	$(p = 0.430)$	$(p = 0.509)$

Table 7.8: Overview of investment behavior from all treatments.

A: Summary of investment (t1)							
	N	mean	std. dev.		N	mean	std. dev.
baseline	37	7.811	3.386	inter	39	9.923	4.106
baseline high	39	8.000	3.729	post	42	9.345	4.091
baseline without	43	8.756	3.506	post high	29	8.310	4.593
pre	48	9.083	3.865	post without	40	8.625	3.796

B: Significance levels for differences in investment (Mann-Whitney)							
			Prob $> \lvert z \rvert$				Prob $> \lvert z \rvert$
baseline	vs	baseline high	0.859	pre	vs	inter	0.247
		baseline without	0.105			post	0.653
		pre	0.117			post high	0.276
		inter	0.011			post without	0.548
		post	0.062				
		post high	0.845	inter	vs	post	0.495
		post without	0.378			post high	0.129
						post without	0.103
baseline high	vs	baseline without	0.121				
		pre	0.154	post	vs	post high	0.196
		inter	0.025			post without	0.341
		post	0.087				
		post high	0.830	post high	vs	post without	0.431
		post without	0.337				
baseline without	vs	pre	0.939				
		inter	0.156				
		post	0.620				
		post high	0.279				
		post without	0.530				

Chapter 8

Summary and Future Research

Humans make decisions not only by rational thought but considerably influenced by their emotions. It seems that emotions influence us in almost any kind of decision situation, through their impact on valuation, judgement, memory, learning and attention. However, only recently the scientific study of emotions has become a major area of research in psychology and other social sciences. In this thesis we tried to outline what emotions are and what makes them important to consider also for economists. Moreover, we presented a series of experimental studies aimed at investigating how emotions influence behavior in two choice situations important to economics.

The first kind of choice situations concern the conservation and creation of cooperative behavior. Cooperation in more or less anonymous, non-repeated interactions is a crucial ingredient for the working of many (modern) societies. How cooperative behavior can be sustained if costly for the individual, is a still not fully understood phenomenon (Hammerstein, 2003). Research has shown that the probability of being punished for non-cooperative behavior can induce people to act cooperatively (Fehr and Gaechter, 2000, 2002). Thus we need to understand what motivates people to incur costs to punish norm violations, and how punishment influences the punished. The hypothesis of this thesis was that emotions play a crucial role in this. The second kind of choice situations studied in this thesis concern risk taking in financial gambles. When taking investment risk, choices are not only influenced by monetary outcomes, but also by the feelings we have about these outcomes (Loewenstein et al., 2001). For example regret about past behavior is a painful emotion that most people would like to avoid. To understand choices it is therefore necessary to understand the anticipation of emotions as regret and rejoicing. Anticipation of emotions is not perfect (Loewenstein and Schkade, 1999) and contingent on the focus of subjects, different emotions can be influential. In addition to anticipated emotions also experienced emotions influence financial risk taking. We presented experiments to shed light on some of these effects.

Since emotions are a complex concept relatively new to economics we defined in chapter 2 the concept of emotions, differentiating them from reflexes, moods and feelings. We shortly explained the processes that lead to the experience of emotions, gave an overview of the general effects of emotions on behavior and on how emotions can

be categorized and compared. We concluded with an overview of different measurement techniques that are used to measure emotions. Due to the nature of emotions being a very "private" experience, emotions are very hard to measure in an objective and precise way. Expression of emotions can be suppressed and the more we focus on techniques that can not be influenced by the subject (e.g. physiological measures as skin conductance, heart rate or brain measures) the less we learn about the specific emotion experienced. However as psychological research shows us, it is very important to differentiate between different kinds of emotions, due to their varying action tendencies. Social psychology utilizes for this reason mostly self-reports, which are arguably the best way of learning about the specific emotions experienced by the subject. Self-reports can be complemented by physiological measures to get a more objective but nevertheless precise measure of emotions. What is largely missing in psychology are studies to link emotions to their influence on behavior. This area is especially interesting to economics. In chapter 3 we gave a short overview of some of the approaches used by economists to include emotions into their theories and models. Namely, the valence approach which assumes that the experience of negative emotions reduces utility and models using emotions as signaling devices. While so far many economic models are mainly concentrating on the impact of anticipated emotions, the dual impact of emotions has to be remembered. Namely that emotions influence behavior directly by influencing memory, attention and valuations but also indirectly through the anticipation of emotions and consequences thereof.

We then turned to studies addressing the problem of the conservation and creation of cooperative behavior. In chapter 4 we studied for the Power-to-Take game, the emotional reactions that lead responders to reciprocation by destructing their own income. We showed that this destruction is related to an increase in arousal prior to taking that decision. Arousal was measured by the skin conductance level (SCL) of subjects during the experiment. High skin conductance levels are related to arousal and can not be consciously controlled by subjects. Therefore SCL is an often used measure of arousal. The observed increase in arousal for subjects deciding to destroy can be related to the cognitive conflict associated with this decision. The conflicting interests are to "do nothing" and to keep the current earnings versus retaliation and to lose earnings. We further combine SCL observations with self-reports of experienced emotions and expectations. We find that anger is related to not fulfilled expectations and to the decision to destruct. We summarize that both self-reported emotion measures and increases in arousal are related to destruction, and that further experienced anger is positively correlated with increases in arousal. The results from this chapter support the use of self-report scales in studies of social interactions, where physiological measures might not be available.

In chapter 5 we turned to explanations of the experience of anger in games allowing for opportunistic behavior and reciprocation. It is often assumed that such anger is related to the experience of envy or jealousy concerning the other person. We stress the differences between these emotions and show that they can not be equated with reactions to unfairness. Unfairness can elicit anger but this does not need to be related

to the feelings of jealousy or envy. Anger might be experienced in both cases, while being caused by different mechanisms. For example a reduction in unfairness, can reduce anger but might not influence the experience of envy.

The existence of anger and its action tendency to punish others, can also lead to retaliation. As we showed in chapter 6, the effectiveness of punishment also depends on the reactions of the individuals who are punished. If individuals feel angry after being punished, the experience of this anger might motivate them to retaliate towards the punisher. Therefore, we may observe multiple rounds of punishment and retaliation between angry individuals. Such a punishment cycle might thus lead to significant destructions of resources. What is needed to avoid such a cycle is a reaction of the punished, that is, after receiving punishment the punished should act more cooperatively and abstain from retaliation. We showed that the social emotions of shame and guilt motivate individuals to react in precisely this way. We studied cooperation and punishment behavior in a simple social dilemma game, for which we introduced a new form of social punishment. Individuals who are punished, always have the opportunity to retaliate, and subjects receiving retaliation can react by further punishment. We claim that, if there exists a punishment technology, it is likely that both the punisher and the punished have access to it. We find that in the presence of our punishment institution, cooperation is sustained at a high level. This is because, second movers return more and first movers who punish do not stop cooperating after experiencing opportunistic behavior. Punishment of opportunistic behavior is common and in multiple cases punishment lead to various rounds of reducing each others earnings. We also replicate the importance of anger as motivation for punishment. First movers punish if they are angry. Retaliation by second movers also makes first movers angry and leads to additional punishment. Finally we observe how social emotions in second movers are related to their decision to retaliate. We find that second movers retaliate if they are angry and do *not* feel shame. In addition, after having experienced shame, second movers are more likely to act cooperatively in the next interaction. We conclude that the experience of shame and guilt are crucial to make punishment effective. If an opportunity for retaliation exists, the experience of anger alone can lead to multiple rounds of punishment and to a significant destruction of resources. This effect can be countered by the experience of moral emotions.

We use the earlier presented schema of the dual impact of emotions, to summarize the observations from chapters 4 to 6 (Figure 8.1). This simple graphic should give an idea of the complexity of the interaction of rational and emotional influences. Knowledge about earnings of participants can create envy and jealousy. This can lead to anger about the situation. However also the cognitive evaluation of the situation can lead to anger if the situation is considered as unfair. This anger can lead to the decision to punish. The evaluation of the situation can also lead to the realization that fairness was violated by own behavior, therefore triggering feelings of guilt or shame. Therefore these emotions can influence experienced anger or the decision making process by inhibiting the action tendency of anger to punish back. This view of the interacting processes is naturally simplistic. For example also the anticipation of regret or
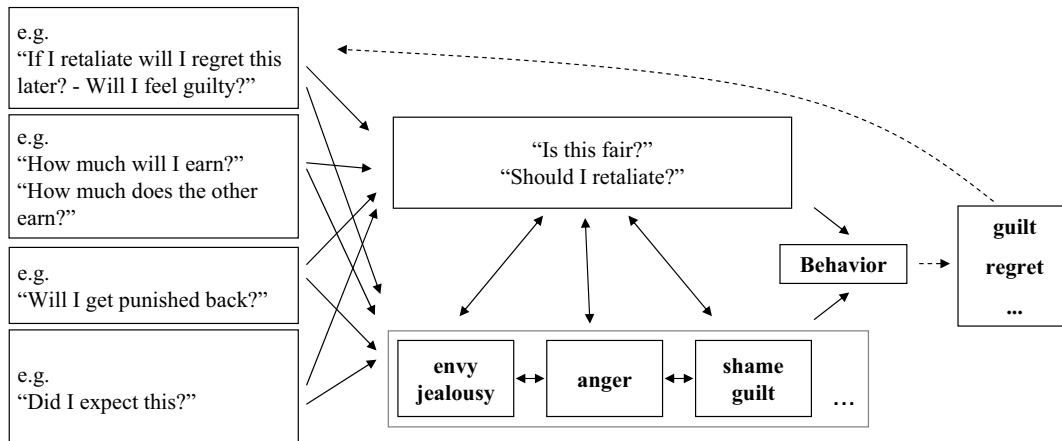
Figure 8.1: Schema of interactions of experienced and anticipated emotions leading to retaliation.

experienced anxiety about the reactions of the other, might influence decisions. The schema points however at the interactions between emotions and cognitive evaluations that lead to behavior.

To fully understand the underlying processes we have to further study the specific interactions between emotions and cognitive evaluations. This can be done by combining multiple measurements of emotions to observe spill-over effects and mutual influences. To model behavior for a population it seems necessary to investigate the distribution of traits in groups of interest. Obviously elicitation of emotions and reactions to them are not the same for everybody. This heterogeneity has to be taken into account to predict behavior. Finally, social emotions seem a rich and promising research area for economists. To understand them we have to learn where social emotions come from, why certain people or cultures react stronger to them than others and how they are related to norms and institutions. An interesting question is to find out how changes in norms, will be reflected by changes in social emotions. We do not know yet how fast these interactions are, for example, how long it takes till a norm is not only cognitively evaluated but also "felt". Further it is important to understand emotional reactions to behavior if norms are not clearly defined in a group, for example, because different groups with different norms live together. Can the awareness of such differences overrule emotional responses?

The findings from chapters 4 to 6 were mostly concerned with the impact of experienced emotions on decision making. In chapter 7 we turned to the importance of prospect based emotions. These include the experience of emotions as anxiety and hope but further the anticipation of emotions as regret, rejoicing and disappointment. We analyzed the importance of these for the example of an investment experiment where additional to the risk from investment a "global" risk was threatening all earn-

ings independent from the investment outcome. Specifically we analyzed and discussed how emotions influence behavior under three timing variants of global risk. Global risk happened either before the investment decision was made (*pre*), after the decision but before the outcome of the investment was known (*inter*) or at the very end when the outcome of the investment was known (*post*). In all treatments we observed that many subjects invest only part of their working money. Thus it might not be well suited to study such decisions with binary choices of extreme investment options. In all treatments involving global risk we observe a similar high percentage of subjects deciding to invest all their working money. In earlier studies it was suggested that a common risk occurring in a separate stage is ignored by subjects (isolation effect). Even though in our experiment the resolution of the global risk was clearly disconnected from the resolution of the decision risk, subjects do not ignore the global risk. We therefore do *not* find evidence for the isolation effect. We also do not find differences in mean investment across the timing variants of global risk. Thus it seems that subjects do not violate timing independence.

The analysis of the experienced and anticipated prospect based emotions shows that the relation of emotions to behavior is not the same for all treatments. We find that hope is related to higher investment in *baseline* (no global-risk) and *inter*. A relation between hope and risk taking is often assumed but seems to be dependent on characteristics of the specific situation. We further observe that experienced irritation can be, dependent on the treatment, related to more as well as less investment. This result is pointing at the importance of ambiguous emotions. Irritation can be related to either anger or fear, two emotions of negative valence that are nevertheless characterized by their differing action tendencies. Interaction with anger might lead to more risk seeking, while interaction with fear may lead to more risk aversion.

Concerning anticipated emotions, we see that indeed subjects anticipate both regret and rejoicing from their decisions. Since investment could be split over two options, we note that both emotions can be experienced if the investment projects either wins (regret for not having invested more) or loses (regret for not having invested less). When dealing with situations of non-extreme investment, the anticipation of these emotions might thus work either in the direction of more or less risk seeking. We argued that real life investment situations are mostly of this kind, that is, people have to decide from a continuum of investment possibilities. Interestingly, we observe that the two counteracting motivations of anticipated regret and rejoicing are mostly present when global risk is threatening. When no global-risk is present, subjects mostly focus on regret from investing too much. Thus the anticipated emotions are leading in this case mainly to low investment.

Finally, we studied the effects of anxiety on investment. We observed both anxiety trait as well as experienced anxiety before and after the taking of the decision. Surprisingly, we find only very weak effects of anxiety. This is surprising given the widespread belief that anxiety should influence investment decisions. We show that while there is still some correlation of anxiety trait with investment in our baseline treatment, no such correlation is observed if global risk is present. Thus high anxiety
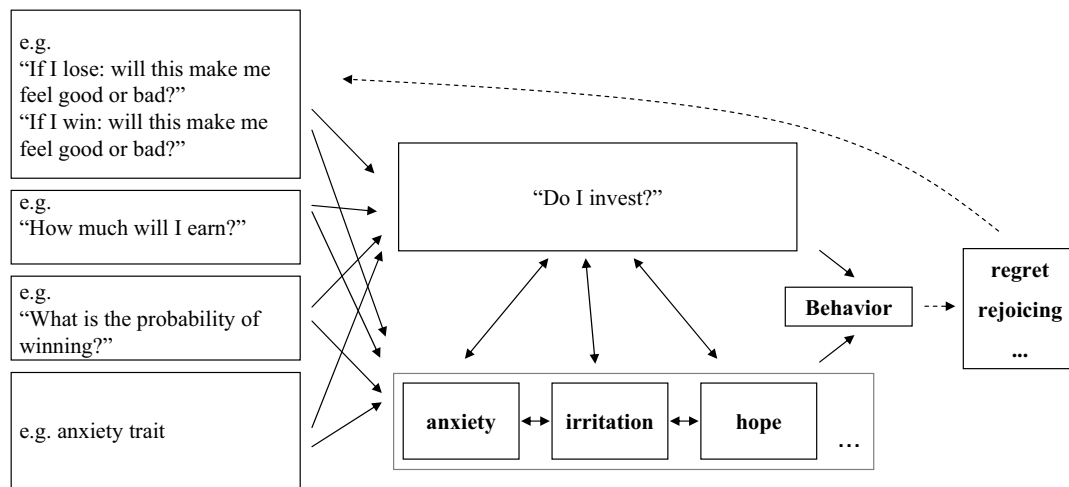
Figure 8.2: Schema of interactions of experienced and anticipated emotions leading to investment.

trait seems to lead to low investment, only if subjects can fully control the risk they are about to take. For baseline as well as a global-risk treatment, we observe that experienced anxiety after the decision taking is influencing further behavior. The lower the anxiety experienced after the taking of the original investment decision, the more likely subjects are to increase their investment when they get the chance to do so.

Summarizing, the anticipation and experience of a variety of emotions is found to be influential in individual decisions concerning choices of financial risk taking. A shift in which emotions are anticipated can lead to shifts in behavior. Investment behavior might thus seem puzzling if anticipated emotions are not measured. We also note in our discussion of behavior, that investment might seem different if not continuous choices are offered but a binary choice between a safe and risky gamble. While the continuous choice gave subjects the opportunity to react to their tendencies for risky as well as safe behavior, in a binary choice behavior will depend on the relative importance of the two tendencies. It seems important to observe binary as well as continuous investment choices, to learn how framing of the choice problem influences behavior.

Figure 8.2 gives a rough overview of the interaction of anticipated and experienced emotions and cognitive evaluations observed in our investment experiment. As for the earlier presented schema the relationships are naturally simplistic. However the relations presented in the schema should point at the interaction of experienced and anticipated emotions when investment is considered. Irritation that is experienced in combination with anxiety might lead to risk averse behavior. Experienced anxiety will be influenced by the anxiety trait but also by cognitive evaluation of the odds of winning and the amount of money I already decided to put at stake. Finally the anticipation of regret and rejoicing will influence how much I am willing to invest.

From this schematic overview it already becomes apparent that many of the levels of interactions need to be explored further. Appreciating the importance of the multiple interactions of experienced emotions, we have to further explore the interaction for example of irritation and anxiety. Considering that some theories of decision making assume the avoidance of anticipated anxiety, we would like to know more about which emotions are anticipated. As our results show, behavior can be very different dependent on which emotions are anticipated. We therefore need to investigate further how the anticipation of emotions is influenced by the perception and framing of a decision problem. Another important direction for research concerning prospect based emotions, is to observe spill-over effects of emotions. How does for example experienced regret or disappointment influence the likelihood to anticipate these emotions in later decision situations? And how does this reflect in behavior?

With this thesis we tried to show the role of emotions in choice situations interesting and relevant for economists. Emotions are neither generally "good" nor generally "bad" for decision making. However they certainly influence the decisions made. We showed that different emotions have very diverse roles, and that economists should become aware of this. Not only types of emotions have to be differentiated, but also the anticipation of emotions from the experience of emotions. Even though a number of theoretical models already consider the impact of emotions, these models are often overly simplistic. Notwithstanding their laudable attempts to model affective reactions, models have to become more refined. If anticipated emotions are considered, also the factors influencing this anticipation have to be considered. If experienced emotions are modelled, the affective strength should not be solely a function of payoffs but further of beliefs, norms, culture and social relations. Only experiments explicitly measuring emotions can lead us to understand what is influencing emotions and help us make good models of the influence of emotions on behavior. Emotions are sometimes hard to measure and difficult to observe, nevertheless we believe that recent developments in emotion research give us the tools to start to understand a phenomenon that is influential whenever a decision is made.

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Samenvatting in het Nederlands

Mensen maken beslissingen niet alleen op basis van rationele overwegingen, maar worden ook beïnvloed door hun emoties. Emoties lijken ons te beïnvloeden in bijna iedere situatie waarin we een beslissing moeten nemen, door hun invloed op onze waarderingen en oordelen en op ons geheugen, leren en aandacht. Maar pas sinds kort wordt de wetenschappelijke analyse van emoties beschouwd als een belangrijk onderzoeksgebied in de psychologie en andere sociale wetenschappen. In dit proefschrift wordt uitgelegd wat emoties zijn en waarom ze ook voor economen belangrijk zijn. Daarvoor presenteren we een aantal experimentele studies, gericht op de invloed van emoties in twee keuzesituaties die belangrijk zijn binnen de economie.

De eerste soort keuzesituaties betreft het ontstaan en behouden van coöperatief gedrag. Samenwerking in min of meer anonieme, eenmalige interacties is een belangrijk ingrediënt voor het functioneren van veel moderne samenlevingen. Hoe coöperatief gedrag kan blijven bestaan hoewel het kostbaar is voor het individu, is een nog steeds niet helemaal begrepen fenomeen (Hammerstein, 2003). Onderzoek heeft bewezen dat mensen coöperatiever zullen handelen als het mogelijk is dat zij voor oncoöperatief gedrag gestraft worden (Fehr and Gaechter, 2000, 2002). Om die reden willen we begrijpen wat mensen motiveert kosten te accepteren om normovertredingen te straffen, en hoe gestrafte mensen reageren op hun straf. De stelling van dit proefschrift is dat emoties daarbij een belangrijke rol spelen. Het tweede type economische keuzesituatie betreft het nemen van risico bij financiële speculaties. Bij het nemen van financieel risico worden beslissingen niet alleen beïnvloed door de monetaire uitkomst, maar ook door hoe we ons zullen voelen over de uitkomst (Loewenstein et al., 2001). Spijt over beslissingen in het verleden is bijvoorbeeld een pijnlijke emotie die veel mensen proberen te vermijden. Om beslissingen te begrijpen is het daarom noodzakelijk voorspelde emoties zoals spijt en vreugde te begrijpen. Voorspelling van emoties is niet foutloos (Loewenstein and Schkade, 1999) en afhankelijk van de focus van proefpersonen kunnen verschillende emoties van invloed zijn. Bovendien beïnvloeden niet alleen verwachte maar ook de daadwerkelijk gevoelde emoties het financieel risicogedrag. We presenteren experimenten die een aantal van deze effecten onderzoeken.

Omdat emoties een relatief nieuw concept zijn binnen de economische wetenschappen, presenteren we in hoofdstuk 2 wat emoties zijn en waarin ze verschillen van reflexen, stemmingen en gevoelens. We leggen in het kort uit welke processen noodzakelijk zijn voor het ervaren van emoties en geven een kort overzicht van de invloed

van emoties op gedrag. Het hoofdstuk besluit met een overzicht van verschillende technieken voor het meten van emoties. Omdat emoties "privé"-ervaringen zijn, is het moeilijk om ze op een objectieve en toch betrouwbare manier te meten. De uitdruk-king van emoties kan onderdrukt worden. Technieken die zijn gebaseerd op het me-ten van fysiologische veranderingen (zoals het geleidingsvermogen van de huid [skin conductance], hartslag en hersenactiviteit) en dus niet door de proefpersoon beïnvloed kunnen worden, geven weinig informatie over welke specifieke emotie wordt erva-ren. Uit psychologisch onderzoek blijkt echter dat we wel onderscheid moeten maken tussen verschillende emoties, vanwege hun verschillende actietendensen. In de so-ciale psychologie worden om die reden vooral vragenlijsten gebruikt voor het meten van emoties. Dat is een van de beste manieren om iets te weten te komen over de specifieke ervaring van emoties. Daarnaast kunnen vragenlijsten gekoppeld worden aan fysiologische maten. Wat grotendeels ontbreekt in de psychologische wetenschap zijn studies die de invloed van emoties op gedrag onderzoeken. Dit gebied is voor-al interessant voor economen. In hoofdstuk 3 geven wij een kort overzicht van hoe economen emoties in hun modellen en theorieën proberen op te nemen. We gaan in op de "valence approach", die ervan uitgaat dat de ervaring van negatieve emoties nut vermindert, en op modellen waarin emoties als signaal worden gebruikt. Terwijl veel economische modellen vooral op de invloed van voorspelde emoties focussen, is juist de tweeledige invloed van emoties belangrijk. Emoties beïnvloeden gedrag op een directe manier via geheugen, attentie en evaluaties; daarnaast bestaat er een indirecte invloed door de voorspelling van emoties en de gevolgen daarvan.

Daarna gaan we over tot studies die het probleem van het ontstaan en behouden van coöperatief gedrag behandelen. In hoofdstuk 4 bestuderen we door middel van het "Power-to-Take" spel de emotionele reacties van mensen die vergelding uitoefenen door het vernietigen van hun eigen geld. We vinden dat dergelijke kapitaalvernieti-ging met een toename in "opwinding" gepaard gaat voorafgaand aan het nemen van de beslissing. Opwinding wordt in het experiment gemeten door de "skin conductance level" (SCL). Een hoog niveau van SCL gaat gepaard met opwinding en kan door mensen niet bewust beïnvloed worden. Daarom is SCL ook in de psychologie een veel gebruikte maat voor opwinding. Wij verbinden de SCL-maat met de antwoorden van zelfbeoordelingslijsten over emoties en verwachtingen. We vinden dat boosheid gere-lateerd is aan gefrustreerde verwachtingen en de beslissing om te vernietigen. Daaruit concluderen we dat zowel de antwoorden van de emotie-vragenlijst als de toename in opwinding in verband staan met vernietiging en dat verder gevoelde boosheid met een toename in opwinding gecorreleerd is. De resultaten van dit hoofdstuk ondersteu-nen het gebruik van zelfbeoordelingsvragenlijsten voor studies van sociale interacties, waar fysiologische maten niet beschikbaar zijn.

In hoofdstuk 5 behandelen we mogelijke verklaringen voor het gevoel van boos-heid in spellen waar opportunistisch gedrag of reciprociteit een rol spelen. Vaak wordt aangenomen dat het gevoel van boosheid overeen komt met de ervaring van jaloezie jegens de andere persoon. Wij benadrukken het verschil tussen de emoties "jealousy"

en "envy" en tonen aan dat ze niet hetzelfde zijn als reacties op oneerlijkheid. On-eerlijkheid kan boosheid veroorzaken, maar dit is niet noodzakelijk gekoppeld aan het gevoel van jaloezie. Boosheid kan in beide gevallen gevoeld worden, maar kan ver-oorzaakt worden door verschillende mechanismen. Een reductie in oneerlijkheid kan bijvoorbeeld boosheid verminderen zonder het gevoel van jaloezie te beïnvloeden.

Het bestaan van boosheid en de daarbij horende actietendens om anderen te straffen kan ook de oorzaak vormen voor vergelding. We zien in hoofdstuk 6 dat de effectiviteit van straf ook afhangt van de reactie van de gestrafte persoon. Als een persoon zich boos voelt nadat hij gestraft werd, kan het gevoel van boosheid hem motiveren om wraak te nemen op de straffer. Daarom verwachten we meerdere ronden van straf en vergelding te zien tussen individuen die boos zijn. Zo'n straf-cyclus kan tot een significante vernietiging van middelen leiden. Om een dergelijke cyclus te vermijden, moet er een reactie van de gestrafte bestaan die hem ertoe aanzet na de ontvangst van de straf coöperatief te handelen en verder geen wraak te nemen. Zoals we aantonen laten de sociale emoties schaamte en schuld mensen precies op deze manier reageren. We bestuderen coöperatie en strafgedrag in een eenvoudig sociaal dilemmaspel, waarvoor wij een nieuw strafmechanisme introduceren. Een speler die gestraft wordt, kan altijd reageren en wraak nemen. Verder kunnen spelers die vergelding ontvangen reageren door verder strafgedrag. We veronderstellen dat als er een strafmogelijkheid bestaat waarschijnlijk zowel straffer als gestrafte toegang ertoe hebben. We vinden dat er in het spel met ons strafmechanisme een hoog niveau van coöperatie blijft bestaan. Dit komt omdat tweede spelers veel teruggeven en omdat eerste spelers die straffen nadat zij opportuun gedrag tegenkomen, niet ophouden met coöpereren. Er wordt vaak gestraft en in sommige vallen leidt dit tot meerdere opeenvolgende ronden van het reduceren van inkomen. Wij zien ook weer het belang van boosheid als motivatie voor het straffen. Eerste spelers straffen als ze boos zijn. Ook het vergelden door tweede spelers maakt eerste spelers boos en laat hen opnieuw straffen. Ten slotte zien we hoe sociale emoties bij de tweede spelers in verband staan met hun beslissing van vergelding. Wij zien dat tweede spelers wraak uitoefenen als zij boos zijn en geen schaamte voelen. Bovendien handelen tweede spelers die schaamte voelden in de volgende interactie vaker coöperatief. We concluderen dat de ervaring van schaamte en schuld essentieel zijn om straf effectief te maken. Wanneer een mogelijkheid tot vergelding bestaat, kan de ervaring van boosheid tot meerdere ronden van straf leiden en tot een significante reductie van middelen. Morele emoties verminderen dit effect.

De hoofdstukken 4 tot 6 zijn vooral gericht op de invloed van het ervaren van emo-ties op het maken van beslissingen. In hoofdstuk 7 richten we ons op de invloed van "prospect based" emoties. Hieronder worden de ervaring van emoties als ongerustheid en hoop verstaan, maar verder ook de verwachting van emoties als spijt, vreugde en teleurstelling. We analyseren het belang hiervan in het geval van een investeringspel, waarbij een globaal risico bestaat dat alle verdiensten bedreigt, onafhankelijk van de uitkomst van de investering. Met name analyseren we hoe emoties van invloed zijn op investeringen, in drie gevallen waar het globale risico op verschillende tijdstippen

plaatsvindt: voor het beslissen over de investering (pre), of na de beslissing maar voordat het resultaat van de investering bekend is (inter) of aan het eind, wanneer ook het uitkomst van de investering bekend is (post). In al deze varianten zien we dat veel deelnemers slechts een deel van hun geld investeren. Daarom lijken binaire keuzes, waar het alleen een optie is om alles of niets te investeren, niet geschikt om dergelijke vraagstellingen te bestuderen. In alle varianten met globaal risico besluit een vergelijkbaar hoog percentage van de deelnemers om al hun geld te investeren. In eerdere experimenten werd gesuggereerd dat een gemeenschappelijk risico dat in een aparte fase plaatsvindt, door deelnemers genegeerd wordt (isolation effect). Hoewel in ons experiment de uitkomst van het globale risico duidelijk onafhankelijk van de uitkomst van het investeringsrisico was, wordt het globale risico door deelnemers niet genegeerd. We zien dus geen bevestiging van het 'isolation effect'. Verder vinden wij geen verschil in gemiddelde investering voor de verschillende tijdstippen van het globale risico. Deelnemers lijken zich aan het principe van tijdsonafhankelijkheid (timing independence) te houden.

Uit de analyse van de ervaren en verwachte "prospect-based" emoties blijkt dat de verhouding van emoties en gedrag niet hetzelfde is in alle treatments. We vinden een verband tussen hoop en hoge investeringen alleen in "baseline" (geen globaal risico) en inter. Het wordt vaak aangenomen dat er een verhouding tussen hoop en het nemen van risico bestaat, maar dit verband lijkt van de karakteristieken van de specifieke situatie afhankelijk te zijn. Verder zien we dat de ervaring van irritatie zowel met meer als met minder investering samengaat. Dit resultaat wijst op het belang van meerduidige emoties. Irritatie kan in verband staan met zowel boosheid als angst, twee negatieve emoties die desondanks door verschillende actietendensen gekarakteriseerd worden. Interactie met boosheid kan tot meer risicozoekend gedrag leiden, terwijl interactie met angst juist tot risico-avers gedrag kan leiden. Voor de verwachte emoties zien wij dat deelnemers zowel spijt als vreugde van hun beslissing verwachten. Omdat investering in twee projecten mogelijk was, merken wij op dat alle beide emoties ervaren kunnen worden als het investeringproject wint (spijt dat de deelnemer niet meer geïnvesteerd had) of verliest (spijt niet minder geïnvesteerd te hebben). In situaties waar een deel van het geld geïnvesteerd wordt, kan de verwachting van zulke emoties dus tot meer of minder risicozoekend gedrag leiden. Wij beargumenteren dat dit voor veel echte investeringssituaties opgaat, met name wanneer mensen moeten beslissen hoeveel van hun totale vermogen ze in verschillende opties investeren. Wij merken verder op dat de twee tegengestelde motivaties, verwachte spijt en vreugde, vooral in varianten met globaal risico van belang zijn. Wanneer er geen globaal risico bestaat, worden de deelnemers vooral beïnvloed door verwachte spijt van te hoge investering. Dus voor dit geval leiden de verwachte emoties vooral tot lage investering.

Ten slotte bestuderen wij de invloed van angst op het investeringsgedrag. Wij meten zowel angstneiging als de ervaring van angst voor en na het nemen van de beslissing. Verrassenderwijs vinden we slechts een heel klein effect van angst op investering. Dit is verrassend gezien de algemeen heersende opvatting dat angst de investering beïnvloedt. We laten zien dat er een lichte correlatie tussen angstneiging en investering

in ons "baseline" treatment bestaat, maar dat er niet zo'n correlatie werd gevonden als er globaal risico is. Dus een sterke neiging tot angst lijkt alleen dan tot lage investering te leiden, als mensen het omvang van het risico volledig kunnen controleren. In de baselinevariant en een van de globale risico varianten zien we verder dat de ervaring van angst volgend op het nemen van de beslissing invloed heeft op verder gedrag. Als er weinig angst ervaren wordt na het nemen van de beslissing, is het waarschijnlijker dat mensen hun investering verhogen als zij daarvoor de kans krijgen.

Samenvattend heeft zowel de verwachting als de ervaring van een veelheid aan emoties invloed op het nemen van beslissingen over financiele risico's. Een verandering in welke emoties verwacht worden kan leiden tot veranderingen in gedrag. Investeringsgedrag kan dus onvoorspelbaar lijken als er geen verwachte emoties gemeten worden. We noteren verder in onze discussie dat investeringsgedrag kan verschillen als er geen continue maar binaire keuzes tussen een zekere en een riskante keuze worden aangeboden. Terwijl de continue keuze deelnemers de mogelijkheid geeft om te reageren op hun neigingen naar veilig of naar riskant gedrag, zal het gedrag in een binaire keuzesituatie afhangen van de relatie tussen de twee tendensen. Het is belangrijk om zowel binair als continu investeringsgedrag te observeren, om te leren hoe de presentatie van het keuzeprobleem gedrag beïnvloedt.

Met deze proefschrift hopen we de rol van emoties te laten zien in voor economen belangrijke keuzesituaties. Emoties zijn niet in het algemeen "goed" of "slecht" voor het nemen van beslissingen, maar ze beïnvloeden het nemen van beslissingen wel. Wij tonen aan dat verschillende emoties ook verschillende functies hebben, en dat economen zich hiervan bewust moeten zijn. Er dient niet alleen onderscheid gemaakt te worden tussen verschillende types emoties maar ook tussen verwachte en ervaren emoties. Hoewel een aantal theoretische modellen de invloed van emoties beschouwt, toch zijn deze modellen vaak te simplistisch. Ondanks hun prijzenswaardige poging om affectieve reacties te modelleren, moeten de bestaande modellen verfijnd worden. Als verwachte emoties in overweging worden genomen, moeten ook factoren bedacht worden die deze verwachting beïnvloeden. Als ervaren emoties beschouwd worden, moet de sterkte van de emoties niet allen en functie van geld zijn maar ook van verwachtingen, normen, cultuur en sociale relaties. Alleen met behulp van experimenten die expliciet emoties in zulke situaties meten, kunnen wij begrijpen hoe emoties beïnvloed worden en kunnen we beginnen de invloed van emoties op gedrag te modelleren. Emoties zijn soms moeilijk te meten en te observeren. Desondanks geloven we dat recente ontwikkelingen in het veld van emotie-onderzoek ons de mogelijkheid geven een fenomeen te begrijpen welk bij iedere genomen beslissing van invloed is.

The Tinbergen Institute is the Institute for Economic Research, which was founded in 1987 by the Faculties of Economics and Econometrics of the Erasmus Universiteit Rotterdam, Universiteit van Amsterdam and Vrije Universiteit Amsterdam. The Institute is named after the late Professor Jan Tinbergen, Dutch Nobel Prize laureate in economics in 1969. The Tinbergen Institute is located in Amsterdam and Rotterdam. The following books recently appeared in the Tinbergen Institute Research Series:

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